INSTITUTE OF CONTROL
AND COMPUTATION ENGINEERING

2009 ANNUAL REPORT
From the Director

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

The Institute offers courses in a broad area of information technology, concentrating on control and decision support systems, at three levels of education. At the first two levels (equivalent to B.Eng. and M.Eng.) the degree programs combine courses from the areas of computer science and control. We are also proud to offer interesting opportunities to our postgraduates, so that they can continue their study and research towards a Ph.D., either in Computer Science or in Control and Robotics. This standard educational offer was supplemented in the academic year 2007/2008 by postgraduate studies in Management of Information Technology Resources organized by Dr. Andrzej Zalewski and Engineering of Management Information Systems and Decision Support Systems organized by Dr. Tomasz Traczyk. There is a growing interest in this form of studies. In the period 2007/2008 23 persons took part in this course, however the 2008/2009 edition attracted 63 listeners. Besides that our Institute, as the representative of the Faculty of Electronics and Information Technology, jointly with the Faculty of Power and Aeronautical Engineering started an Erasmus Mundus Masters Program in Robotics. 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.

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 Tatjewski is responsible for this task. Four faculties of WUT participate in it. It is scheduled for the years 2008–2012.

In 2009 the group headed by Prof. Ewa Niewiadomska-Szynkiewicz was involved in organizing the 12-th National Conference on Evolutionary Algorithms and Global Optimization, May 31 - June 3, 2009, Zawoje, Poland, which gathered Polish scientists working in the area of artificial intelligence, modeling and optimization. As usual in September the Institute took part in the annual event called the Science Festival. Prof. Włodzimierz Kasprzak delivered a lecture entitled Computer Vision in Autonomous Machines. Moreover, laboratory presentations were organized by Mr. T. Winiarski, and Mr. A. Wilkowski. The Group of Robot Programming and Pattern Recognition, has been involved in a 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 2009 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 defence, of the Ministry of Science and Higher Education. The project coordinated by ICCE involves also NASK, Polish Security Printing Works and University of Warsaw enabling the creation of a network of collaborating biometrics laboratories. Prof. Eugeniusz Toczyłowski prolonged for the year 2009 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 staff of the institute for their efforts and contributions to our achievements in teaching and research.

Cezary Zieliński
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1 General Information

The following information about organization of the Institute reflects the situation on December 31, 2009.

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 Wawrzyński

Assistants: Tomasz Kornuta, Przemysław Strzelecki (until Sept. 2009), Tomasz Winiarski

Senior Lecturer: Michał Warchol

Ph.D. Students: Marcin Chochowski, Małgorzata Kudelska, Andrzej Igielski, Michał Karpowicz, Tomasz Kornuta, Michał Kudelski, Piotr Kwaśniewski, Marek Majchrowski, Michał Marks, Jacek Michalek, Łukasz Mirtcki, Bartosz Papies, Joanna Putz-Leszczyńska, Łukasz Stasiak, Przemysław Strzelecki, Anna Sibilska-Mroziewicz, Piotr Trojanek, Artur Wilkowski
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, and software for computer aided analysis and design of complex systems. Particular attention is given to distributed and parallel, synchronous and asynchronous, computations as well as to analysis and design of control algorithms and pricing techniques for computer networks. 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 signature, face image, 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 Szenk, Andrzej Zalewski

Assistant: Andrzej Ratkowski (since Oct. 2009)

Senior Lecturers: Jerzy Gustowski, Zygmunt Komor, Urszula Kręglewska

Senior Engineer: Włodzimierz Macewicz

Ph.D. Students: Ali Mhammed Benniran, Adam Działak, Anna Felkner, Andrzej Grudzień, Maciej Grula, Szymon Kijas, Marcin Ludzia (until Oct. 2009), Andrzej Ratkowski, Łukasz Szejba, 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, analysis, design and quality evaluation methods, and software audit. A new research area is service-oriented architecture (SOA). Apart of the research activity, we have been working on a number of commercial projects related to the development and evaluation of huge software systems for public organizations and for the industry. The scope of those projects included business process modeling, requirements analysis, strategic planning, conducting the testing process, and software audit.
1.2 Organization of the Institute

**Operations and Systems Research Division**

*Division Head:* Professor Eugeniusz Toczyłowski

*Professors:* Włodzimierz Ogryczak, Eugeniusz Toczyłowski, Wiesław Traczyk

*Readers:* Jerzy Paczyński, Tomasz Traczyk

*Assistant Professors:* Krzysztof Fleszar (until Sept. 2009), Janusz Granat, Mariusz Kaleta, Adam Krzemienowski (on leave since Oct. 2009), Krzysztof Pieńkosz, Grzegorz Płoszajski, Kamil Smolira (since May 2009), Andrzej Stachurski, Tomasz Śliwiński, Izabela Żółtowska

*Assistantants:* Przemysław Kacprzak (since Oct. 2009), Piotr Pała (since Oct. 2009)

*Senior Lecturers:* Tadeusz Rogowski, Jerzy Sobczyk

*Ph.D. Students:* Krzysztof Bareja, Przemysław Kacprzak, Kamil Kołtyś, Bartosz Kozłowski (until Feb. 2009), Robert Kuźmiuk, Michał Majdan, Paweł Markowski, Andrzej Midera, Piotr Modliński, Paweł Olender (since Feb. 2009), Piotr Pała, Adam Połomski (since Feb. 2009), 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. Also, research is carried on the methods of reasoning in knowledge based systems.
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 multireservoir systems.

Distributed Simulation
CSA&S (Complex Systems Analysis & Simulation)
heterogeneous software environment providing a framework for simulation experiments carried out on parallel computers.

ASim/Java (Asynchronous Simulation/Java)
library that may be used to build parallel or distributed discrete event simulators

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
1.3 Research Areas

Complex Systems Group

Quality of Service in IP Networks

- Differentiation of IP services
- Quality of service
- Pricing support
- Integration with NSP operation systems

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

Parallel and distributed computations

- research on price and direct 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 2001

New software tools:
- WDM (windows distributed machine) – a software environment for performing distributed computations in a cluster of machines working under windows
- GEPAS (generic parallel suite) – an implementation of distributed shared memory in network
- NONOS (nonlinear optimization solver) – an ASP type optimization server (submission by e-mail or browsers)
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:

\[ a \in [a_\ell, a_u], \quad b \in [b_\ell, b_u], \quad \forall \in \{+,-,\times,\div\} \Rightarrow a\forall b \in [a_\ell b_\ell, a_\ell b_u + a_u b_\ell, a_u b_u]\]

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:

\[ [a, b] + [c, d] = [a + c, b + d], \quad [a, b] \cdot [c, d] = [\min\{ac, ad, bc, bd\}, \max\{ab, ac, bd, ad\}].\]

Interval (inclusion) function:

\[ f(x) = x^2 + 2x + 1, \quad f(x) = x^3 + 2x + 1, \quad x \in [a, b] \Rightarrow f(x) \in f([a, b]) \]

\[ f'(-5, 1) = -5, 1^2 + 2(-5, 1 + 1 = -5, 2 \in [0, 16].\]

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

Problems that can be solved:
- systems of nonlinear equations
- constraint satisfaction problems
- global optimization problems
- multicriteria optimization problems (convex and nonconvex)

Complex Systems Group

Interval computations seek the Pareto-front of nonlinear multicriterial problems

compute (q(), x0, ey, ex)
// L is the list of quadruples
// (y, L_{In}, L_{bound}, L_{unchecked}
// where L's are lists of qes x
y0 = q(x0);
enqueue(L, (y0, {}, {}, (x0)));
while (a quadruple in L, for which
wid(y) > ey) then
pop this quadruple
(y, L_1, L_2, L_3) from L;
if (L_2?) then
delete sets dominated by y;
end if
if (wid(y) > ey) then
biset y;
invert resulting sets;
enqueue results;
end if
end while
end compute
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)

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 and dynamic programming, 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 features, texture features, grid features, ...

"Hidden Signature" - solution for template creation

We introduced the idea of hidden signature an artificial signature which has a feature of minimizing the mean dissimilarity between itself and the signatures from the training set.

This idea has been successfully applied to both on-line and off-line verification systems and significantly improved its results. Both systems were tested on public databases MCYT and SVC.
1.3 Research Areas

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

Biometrics
Biometric authentication for secure remote access

Novel authentication protocols and techniques employing biometrics

VPN & wireless networks applications

Development of biometric capable mobile devices and workstations

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

Central template database design and management

Multiple biometrics (iris, fingerprint and others)
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

Sample tracking sequence (24 fps)
Frame #0: Particles spread all over the image (left: particle space, right: the image space)
Frame #4: Particles converged to objects, number of objects detected automatically
Frame #4: Dust filtering for exact tracking

Biometrics and Machine Learning Group

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
1.3 Research Areas

**Biometrics and Machine Learning Group**

**Biometrics**

*Biometric cryptography*

- 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 e.g. iris codes)
- Comparison of properties and effectiveness of different algorithms for biometric modalities
  - iris modality – Osiris, Czajka, Masek, Neurotechnology
  - fingerprint – NIST, Neurotechnology
- Analysis of application of different biometric cryptography approaches to different modalities/algorithms
- 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.

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.
1.3 Research Areas

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)

Robot Programming and Pattern Recognition Group

**MRROC++ robot programming framework**

- a collection of: C++ classes, QNX 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
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

Control architecture for autonomous mobile robot teams

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

Robot Programming and Pattern Recognition Group

Sensor based two-handed manipulation

Rubik's cube puzzle as a benchmark task for service robots

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 hold 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)
**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, ready-to-use communication mechanisms in both FraDIA and MRROC++ 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 MRROC++
  - Object-oriented design: set of base abstract classes and interfaces, collection of ready to use components, utilization of multiple design patterns

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**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

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**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 fataing 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 overcome by the introduction of an active observer, which can perform actions which 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 lighting (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 a 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  Following an unknown contour  Rotating a crank  Copying drawings

Robot Programming and Pattern Recognition Group

Planning and controlling a swarm of mobile fixtures

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

**Text recognition in outdoor images**

Licence plate detection and text recognition (cars, containers)

---

**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"): T, A, K, N, I, E, K, A, T
Robot Programming and Pattern Recognition Group

1.3 Research Areas

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

Robot Programming and Pattern Recognition Group

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

Example of an 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

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
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

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
ICCE, 2009 Annual Report

1.3 Research Areas

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

Software Engineering Group

Software development

Research topics:
- Software development methods
  - Object-oriented analysis and design
  - Structured analysis and design
- Business process modeling
  - Workflow, Data flow diagram, Function tree
- Requirements engineering
- Acceptance testing
- Software processes
  - Waterfall, incremental, formal

Systems and tools:
- Rational Rose
- Rational RequisitePro
- Structured Architect
1.3 Research Areas

Software Engineering Group

Evaluation of the software quality

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

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

Software Engineering Group

Distributed Open Systems

Research topics:
- Service Oriented Architectures (SOA)
  - Architecture and Architecture Decisions
  - System Evolution and Transformation
- Security in Distributed Open Systems
- Role-Based Trust Management languages
  - Syntax and Semantics
  - Credentials
  - Credential Chain Discovery
  - Soundness and Complexity of Inference Rules

Languages and Conceptual Tools:
- $RT_0$, $RT_1$, $RT_2$, $RT^\top$
- BPEL
- Architecture Decision Models
1.3 Research Areas

Operations Research and Management Systems Group

Designing of infrastructure markets under constraints decentralized market structure

- Object and subject market structure
- Market rules designing
- Strategic and tactical market planning
- Real-time operational control
- Market operator decisions support tools
- XML-based description of market

Operations Research and Management Systems Group

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

Market state:
- Long term planning
- Short term planning

Bilateral market
Power Exchange
Real-time market
Local markets
Hourly contracts positions
Sale/buy offers
1.3 Research Areas

Operations Research and Management Systems Group

Library catalogue digitization

- Skew correction
- Binarization
- Noise elimination
- Segmentation
- Framing
- Recognition

C.88548

M³ Multicommodity Market Model

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

- 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
1.3 Research Areas

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

Optimization and Decision Support Group

Risk Measures and Optimization under Risk

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

**Optimization and Decision Support Group**

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 Method Diagram]

- Reference point
- Solution

**Optimization and Decision Support Group**

Application of the reference point method for land resource assessment

![Application of the reference point method for land resource assessment]
Optimization and Decision Support Group

Fair network design and optimization

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

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<th>FACULTY and STAFF</th>
<th>2007</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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* 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, and Research Associates, as well as Technical Staff. The personal information below regards the period of January 1 – December 31, 2008.

2.1 Professors Emeriti

Władysław Findeisen  Professor (retired July 1999)

Systems Control Division, Complex Systems Group
room 524, tel. 660 7397 and 825 0995
W.Findeisen@ia.pw.edu.pl


Radosław Ładziński  Professor (retired January 1998)

Systems Control Division, Complex Systems Group
room 570, tel. 660 7648
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 Pułaczewski  Senior Engineer (retired since October 2003)

Systems Control Division, Robot Programming and Pattern Recognition Group
room 570, tel. 660 7648
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. 660 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.

Andrzej P. Wierzbicki  Professor (retired March 2004)

Operations and Systems Research Division, Optimization and Decision Support Group
room 24, tel. 6607750, 8255280
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 working for Biometric Laboratories. He is a member of the NASK Research Council (2006–). Voting representative of NASK in Technical Committee No. 182 on Information Security in IT Systems (2007–) and in Technical Committee on Biometrics (2009–) 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 (part-time)

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.

Krzysztof Fleszar  Assistant Professor (until September 2009)

Operations and Systems Research Division, Operations Research and Management
Systems Group
room 561, tel. 22 234 7123
K.Fleszar@ia.pw.edu.pl, www.ia.pw.edu.pl/~kfleszar

* M.Sc. 2000, Ph.D. 2004 from WUT.*

With WUT since 2003.
*Interests:* Combinatorial optimisation, scheduling and allocation, combinatorial auctions decision support, multi-dimensional optimisation.

Janusz Granat  Assistant Professor

Operations and Systems Research Division, Optimization and Decision Support Group
room 25A, tel. 22 234 7640
J.Granat@ia.pw.edu.pl, www.ia.pw.edu.pl/~janusz

* M.Sc. 1986, Ph.D. 1997 from WUT.*

With WUT since 1987, chairman of IFIP Working Group TC 7.6, Optimization-Based Computer Modeling and Design
*Interests:* Decision support systems, multicriteria decision analysis, data warehouses, decision support in telecommunication industry.

Jerzy Gustowski  Senior Lecturer

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

* M.Sc. 1979 from WUT.*

With WUT since 1979.
*Interests:* Low level software for computer control, interfacing, single-chip microcomputers, PLC controllers.
Mariusz Kaleta  Assistant Professor

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

M.Sc. 2000, Ph.D. 2005, from WUT
With WUT since 2003.
Interests: Discrete optimization, operations research and management, decision support in energy market.

Mariusz Kamola  Assistant Professor (part-time)

Systems Control Division, Complex Systems Group
room 573, tel. 22 234 7126
M.Kamola@ia.pw.edu.pl, www.ia.pw.edu.pl/~mkamola

M.Sc. 1997, Ph.D. 2004 from WUT.
With WUT since 2002.
Interests: Modeling and simulation, optimization, parallel computation, IP networks.

Andrzej Karbowski  Assistant Professor

Systems Control Division, Complex Systems Group
room 572, tel. 22 234 7632
A.Karbowski@ia.pw.edu.pl, www.ia.pw.edu.pl/~karbowski

M.Sc. 1983, Ph.D. 1990 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 554, tel. 22 234 7866
W.Kasprzak@ia.pw.edu.pl, www.ia.pw.edu.pl/~wkasprzak

With WUT since 1997. Member of Polish Section of IAPR.
Interests: Computer vision, speech recognition, pattern classification, signal analysis, artificial intelligence.
Zygmunt Komor  Senior Lecturer (part-time)

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 (on leave since Oct. 2009)

Operations and Systems Research Division, Optimization and Decision Support Group
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
MLawrynczuk@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 8250995
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.
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


interests: Large scale systems, computer simulation, computer aided control systems design, environmental systems management, distributed computations, global optimization, telecommunications 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


With Warsaw University of Technology since 1969, first with the Institute of Mathematics (until 1978) then with ICCE. Visiting Assistant Prof. at Lefschetz Center for Dynamical Systems of Brown University, Providence, RI (1980–1981), Visiting Associate Prof.


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/~paczynsk

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.

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 Płoszański 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


Interests: Software engineering, software quality evaluation, software specification and design methods, real-time systems.

Kamil Smolira Assistant Professor (since May 2009)

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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 554, tel. 22 234 7866
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

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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.
2.2 Senior Faculty

Piotr Tatjewski  Professor (Head of Division)
Control and Software Engineering Division, Control Engineering Group
room 524, tel. 22 234 7397 and 825 0995
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M.Sc. 1972, Ph.D. 1976, D.Sc. 1988, the title of Professor of Technical Sciences awarded in 2003, appointed to ordinary professorship in 2006


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.Toczylosk@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 since August 2005)

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room 22/23, 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.

Wiesław Traczyk  Professor (part-time)

Operations and Systems Research Division, Optimization and Decision Support Group
room 523, tel. 22 234 7791
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M.Sc. 1959, Ph.D. 1964, D.Sc. 1969 from WUT, the title of Professor awarded 1983.


Interests: Knowledge engineering, expert systems, artificial intelligence.

Michał Warchol  Senior Lecturer, part-time

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room 560, 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 572a, tel. 22 234 7120
P.Wawrzynski@elka.pw.edu.pl, http://staff.elka.pw.edu.pl/~pwawrzyn

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

With WUT since 2005.

Interests: Reinforcement learning, neural networks; modeling of memory, consciousness, and perception; adaptive control, learning robots.
Adam Woźniak Reader

Systems Control Division, Complex Systems Group
room 560, tel. 22 234 7665
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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)

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room 565, tel. 22 234 5102, 8255280
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

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

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

With WUT since 2005.

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

2.3 Supporting Faculty and Staff

Przemysław Kacprzak  Assistant (since Oct. 2009)

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 (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

Włodzimierz Macewicz  Senior Software Engineer

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room 525, tel. 22 234 7699
W.Macewicz@ia.pw.edu.pl, www.ia.pw.edu.pl/~wujek

M.Sc. 1983 from WUT.

With WUT since 1983.

Interests: Computer networks, data bases, operating systems, programming languages, text processing.
Piotr Pałka  Assistant (since Oct. 2009)

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M.Sc. 2005, Ph.D. 2009 from WUT.
With WUT since 2009.
Interests: Multi-agent systems, mechanism design, market design, incentive compatibility.

Andrzej Ratkowski  Assistant (since Oct. 2009)

Control and Software Engineering Division, Software Engineering Group
room 555, tel. 22 234 7997
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M.Sc. 2005 from WUT.
With WUT since 2009.
Interests: Software engineering, Service Oriented Architecture, performance engineering.

Przemysław Miroslaw Strzelczyk  Assistant (until Sept. 2009, part-time)

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room 518A, tel. 22 234 7805
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M.Sc. 2005 from WUT.
Received his M.Sc. in Information Technology in 2005 from Warsaw University of Technology. Since 2008 he is with Warsaw University of Technology, and since 2004 with Research and Academic Computer Network NASK working for Biometric Laboratories. He is a graduate student member of the IEEE (Institute of Electrical and Electronics Engineers, Inc., 2007-) and serves as the Publicity Committee Officer of the IEEE Poland Section (2007-).
Interests: Biometrics, pattern recognition, systems security.

Piotr Trojanek  Software Engineer (since Apr. 2009)

Systems Control Division, Robot Programming and Pattern Recognition Group
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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.
2.4 Ph.D. Students

**Tomasz Winiarski** Assistant (part-time)

Systems Control Division, Robot Programming and Pattern Recognition Group

room 012, tel. 22 234 7117

T.Winiarski@ia.pw.edu.pl, http://robotics.ia.pw.edu.pl/tomaszewiniarski

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

With WUT since 2004.

*Interests:* Robot control systems, artificial intelligence.

**2.4 Ph.D. Students**

**Krzysztof Bareja** Ph.D. Student

Operations and Systems Research Division, Optimization and Decision Support Group

room 556, tel. 22 234 7124

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Systems Control Division, Biometrics and Machine Learning Group

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*Supervisor:* Krzysztof Sacha

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*Supervisor:* Krzysztof Sacha
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Supervisor: Eugeniusz Toczyłowski
For short cv and activities see p. 48.

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Supervisor: Cezary Zieliński
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Supervisor: Andrzej Pacut
2.4  Ph.D. Students

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Supervisor: Andrzej Pacut

Robert Kuźmiuk  Ph.D. Student

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room 526, tel. 22 234 7125
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Supervisor: Cezary Zieliński

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Supervisor: Włodzimierz Ogryczak

Paweł Markowski  Ph.D. Student

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Supervisor: Włodzimierz Ogryczak
Michał Marks Ph.D. Student

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room 573, tel. 22 234 7126
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Supervisor: Ewa Niewiadowska-Szynkiewicz

Jacek Michalek Ph.D. Student (since Oct. 2009)

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Supervisor: Andrzej Pacut

Łukasz Mirtecki Ph.D. Student (since Feb. 2009)

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Supervisor: Andrzej Pacut

Piotr Modliński Ph.D. Student (since Mar. 2008)

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Supervisor: Eugeniusz Toczyłowski

Paweł Olender Ph.D. Student

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Supervisor: Włodzimierz Ogryczak

Piotr Pałka Ph.D. Student (until Oct. 2009)

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Supervisor: Eugeniusz Toczyłowski
For short cv and activities see p. 49.

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Supervisor: Włodzimierz Ogryczak

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Supervisor: Andrzej Pacut

Andrzej Ratkowski  Ph.D. Student  
Control and Software Engineering Division, Software Engineering Group  
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Supervisor: Krzysztof Sacha  
For short cv and activities see p. 49.

Piotr Rzepakowski  Ph.D. Student  
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room 556, tel. 22 234 7124  
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Supervisor: Włodzimierz Ogryczak

Anna Sibilska-Mroziewicz  Ph.D. Student (until Mar. 2008)  
Systems Control Division, Robot Programming and Pattern Recognition Group  
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Supervisor: Cezary Zieliński

Łukasz Stasiak  Ph.D. Student (until Oct. 2009)  
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Supervisor: Andrzej Pacut

Przemysław Mirosław Strzelczyk  Ph.D. Student  
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*Supervisor:* Piotr Tatjewski

Piotr Sztandera  Ph.D. Student

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*Supervisor:* Krzysztof Sacha

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*Supervisor:* Piotr Tatjewski

Piotr Trojanek  Ph.D. Student

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*Supervisor:* Włodzimierz Kasprzak

### 2.5 Administrative and Technical Staff

Alicja Trojanowska  Secretary, Student affairs.

room 23, tel. 22 234 7750
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*M.Sc. 2002 from Warsaw School of Management and Marketing.*
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Jadwiga Osowska Manager, Finances.  
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M.Sc. 1975 from WUT.

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Ryszard Tchorz Technical support.  
room 559, tel. 22 234 7698

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 2008/2009

### 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>Adaptive and Learning Systems</td>
<td>SAU</td>
<td>2 – 1 –</td>
<td>SIDJB, SIDJC, PP-SID</td>
<td>P. Wawrzyński (spring)</td>
</tr>
<tr>
<td>Administration of UNIX and TCP/IP</td>
<td>ASU</td>
<td>2 – 2 –</td>
<td>OSK, OT</td>
<td>J. Sobczyk (spring/fall)</td>
</tr>
<tr>
<td>Algorithms and Data Structures</td>
<td>AISD1</td>
<td>2 – 1 –</td>
<td>sem. 3</td>
<td>A. Żalewski (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>Biometric Identity Verification</td>
<td>BIT</td>
<td>2 – 1 –</td>
<td>SIDJB, SIDJC, PP-SID</td>
<td>A. Czajka (spring)</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>ECONE</td>
<td>2 1 1 –</td>
<td>ANGL, OT</td>
<td>J. Sobczyk (spring)</td>
</tr>
<tr>
<td>Computer Networks (I)</td>
<td>SKM</td>
<td>2 – 1 1</td>
<td>SKOR, OT</td>
<td>J. Sobczyk (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 1</td>
<td>BDSI, OT</td>
<td>T. Traczyk (spring/fall)</td>
</tr>
<tr>
<td>Decision Support</td>
<td>WDEC</td>
<td>2 – 2 –</td>
<td>MKPWD, OT, PP-SID</td>
<td>J. Granat (spring/fall)</td>
</tr>
<tr>
<td>Decision Support Under Risk Conditions</td>
<td>WDWR</td>
<td>2 – 1 –</td>
<td>PZ-I, OT</td>
<td>W. Ogrzyck (spring)</td>
</tr>
<tr>
<td>Decyzje w warunkach współzawodnictwa</td>
<td>DWW</td>
<td>2 – 1 –</td>
<td>PZ-I, PZ-SID, OT</td>
<td>A. Woźniak (spring)</td>
</tr>
<tr>
<td>Digital Circuits</td>
<td>EDC1</td>
<td>2 – 2 –</td>
<td>ANGL</td>
<td>C. Zieliński (spring)</td>
</tr>
<tr>
<td>Discrete and Network Optimisation</td>
<td>ODS</td>
<td>2 – 1 –</td>
<td>PZ-I, PZ-A, PZ-O, OT</td>
<td>E. Toczyłowski (fall)</td>
</tr>
<tr>
<td>Distributed Operating Systems</td>
<td>RSO</td>
<td>2 – 1 –</td>
<td>PZ, OT, PZ-I, PZ-SID, PZ-ISI</td>
<td>T. Kruk (spring)</td>
</tr>
<tr>
<td>Dynamic Systems</td>
<td>EDYSY</td>
<td>2 – 2 –</td>
<td>ANGL, OT</td>
<td>M. Ławryńczuk, P. Marusak (spring/fall)</td>
</tr>
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<td>Event programming (I)</td>
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<td>ATP, OT</td>
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<td>Fundamentals of Digital Technology</td>
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<td>Introduction to Robotics</td>
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<td>Modelling and Control of Robotics</td>
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<td>ANGL</td>
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<td>Mobile robots</td>
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<td>ANGL, ECETC, OT</td>
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<td>ANGL, OT</td>
<td>T. Kruk (fall)</td>
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<td>ANGL, ECETC, OT</td>
<td>P. Tatjewski, M. Lawryńczuk, P. Marusak (spring)</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>Parallel Numerical Methods</td>
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<td>ANGL, OT</td>
<td>A. Stachurski (fall)</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 Management and Scheduling</td>
<td>ZAH</td>
<td>2 – 2</td>
<td>MKPWD, OT, MUS, PP-SID</td>
<td>E. Toczyłowski (spring/fall)</td>
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<td>Programmable Controllers</td>
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<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>ANGL, ECETC, OT</td>
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<td>Software Engineering</td>
<td>IOP</td>
<td>2 – 1</td>
<td>OSK, OT</td>
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<td>Software Specification and Design</td>
<td>SPOP</td>
<td>2 – 1</td>
<td>OK, 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, OT, MUS, PP-SID</td>
<td>K. Malinowski (spring)</td>
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**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>OT</td>
<td>all levels</td>
<td>free electives</td>
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<tr>
<td>ANGL</td>
<td>all levels</td>
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<td>BDSI</td>
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<td>specialization in Databases and Information Systems</td>
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<td>OSK</td>
<td>B.Sc.</td>
<td>specialization in Computer System Programming</td>
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<td>ISO</td>
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<td>specialization in Intelligent Computation Systems</td>
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<td>specialization in Control</td>
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<td>SKOR</td>
<td>B.Sc.</td>
<td>specialization in Computer Networks and Distributed Computations</td>
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<tr>
<td>ATP</td>
<td>B.Sc.</td>
<td>specialization in Programming Algorithms</td>
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<td>SYK</td>
<td>B.Sc.</td>
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<td>SCRJC</td>
<td>B.Sc., M.Sc.</td>
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<td>M. Sc., Ph.D.</td>
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<td>PZ-I</td>
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<td>advanced classes, informatics</td>
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<td>PZ-SID</td>
<td>M.Sc., Ph.D.</td>
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<td>PP-SID</td>
<td>M.Sc., Ph.D.</td>
<td>fundamental classes, Decision and Information 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. First two editions have attracted 86 students of various background.

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, applications 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 co-ordinate two specialisations: 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


A step beyond flexible/reconfigurable fixtures for higher continuous adaptation of production resources 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 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, all without moving/removing the part from the fixture. 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.


This work focuses 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 is developed for that purpose. Force sensing and visual servoing are used to perform service tasks. Moreover, the Human-Machine Interface is under investigation. Both speech understanding and recognition of gestures are studied. The experiments are conducted on a two-handed robot system equipped with cameras and force sensors. The control software is based on the MRROC++ robot programming framework.


This project concentrates on position-force control of manipulators. Diverse position-force control algorithms are implemented and their performance is being compared. Those investigations should lead to the formulation of basic motion primitives that will enable the expression of any task involving end-effector motion in free space, in contact with an object, and in the intermediate phase between free motion and contact. The elaborated control methods are tested on a real robot. The control software is based on the MRROC++ robot programming framework.


This project concentrates on visual servo controllers. This kind of coordination is of fundamental importance when acquiring and releasing objects or when executing tasks needing contact between tools and objects. Different structures of visual servos are compared and hybrid control methods are being elaborated. Produced control methods are tested on a real robot. The control software is based on the MRROC++ robot programming framework.

The general objective of the grant is to develop and implement the Crisis Management System (CMS) dedicated for urban agglomeration of Warsaw. The Expected results are: a set of threat models (e.g. predictive) and algorithms covering threats defined in the catalogue of urban threat, a demonstrable distributed software components of CMS for threat analysis supporting. A real urban threat is described by: a type of threat, a source of threat, critical infrastructures, possible losses, methods of counteractions, etc. The following type of threats are considered: military, chemical, biological, radiological, fire, flood, network infrastructures (service), terrorist, environmental catastrophes. The focus is on the synergy effect of complex threats. Due to the complexity of the system the distributed software environment is proposed as a simulation framework. The general idea of CMS software system is as follows: it will consist of autonomy of simulators in a wide and heterogeneous ‘open architecture’ network, the event-driven, continues and astronomical time management will be considered. coherent simulation – same time and events for all software applications and users, reusability of simulators and other components. The simulator will be used to predict states or factors values for next periods and simulate the course and effects of terrorist action. The goal of ICCE team is to realize 18th task of the project: Prediction and simulation of floods of the Vistula river and crisis management in Warsaw during flood. The expected final result of this task is the component of CMS for flood modeling, simulation, prediction and decision support concerned with flood management in the agglomeration of Warsaw.


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 are planned. 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) will be dedicated to complex convex and nonconvex optimization problems. The integrated software platform EPOCS will provide tools for calculating local and global solutions on parallel and multi-core computers or computer clusters. It will contain algorithms for local and global optimization, and solvers based on interval analysis. The graphical interface will be provided to optimization problem definition and results presentation. The effectiveness of optimization algorithms will be tested through numerical experiments. Both planned libraries will be the useful tools for research and education. The results of the project will be described in the research papers, a book devoted to parallel computing, and presented on conferences.


The project is concerned with the formal analysis of the properties of the solutions to the games induced by the distributed resource allocation algorithms. Its goal relates to the problem of implementation of the choice rules, defined on the families of relational structures, in the form of mappings called mechanisms. A choice rule is said to be implemented by a mechanism under a given game concept if the mechanism defines a game with the solutions, compatible with the selected concept, generating outcomes defined by choice rule. The research conducted within the project, mostly with use of the apparatus of set-theory and convex analysis, is aimed at investigating the necessary and sufficient conditions for implementation of the Pareto-optimal choice rules in Nash equilibria. In particular, the implementation problem is studied in the context of network resource allocation in the setting of price-anticipating agents. Necessary and sufficient
conditions are formulated here for the auction algorithms based upon flow maximization
games with efficient pure-strategy Nash equilibria. The conditions are then applied to
design distributed network resource allocation algorithms.


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 main goal of this project is development and evaluation of optimization models for supporting effective electricity markets. Multicommodity turnover mechanisms allows for joint balancing of many interdependent commodities considering infrastructure, individual and other (e.g. environmental) constraints. Proposed models will allow to achieve greater efficiency of market systems. Electricity markets were chosen because of their unique requirements and constraints. Proposed models could be used for other infrastructure markets (gas, telecommunication) after adaptation. The result of this project will include models for crossborder auctions, joint balancing of energy and options and creation of customized offers.


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.


The role of the system is to support trading decision making taking into consideration the uncertainty of the business environment and of the technical factors. The system is design to perform the following operations:

- long-term planning: financial result planning for the market corporate operations over the year and longer horizon,
mid-term planning: risk analysis and the optimization of the company participation in different market segment (monthly and quarterly horizon perspective),

short-term planning: operational support considering of the trading decision risks (daily or even hourly perspective).


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 consistency 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.

Many of market analyses are accomplished with assumption of perfect competition and absence of market power. This is a strong assumption, as there exist a number of the oligopolistic markets often strongly tied-up with a natural monopolistic economy (e.g. electricity energy markets, bandwidth allocation on telecommunication markets, railway slot allocation etc.). On such markets the market power does exist, and, which is more important, can be easily exploited by some market participants. Therefore, incentive compatibility analysis, and elaboration of incentive compatible mechanisms is an important regulation issue.

Thus, we propose the Parametric Pricing Rule, which has good properties for multi-commodity exchange with infrastructure constraints under oligopoly conditions. We figure, that the parametric pricing rule has cost for adopting. Such cost results from budget imbalance, and means that auction operator has to surcharge to obtain budget balance. We propose the algorithm to reduce the budget imbalance. Finally, we compare the classical, double pricing rule with the parametric pricing rule. The results of the comparison are as follows - under oligopoly conditions, the costs resulting from parametric pricing rule (the budget imbalance costs) are less than costs resulting from dual pricing rule (the speculation costs).

Intelligent system for diagnosis and supervisory control of industrial processes ‘DiaSter’. Granting period 18.05.2007 – 17.11.2009. General principal investigator: Jan Maciej Kościelny (Faculty of Mechatronics, WUT), principal investigator from ICCE: Piotr Tatjewski, investigators from ICCE: Piotr Marusak, Maciej Ławryńczuk.

The aim of the project was to build program package DiaSter for advanced modeling, simulation, diagnostics and control of technical processes, capable to perform the following tasks: modeling and identification of processes using different classes of models (including fuzzy and neural), data mining in large technical data bases, construction of industrial simulators, industrial diagnostics of elements and processes, tuning of control loops, supervisory feedback control and set-point optimization. The group from ICCE headed by Prof. Tatjewski was responsible for development of software for model-based predictive control (MPC) based on linear and nonlinear process models and for development of selected optimization routines, general purpose routines and specialized ones, for on-line set-point optimization cooperating with predictive controllers.


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.


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 registration (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, but at the same time fit Polish legislation.


Robotic soccer has become a standard "real-world" test-bed for autonomous multi-robot systems. The goal of the project was to design and develop a team of mobile robots playing soccer. The robot hardware consists of two main components: mechanical part and electronics. The mechanical system is composed of an omnidirectional mobile base and a ball kicking system. The electronics comprises Atmel ATmega microcontroller, motor controllers, and RF module.

5 Degrees Awarded

5.1 Ph.D. Degrees

Advisor: Piotr Tatjewski

marek strzelczyk
Zastosowanie algorytmów ewolucyjnych do zadań optymalizacji z modelem niepewności w postaci scenariuszy wielowariantowych
Thesis defended on January 13, 2009

krzysztof sztyber
Odporne algorytmy regulacji predykcyjnej w warunkach niepewności modelu
Thesis defended on April 21, 2009

Konrad Wojdan
System optymalizacji bieżącej punktu pracy procesów technologicznych inspirowany działaniem układu immunologicznego
Thesis defended on November 10, 2009

Advisor: Eugeniusz Toczyłowski

Kamil Smolira
Analiza mechanizmów bilansowania na rynkach czasu rzeczywistego
Thesis defended on January 13, 2009

Piotr Pałka
Analiza zgodności motywacji mechanizmów wieloagentowej platformy wymiany towarowej
Thesis defended on December 1, 2009

Advisor: Cezary Zieliński

Tomasz Winiarski
Specification and Implementation of Force Control Tasks for Robot Manipulators
Thesis defended on December 1, 2009

Maciej Staniak
Structures of Visual Servos for Manipulator Control
Thesis defended on December 8, 2009

5.2 M.Sc. Degrees

Advisor: Jarosław Arabas (Inst. of Comp. Science)

M. Talak
Metody sztucznej inteligencji w wewnętrznym wykrywaniu plagiatów
Degree awarded on October 2009
Advisor: **Piotr Arabas**

**K. Studziński**

*Tools for Self-similar Traffic Generation and Analysis*

Degree awarded on October 2009

**P. Adamczak**

*System aukcyjny dla potrzeb operacyjnych w lotnictwie cywilnym*

Degree awarded on September 2009

Advisor: **Krzysztof Chabko (Inst. of Comp. Science)**

**K. Narkovic**

*Symulacja podpowierzchniowego rozpraszania światła w czasie rzeczywistym*

Degree awarded on October 2009

Advisor: **Andrzej Ciemski (Inst. of Comp. Science)**

**T. Wiechecki**

*Wpływ optymalizacji wykorzystania zasobów na zwiększenie efektywności pracy magazynu*

Degree awarded on March 2009

**M. Karbowy**

*Współczesne techniki integracji systemów informatycznych*

Degree awarded on October 2009

Advisor: **Adam Czajka**

**J. Michalek**

*Test żywotności dla celów biometrii tęczówki z wykorzystaniem dynamiki źrenicy*

Degree awarded on March 2009

Advisor: **Paweł Domański**

**M. Litniewski**

*Analiza wielokryterialnych metod doboru optymalnego portfela*

Degree awarded on March 2009

Advisor: **Janusz Granat**

**J. Szlichta**

*Gromadzenie wiedzy o projektach informatycznych i jej wykorzystanie w podejmowaniu decyzji*

Degree awarded on March 2009

**S. Olszewski**

*Wielokryterialne wyszukiwanie informacji w serwisach WWW*

Degree awarded on March 2009

**A. Gosk**

*Charakterystyka wybranych metod optymalizacji zapytań w bazie Teradata*

Degree awarded on July 2009 (with honors)
Advisor: Mariusz Kamola

P. Jaworski
Aukcyjny system rezerwacji częstotliwości radiowych
Degree awarded on October 2009

P. Zyskowski
Chaotic behavior propagation in computer networks – case study
Degree awarded on November 2009

Advisor: Andrzej Karbowski

M. Wanatowski
Metody optymalizacji równoległej z dekompozycją bezpośrednią w zadaniach z ograniczeniami funkcyjnymi
Degree awarded on March 2009

Advisor: Włodzimierz Kasprzak

A. Nienaltowski
Wyszukiwarka internetowa wspomagana modelem sekwencji słów
Degree awarded on December 2008 (within the WUT distance learning programme (OKNO))

M. Kozinski
Wizyjne rozpoznawanie gestów dłoni do celów sterowania robotem
Degree awarded on April 2009

P. Przybysz
Rozpoznawanie zadań mówionych
Degree awarded on April 2009

R. Brzezanski
Oprogramowanie do sterowania robotami mobilnymi z elementami grafiki 3D i analizy obrazów ręki
Degree awarded on April 2009 (within the WUT distance learning programme (OKNO))

K. Czapnik
Rozpoznawanie gestów dłoni w sekwencji obrazów cyfrowych
Degree awarded on June 2009

M. Mulawa
System detekcji i obsługi kodów graficznych QR w zastosowaniach mobilnych
Degree awarded on June 2009

Ł. Czajka
Rozpoznawanie obrazów zawierających obiekty przekazywane robotowi przez człowieka
Degree awarded on September 2009

M. Orzechowski
System agentowy umożliwiający dostęp do danych w języku naturalnym
Degree awarded on October 2009

T. Szczepeński
Projekt szkieletowego systemu ekspertowego
Degree awarded on September 2009
Advisor: **Bartłomiej Kubica**

R. Dąbrowski  
_Reprezentacje macierzy przedziałowych optymalizujące algorytmy cache – oblivions_  
Degree awarded on September 2009

K. Jastrzębski  
_Different parallelism approaches to interval computations_  
Degree awarded on October 2009

Ł. Szczap  
_Different parallelism approaches to interval computations_  
Degree awarded on October 2009

Advisor: **Maciej Ławryńczuk**

D. Czub  
_Sieci neuronowe w zagadnieniach modelowania i algorytmach regulacji predykcyjnej_  
Degree awarded on March 2009

S. Panas  
_Projektowanie algorytmów regulacji predykcyjnej z modelami neuronowymi_  
Degree awarded on June 2009

Advisor: **Piotr Marusak**

P. Ostrówka  
_Sterowanie predykcyjne nieliniowych obiektów z ograniczonymi wyjściami_  
Degree awarded on September 2009

Advisor: **Julian Myrcha (Inst. of Comp. Science)**

K. Rymuza  
_Problematyka interoperacyjności na tle procesów informatyzacyjnych w administracji publicznej_  
Degree awarded on October 2009

Advisor: **Ewa Niewiadomska-Szynkiewicz**

J. Korycki  
_Zastosowanie środowiska do symulacji OMNet++ do analizy wybranych problemów w sieciach teleinformatycznych_  
Degree awarded on May 2009

A. Gerula  
_Algorytmy hierarchiczne do wyznaczania ścieżek transmisji danych w sieciach ad-hoc_  
Degree awarded on October 2009

M. Antonik  
_Ant-based routing algorithms for mobile ad hoc networks_  
Degree awarded on October 2009
Advisor: Włodzimierz Ogryczak

M. Górecki
Uporządkowane średnie ważone jako kryteria wyboru optymalnych lokalizacji
Degree awarded on July 2009

J. Jagusztyn - Grochowska
Hedging w oparciu o miarę CVaR
Degree awarded on September 2009 (with honors)

J. Chościłowicz
Wybrane zagadnienia niezawodności i jakości usług w korporacyjnych rozległych sieciach komputerowych
Degree awarded on October 2009 (within the WUT distance learning programme (OKNO))

K. Sobiech
Modele jednostronne replikacji indeksu w analizie portfelowej
Degree awarded on September 2009

B. Duras
Optymalizacja wartościowanej porządkowej średniej ważonej dla wspomagania rozdziału zasobów w sieciach z awariami
Degree awarded on October 2009

Advisor: Krzysztof Pieńkosz

T. Kaleta
Algorytmy rozkroju pasa materiału
Degree awarded on October 2009

D. Dulęba
Algorytmy heurystyczne dla jednowymiarowego problemu pakowania z ograniczoną podzielnością elementów
Degree awarded on October 2009

Advisor: Grzegorz Płoszański

G. Chęciński
Wybrane zagadnienia zarządzania finansowego przedsiębiorstwem w warunkach ryzyka w aspekcie dydaktycznym
Degree awarded on March 2009

B. Węgrzyn
Algorytmy korekcji deformacji obrazu spowodowanych niepłaskim odkształceniem kart skanowanych książek
Degree awarded on March 2009
Advisor: **Grzegorz Protaziuk (Inst. of Comp. Science)**

K. **Flont**  
*Efektywne algorytmy klasyfikacji danych pochodzących ze spektrometru masowego SELDI-TOF*  
Degree awarded on September 2009

P. **Golcz**  
*Klasyfikacja emocjonalna tekstów*  
Degree awarded on October 2009

Advisor: **Tadeusz Rogowski**

G. **Grabka**  
*Technologie usług głosowych w bezprzewodowych sieciach WIFI i WIMAX*  
Degree awarded on November 2009 (within the WUT distance learning programme (OKNO))

Advisor: **Przemysław Rokita (Inst. of Comp. Science)**

M. **Wojtkowski**  
*Metoda elementów dyskretnych*  
Degree awarded on October 2009

Advisor: **Krzysztof Sacha**

M. **Bakalarz**  
*Weryfikacja oraz generacja kodu do sterowania PLC dla automatów czasowych zapisanych w postaci diagramu UML*  
Degree awarded on March 2009

Advisor: **Marcin Szlenk**

J. **Siemińska**  
*Definiowanie metod zwinnych w środowisku Rational Metod Composer*  
Degree awarded on March 2009

G. **Pusz**  
*Generowanie aplikacji wykonanej w technologii EJB z modelu zapisanego w UML*  
Degree awarded on June 2009

Advisor: **Wojciech Szynkiewicz**

K. **Porczyk**  
*Śledzenie ruchomego celu przez robota mobilnego*  
Degree awarded on October 2009

P. **Wilkowski**  
*Wykorzystanie algorytmu detekcji i lokalizacji w zadaniu chwytania*  
Degree awarded on October 2009

M. **Kawka**  
*Budowa i oprogramowanie grupy autonomicznych robotów mobilnych*  
Degree awarded on October 2009

74
Advisor: Piotr Tatjewski

W. Łącz
Predykcjcyjne sterowanie nadrzędne wartościami zdanymi regulatorów bezpośredniego działania
Degree awarded on March 2009

Advisor: Tomasz Traczyk

M. Bańkowska
Analiza porównawcza języków procedur składanych PL/SQL, SQL PL, PL/pgSQL I T-SQL
Degree awarded on October 2009

Advisor: Adam Woźniak

P. Najgebauer
Inequality analysis in the local public good provision problem
Degree awarded on October 2009

Advisor: Andrzej Zalewski

A. Kątcka
Modelowanie choreografii usług w architekturze MDA
Degree awarded on March 2009

P. Michalak
Język programowania systemów usługowych
Degree awarded on October 2009

A. Izdebski
Metodyka badania wydajności oprogramowania działającego w środowisku usługowym z wykorzystaniem modelu sieci kolejek
Degree awarded on October 2009

A. Domagalik
Testowanie akceptacyjne procesów biznesowych w architekturze usługowej
Degree awarded on October 2009

5.3 B.Sc. Degrees

Advisor: Piotr Arabas

D. Grzegorczyk
Aplikacja pomiarowa dla sieci DiffServ
Degree awarded on February 2009

Advisor: Adam Czajka

R. Brize
Rozpoznawanie tęczówki metodą Daugman’a
Degree awarded on June 2009
Advisor: **Janusz Granat**

M. **Dorociński**  
*Zorientowana zdarzeniowo analiza danych multimodalnych*  
Degree awarded on March 2009

J. **Hurkała**  
*Architektura systemu przetwarzającego zdarzenia ze stron WWW*  
Degree awarded on March 2009

A. **Hurkała**  
*Internetowe usługi informacyjne zorientowane zdarzeniowo (EventWeb)*  
Degree awarded on March 2009

P. **Głuszczyk**  
*Zorientowana zdarzeniowo analiza danych sensorowych*  
Degree awarded on March 2009

Advisor: **Jerzy Gustowski**

K. **Matlak**  
*Stanowisko laboratoryjne manipulatora elektrycznego*  
Degree awarded on June 2009

M. **Pawlus**  
*Rozproszony system sterowania sieci AS-i. Stanowisko laboratoryjne*  
Degree awarded on June 2009

P. **Krajewski**  
*SCL-strukturalny język programowania platformy S7*  
Degree awarded on June 2009

M. **Lubaś**  
*Obiekty wirtualne sterowane przez PLC*  
Degree awarded on June 2009

R. **Smagowski**  
*S7-Graph – graficzny język sterowania sekwencyjnego*  
Degree awarded on October 2009

P. **Dobrzyński**  
*Rozproszony system sterowania - sieć Profibus technologia OPC*  
Degree awarded on October 2009

Advisor: **Mariusz Kaleta**

J. **Wiśniewski**  
*Implementacja API do obsługi podpisu elektronicznego XAdES w języku Java*  
Degree awarded on February 2009

A. **Khozhamuratov**  
*System wieloagentowy do symulacji gry rynkowej*  
Degree awarded on June 2009
Advisor: **Mariusz Kamola**

B. Piech

*Projektowanie i implementacja narzędzi wspomagających refaktoryzację w języku BPEL4WS*

Degree awarded on February 2009

T. Zawadzki

*Automatyczna generacja dokumentacji serwisów WebMethods w postaci diagramów UML*

Degree awarded on October 2009

K. Rybak

*Środowisko badawcze dla problemu nieuczciwego pozycjowania stron WWW w wyszukiwarkach internetowych*

Degree awarded on September 2009

Advisor: **Włodzimierz Kasprzak**

P. Braniewski

*Rozpoznawanie swobodnych kodów tekstowych w obrazach cyfrowych*

Degree awarded on September 2009

Advisor: **Tomasz Kornuta**

M. Szymczak

*Mechanizm akwizycji obrazu w strukturze ramowej FraDIA*

Degree awarded on September 2009

Advisor: **Adam Kozakiewicz**

H. Zęgota

*SIP Platform with conference services; Configuration of telecom layer and preparation for deployment of web based GUI*

Degree awarded on June 2009

A. Kostrzewa

*SIP Platform with conference services High level architecture with web based control panel and GUI*

Degree awarded on September 2009

Advisor: **Bartłomiej Kubica**

P. Grześ

*Porównanie algorytmu optymalizacji globalnej z wykorzystaniem arytmetyki przedziałowej i afonycznej*

Degree awarded on September 2009
Advisor: **Maciej Ławryńczuk**

P. Pawłowski  
*Przybornik do efektywnego uczenia radialnych sieci neuronowych*  
Degree awarded on February 2009

J. Godlewski  
*Krytyczne porównanie gradientowych i heurystycznych algorytmów uczenia sieci neuronowych*  
Degree awarded on February 2009

Advisor: **Piotr Marusak**

E. Bonevich  
*Sposoby uwzględniania ograniczeń wyjść obiektu w algorytmach predykcjnych. Symulacyjne badania porównawcze*  
Degree awarded on September 2009

Advisor: **Ewa Niewiadomska-Szynkiewicz**

M. Niemczuk  
*System do tworzenia zapasowych kopii danych z urządzeń mobilnych*  
Degree awarded on February 2009

P. Osiński  
*Comparative study of SSI cluster systems*  
Degree awarded on March 2009

D. Piotrowski  
*Przegląd i badania symulacyjne mechanizmów aukcyjnych*  
Degree awarded on June 2009

Advisor: **Michał Nowacki (Inst. of Comp. Science)**

P. Drążyk  
*iPhone Universal SDK*  
Degree awarded on September 2009

P. Zarzycki  
*iPhone Application SDK*  
Degree awarded on September 2009

Advisor: **Robert Nowak (Inst. of Electronic Systems)**

M. Michalak  
*Optymalizacja sekwencji DNA kodujących białka*  
Degree awarded on October 2009

Advisor: **Krzysztof Pieńkosz**

K. Tomżyński  
*Heurystyczne algorytmy rozwiązywania problemu plecakowego z ograniczoną liczbą pakowanych elementów*  
Degree awarded on February 2009
Advisor: **Grzegorz Płoszajski**

E. MAJKOWSKI  
*Ekstrakcja danych ze spisów treści zeskanowanych programami OCR*  
Degree awarded on February 2009

W. SZYMAK  
*Wspomaganie tworzenia metadanych technicznych i strukturalnych w zadaniu digitalizacji dóbr kultury*  
Degree awarded on February 2009

Advisor: **Krzysztof Sacha**

Ł. SZANIAWSKI  
*Projektowanie aplikacji w technologii EJB 3.0*  
Degree awarded on June 2009

Advisor: **Andrzej Stachurski**

M. BRZEZIŃSKI  
*Różne aspekty optymalizacji stron internetowych Forma E-kursu*  
Degree awarded on March 2009

K. WNUK  
*Metody wyznaczania punktów zwrotnych na giełdzie oparte na liczbach Fibonacciego*  
Degree awarded on March 2009

P. GOŁASZEWSKI  
*Implementacje i testowanie metod quasi-newtonowskich korzystających z afinicznych operatorów projekcyjnych*  
Degree awarded on March 2009

J. MAZUREK  
*Porównanie efektywności algorytmów kластeryzacyjnych i genetycznych w zadaniach poszukiwania globalnego optima*  
Degree awarded on September 2009

Advisor: **Tomasz Starecki (Inst. of Electronic Systems)**

P. GAWRON  
*Design of a communication interface in a home automation system*  
Degree awarded on October 2009 (with honors)

G. NIEMIROWSKI  
*USB interface-based controller for testing prototype devices*  
Degree awarded on October 2009
Advisor: Marcin Szlenk

M. Szymaniuk
Witryna WWW Ośrodka Języka Angielskiego SJO PW
Degree awarded on February 2009

P. Borysiuk
Regression - Unit Testing Automation in PTK Centertel
Degree awarded on September 2009

K. Kiełbasa
Modelowanie i generowanie kodu aplikacji w technologii Flex
Degree awarded on September 2009

Advisor: Wojciech Szynkiewicz

K. Czajkowski
Planowanie i symulacje chwytów za pomocą sztucznej trójpalczastej ręki
Degree awarded on September 2009

Advisor: Piotr Tatjewski

A. Biernacki
Oprogramowanie i symulacja układów regulacji predykcyjnej z modelami obiektów typu Hammersteina
Degree awarded on February 2009

Advisor: Eugeniusz Toczyłowski

L. Karbowi
Algorytmy i modele aukcji iterowanych
Degree awarded on October 2009 (with honors)

Advisor: Tomasz Traczyk

M. Mazur
Działająca przez WWW przeglądarka do plików FITS dla eksperymentu π of the sky
Degree awarded on June 2009

M. Rybiński
Zaprojektowanie i wykonanie bazy danych I aplikacji wspierających dokumentowanie zagrożonego detalu architektury w ramach projektu ‘Ginący detal’
Degree awarded on October 2009

Advisor: Paweł Wawrzyński

A. Piłaszkiewicz
Q-ruting w mobilnych sieciach AD-HOC
Degree awarded on October 2009
Advisor: **Tomasz Winiarski**

T. Zupka  
_Eliminacja wpływu siły grawitacji na odczyty z czujnika sił i momentów sił_  
Degree awarded on February 2009

M. Kulesza  
_Sprzęg czujnika siły ATI-IA F/T 3084 Gamma z komputerem PC_  
Degree awarded on May 2009

M. Żbikowski  
_Graficzne środowisko symulacyjne systemu wielomanipulatorowego_  
Degree awarded on June 2009

T. Bem  
_Robot playing checkers_  
Degree awarded on September 2009 (with honors)

Advisor: **Andrzej Zalewski**

M. Góręcki  
_Automatyzacja porównywania wyników zapytań do baz danych z wcześniej zdefiniowanymi oczekiwaniami_  
Degree awarded on February 2009

G. Łach  
_Kooperacja procesów biznesowych między organizacjami w architekturze usługowej_  
Degree awarded on September 2009

Advisor: **Cezary Zieliński**

M. Strugiński  
_Graphical User Interface generator for MRROC++ system_  
Degree awarded on June 2009

P. Sakowicz  
_Automatyczna kalibracja systemu robot-kamera_  
Degree awarded on July 2009
6 Publications

6.1 Monographs


6.2 Chapters in Scientific or Technical Books


6.2 Chapters in Scientific or Technical Books


6.3 Scientific and Technical Papers in Journals


6.3 Scientific and Technical Papers in Journals


ICCE, 2009 Annual Report  

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 Abstracts


6.6 Reports and Other Papers


