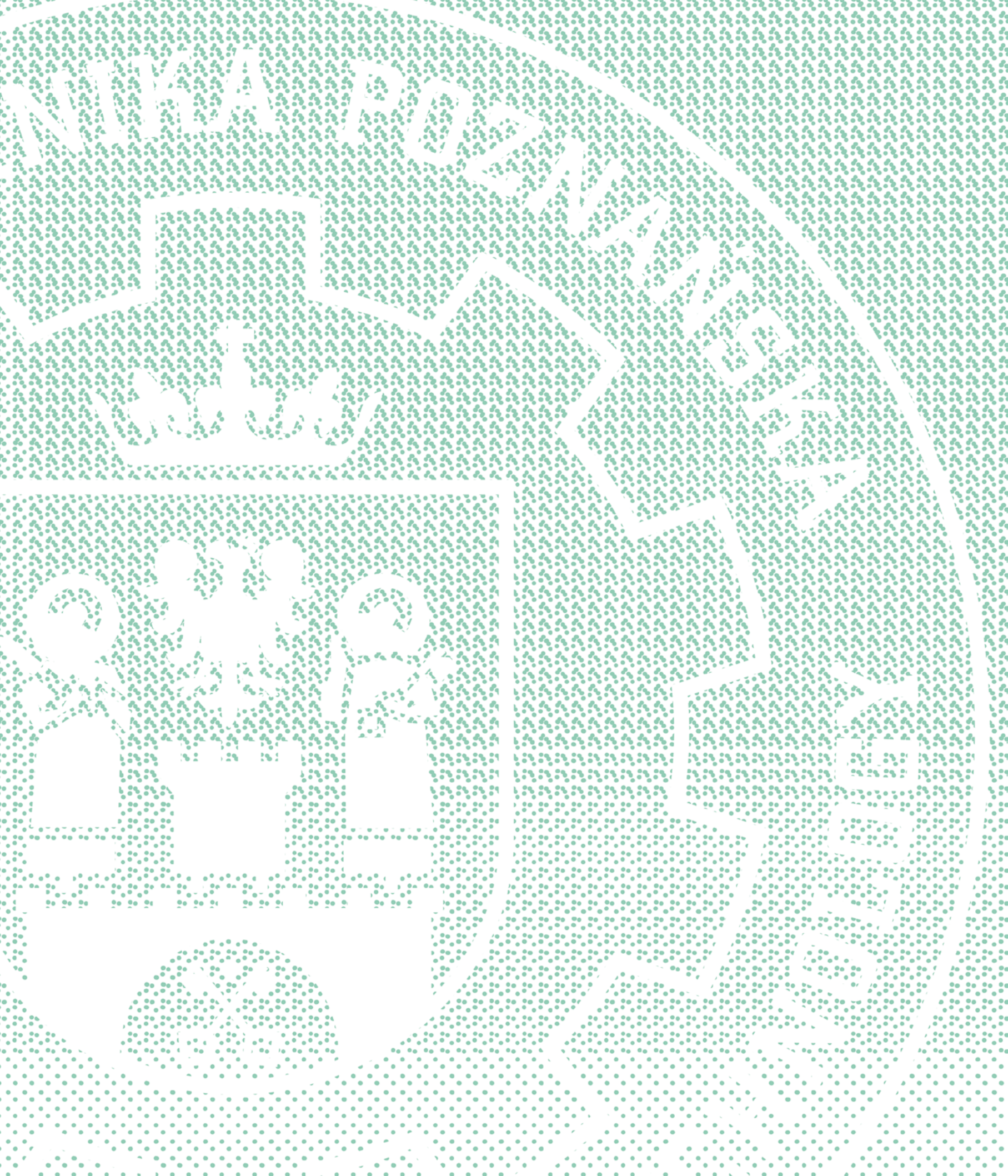**Promotional catalogue**
of apparatus and laboratories of Poznan University of Technology

FACULTY OF **COMPUTING**

Information on the selected test equipment at the
Faculty of Computing, Poznan University of Technology

The Faculty of Computing (WI) offers studies in the following three fields: Automatic Control and Robotics, Computing, and Bioinformatics. The quality of teaching at the Faculty of Computing was confirmed by the Polish Accreditation Commission granting the field of Computing the highest assessment - with a distinction twice in a row for the years 2004-2008 and 2009-2016. Since 2001 the field of Computing has been awarded top ranks in two independent rankings prepared by the Committee of Computer Science of the Polish Academy of Sciences and Polityka, a prestigious national weekly magazine. In 2012 our Computing was awarded as the „Best faculty" and for having the „Best program of studies in the field of computing" by the Ministry of Science and Higher Education. Currently the Faculty of Computing has a scientific category A awarded by the the Ministry of Science and Higher Education. The Faculty of Computing consists of the Institute of Computing, the Chair of Control and Systems Engineering and the Department of Computer Engineering. Three professors from the Faculty of Computing hold honorary doctorates granted by Polish and foreign universities and two professors have been awarded prizes, the so called Polish Nobel, by the Foundation for Polish Science. The Faculty has 18 highly specialized, modern technology laboratories used for teaching, research and implementation projects.

Since 2013 The Faculty of Computing has been working on 29 projects financed from national funds, structural and the Seventh Framework Programme as well as other development programs. Over the last 5 years the Faculty has been doing projects for companies and institutions. We are interested in joint research and implementation projects, research and development, providing expertise and delivering dedicated training courses for companies and institutions both in Poland and abroad, especially in the broad fields of artificial intelligence, data mining, optimization, automatic control and robotics, designing

Professor Andrzej Jaszkiewicz, DSc Eng.

Dean of Faculty of Computing

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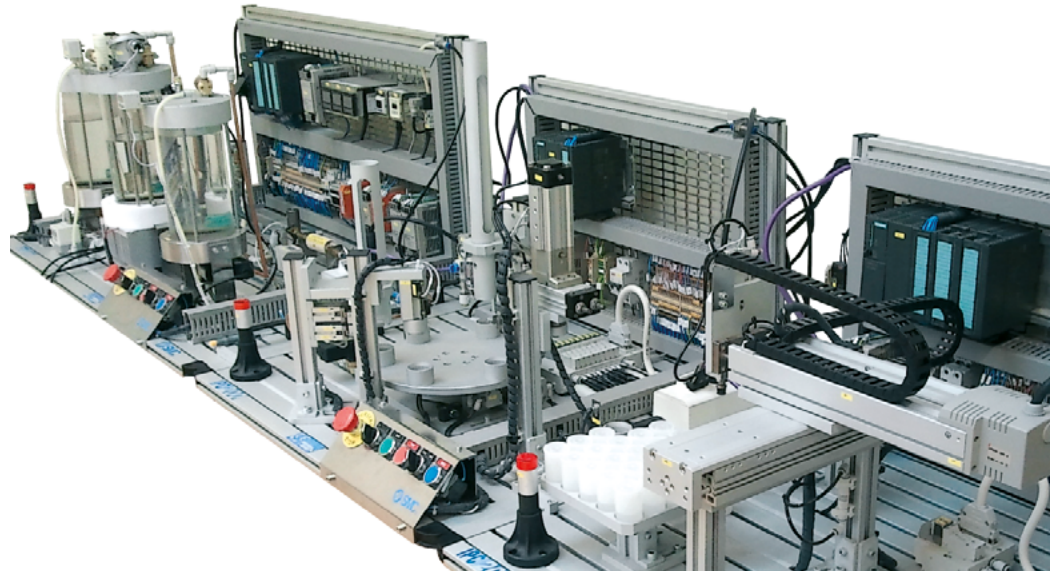**Institute of Computing Science**

Laboratory of Operational Research and Artificial Intelligence

EXPERIENCE AND COMPETENCES:

- algorithms for discrete-continuous scheduling problems
- algorithms for traffic control
- inteligent buildings
- signal processing
- speech recognition
- mobile systems
- multiagent expert systems
- computer control systems for environmental protection
- metaheuristics
- algorithms for project scheduling problems
- Internet of Things
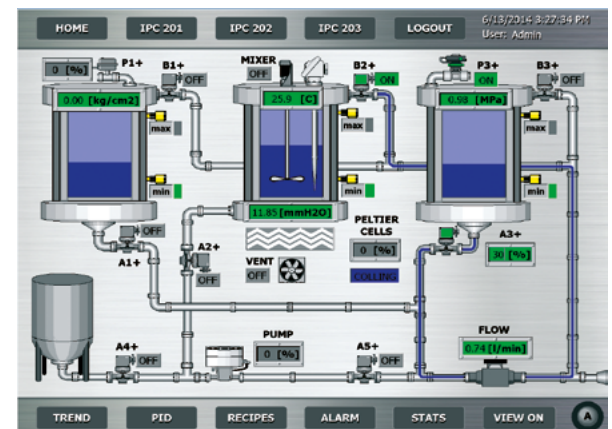- programming PLC controlers
- semantic technologies

KEYWORDS

- optimization
- control systems
- visualization
- mobile systems
- artificial intelligence
- Internet of Things

Description of the Monitoring and visualization of processes laboratory (L.2.7.14BT)

Laboratory of Monitoring and Visualization of Processes is equipped with panels and multipanels that can cooperate with the Programmable Logic Controllers (PLC). For teaching how to construct Human Machine Interfaces - HMI (i.e. interfaces for servicing machines and devices) and how to construct supervisory control systems of processes - SCADA, the physical models of objects/processes are used. These models allow to understand the principles of continuous and discrete processes control, error diagnosis and the implementation of typical industrial measurements and control of such parameters, as fluid flow, level, temperature and pressure. The laboratory is also equipped with a model of the complete production line (of SMC company) consisting of the following substations: preparation of the product, product packaging and storage of finished products. For the synthesis and testing of control algorithms in the production line model, it is necessary to use knowledge from different fields of engineering and industrial technologies: pneumatics, electropneumatics, electronics, drive systems control and fluid parameters control. The control is performed using PLCs operating in the Profibus networks. The monitoring and visualization of the production processes are performed by means of panels, PCs monitors, or remotely, via the Internet. In this way understanding of the production processes is highly increased and methods of performing monitoring and visualizations are demonstrated. The production line lab kit also enables the synthesizing and testing advanced intelligent control algorithms and building distributed HMI/SCADA systems.

KEYWORDS

· monitoring
· visualization
· intelligent control system
· SCADA
· HMI

FACULTY OF **COMPUTING**

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Institute of Computing Science

Laboratory of Intelligent Decision Support Systems

KEYWORDS

- computational intelligence
- optimization and prediction
- multiple criteria decision aiding
- data mining and machine learning
- image recognition

EXPERIENCE AND COMPETENCES:

- design and implementation of efficient algorithms for complex optimization problems (with special focus on transportation, logistic and manufacturing), customized for their characteristics and specific requirements
- intelligent analysis of difficult data, including inconsistent, imbalanced and big data sets, and data streams, construction of prediction models for complex problems
- multiple criteria decision aiding aiming at constructing a recommendation consistent with preferences of decision makers in classification, ranking and best choice problems

APPLICATIONS, IMPLEMENTATIONS, OFFER:

- advanced algorithms for truck routing, considering multiple requirements imposed, e.g., on work time or truck loading time, and resulting in reduction of transportation costs by 5-20% (Interlan)
- systems for predicting product demand and employment, identification of factors leading to faulty product batches (Philips Lighting Poland)
- machine learning prediction models for traffic in road networks (NaviExpert)
- adaptive machine learning algorithms for a spoken language understanding system (Orange Labs)
- best-to-date worldwide machine learning classifier (deep neural network) for detection of blood vessels in ophthalmological imaging
- multiple criteria decision aiding in such problems as evaluating tender offers, constructing rankings of research units, schools and faculties, production and service units, programming of rural water supply systems (Institute of Technology and Life Sciences – Falenty, Agricultural Advisory Center – Brwinów, Regional Labor Office – Poznań)
- systems for retrieval of medical publications and for supporting preliminary clinical diagnosis (Wielkopolska Center of Telemedicine)
- consulting on design and implementation of advanced image recognition systems
- training in decision support and data exploration techniques
- organizing students competitions aimed at solving specific real-life decision and prediction problems (OLX, Roq.ad)

Laboratory of Algorithm Design and Programming Systems

EXPERIENCE AND PROFESSIONAL COMPETENCE:

- design of algorithm and analysis of computational complexity of combinatorial problems
- theory of scheduling in multiprocessor systems
- design of parallel algorithms
- design of compilers of programming languages
- real-time systems
- approaches to software development and testing
- project-management methodologies (Prince2, XPrince)
- cost estimation for software systems (IFPUG FPA, COSMIC)
- optimization of production and business processes
- combinatorial aspects of molecular biology
- algorithms of DNA sequencing
- bioinformatics
- comprehensive visualization and analysis of data
- clustering of data
- computational modeling and analysis of biological molecules
- quality assessment of molecular models and biological processes
- content management systems

APPLICATION, IMPLEMENTATION, OFFER:

- Software testing project: executing manual and automated test cases of dedicated web applications, designing test cases, verification of test data (Roche Poland)
- Eclipse Support Center (in partnership with IBM) – providing global technical support at the L2 and L3 level for users of Eclipse-based tools, developing new solutions based on Eclipse and development of the Eclipse platform itselt, delivering training on the Eclipse platform
- providing expertise and training/workshops on cost estimation of software systems based on the functional size measurements (PKP PLK S.A., Comarch S.A., BZ WBK S.A., Ministry of Infrastructure and Development)
- algorithms of optimization of production line (Volkswagen Poland)
- genetic vaccine decision support system
- comprehensive analysis of bioinformatics' data
- design and optimization of production and business processes
- Post-graduate study on Software Engineering

KEYWORDS

- optimization
- algorithm design
- bioinformatics
- computational complexity analysis

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Information on the selected test equipment at the Faculty of Computing, Poznan University of Technology
Institute of Computing Science

Laboratory of Computing Systems

EXPERIENCE AND COMPETENCES:

- security of information systems
- distributed and parallel processing, cloud computing
- design and management of computer networks
- operating systems
- design of computer systems
- database and data warehouse design
- database administration
- tuning for relational databases and database applications
- business analytics
- data mining
- social network analysis
- XML data processing technologies
- internet technologies
- computer graphics and data processing using graphics processing units (GPUs)

KEYWORDS

- distributed processing
- computer networks
- computer systems
- databases and data warehouses
- database analysis

APPLICATIONS, IMPLEMENTATIONS, OFFER:

- "Development of Cloud & Big Data Verification & Validation Methodology", supported by Samsung Electronics
- "Verification Methodology for Real-Time Big Data & Mobile/Hybrid Cloud", supported by Samsung Electronics
- "Development of computing infrastructure at GEOPOZ", industrial project funded by GEOPOZ
- dedicated technological trainings for business organizations (among others Roche, GEOPOZ, IMPAQ, Rodan Systems, Jeronimo Martins Dystrybucja, SPIN)
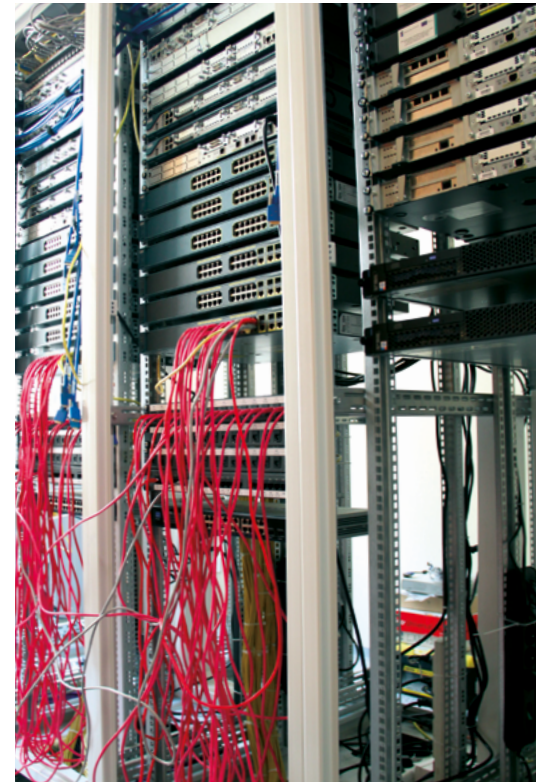- postgraduate studies: computer networks, databases, data warehouses

Laboratory of Local Cisco Networking Academy

The Institute of Computing Science conducts a Local Cisco Networking Academy. The Academy offers an opportunity to acquire theoretical and practical knowledge in design, development, and maintenance of modern computer networks. The course graduates are prepared to obtain the industry-recognized Cisco Certified Networking Associate (CCNA) certificate. The curriculum of the Cisco Networking Academy consists of four semesters and features the following topics: network terminology and standards, reference models and architectures, network cabling, network devices, IP addressing and operation, routing protocols, and WAN technologies. Our laboratory is equipped with several dozen Cisco networking devices including routers, switches, and wireless access points for hands-on lab experiences. The devices allow students to configure complex network configurations and troubleshooting realistic networking systems. Apart from traditional lectures and laboratory classes, a whole set of multimedia resources and simulation tools is provided for additional self-education. The courses, taught by trained and certified instructors, should be an interesting proposition for companies of digital economy.

KEYWORDS

· computer networks
· networking devices
· Internet protocols
· Internet technologies

FACULTY OF **COMPUTING**

Information on the selected test equipment at the Faculty of Computing, Poznan University of Technology
Chair of Control and Systems Engineering

Chair of Control and Systems Engineering

KUKA LWR4+ Robot

APPLICATION:

- KUKA LWR 4+ robot has 7 degrees of freedom. The robot can be freely guided throughout its work envelope by hand. Manual guidance makes programming intuitive and efficient. The torque sensors in the axes make the LWR 4+ particularly well suited to force-controlled tasks, process monitoring, and also position detection and referencing of objects. An example of the use of robots is to assist physicians with surgical procedures (e.g. the use of a robot for removing ear brain abscess).

KEYWORDS

- the use of robots in medicine and rehabilitation
- compliance control
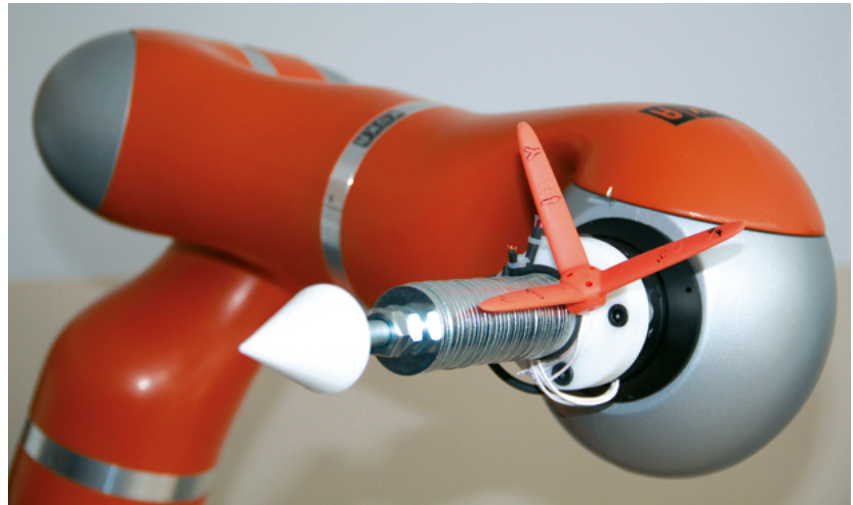
TECHNICAL SPECIFICATIONS:

The Robot KUKA LWR 4+ (Lightweight robot) is a new generation of robots equipped with torque control.

Robot KUKA LWR has the following properties:

- 7 degrees of freedom
- very good payload to mass of the robot ratio that is equal to 1:1
- generation of robot motion, in order to achieve the set position defined in the Cartesian space or the joint space
- the ability to simulate the variable stiffness of the springs of both the joints and in the Cartesian space
- compensation of gravity effects, the possibility of movement of the manipulator under the influence of an external force to the robot arm
- estimation of exerted forces and torques acting on the robot gripper and at each of their joints
- speed control and the forces and torques acting on the robot arm

Omega 7
haptic device

TECHNICAL SPECIFICATIONS:

With its unique active grasping extension, The Omega 7 is the most versatile haptic device available so far. Its end-effector covers the natural range of motion of the human hand and is compatible with bi-manual teleoperation console design. The combination of full gravity compensation and driftless calibration contributes to greater user comfort and accuracy.

- it has structure of delta-based parallel kinematics, hand-centered rotations, rotations decoupled from translations, active gravity compensation
- workspace: translation: 160 x110 mm, rotation: 240 x 140 x 180 degree, grasping: 25 mm
- forces: translation: 12.0 N, grasping: ± 8.0 N
- resolution: translation < 0.01 mm, rotation 0.09 degree, grasping 0.006 mm
- stiffness: closed-loop 14.5 N/mm
- interface: USB 2.0
- platforms: Microsoft Windows XP / Vista / 7 / 8; Windows CE 7; Linux kernel 2.6 / 3.x; Apple OS X;
- QNX 6.5 / 6.6; WindRiver VxWorks 6.3 / 6.8 / 6.9
- it can be operated by right- or left-handed person

APPLICATION:

- The Omega 7 provides 3D active force feedback, allows rotation sensing and active grasping for a wide range of applications in the following areas:
  - medical and space robotics
  - micro and nano manipulation
  - teleoperation consoles
  - virtual simulations
  - training systems
  - research and development

KEYWORDS

- HMI interface
- haptic

FACULTY OF **COMPUTING**

Information on the selected test equipment at the Faculty of Computing, Poznan University of Technology
Chair of Control and Systems Engineering

Robot KR6 R900 six (KR AGILUS)

TECHNICAL SPECIFICATIONS:

Characteristics of the KR AGILUS series:

- number of axes 6
- maximum reachability 901 mm
- maximum payload 6 kg
- pose repeatability ±0.03 mm
- minimum cycle times. The KR AGILUS six has six axes and is consistently rated for particularly high working speeds. At the same time it offers high precision.
- space-saving integration, low space requirements.
- integrated energy supply system.
- includes EtherCAT/EtherNet (bus cable), three 5/2-way valves (compressed air), direct airline and inputs/outputs.
- KR C4 architecture and functionalities. They are operated via the KR C4 compact controller, with the same range of functions as the service-proven KR C4 controller.
- KUKA Safe Operation functionality, which radically simplifies the effective cooperation of humans and machines

KEYWORDS

- authorized training robot programming KRC2 and KRC4
- automation and palletization

APPLICATION:

- The performance of the KR AGILUS series is unique in its payload category. It has six axes, very high speed, short cycle times and an integrated energy supply system. The most popular applications of these robots are in handling tasks, especially pick-and--place tasks.
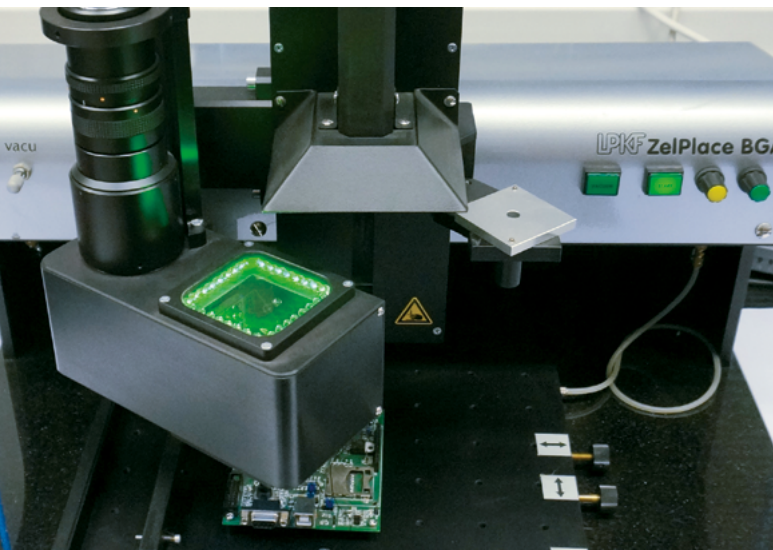
Chair of Computer Engineering

Laboratory Prototyping Printed Circuit Board

TECHNICAL SPECIFICATIONS:

- minimum track width: 4 mil (0.1 mm)
- minimum distance of 4 mil (0.1 mm)
- minimum hole 6 mil (0.15 mm)
- working area (x / y / z): 9 „x 12" x 1.5" (229 x 305 x 38 mm)
- resolution (x / y): 0.01 mil (0.25 microns)
- resolution (from): 0.02 mil (0.5 microns)
- maximum spindle speed: 100,000 rpm
- tool changer: Automatic, 10 positions
- spindle: 1/8"
- the possibility of drilling 150 holes per minute
- positioning speed (max.): 150 mm per second

APPLICATION:

- The laboratory equipment enables a rapid prototype electronic devices. Starting with a multilayered printed circuit board with metallization of holes to mount electronic components on a printed circuit made with the launch of the prototype and verifying proper operation.

The lab is the machinery manufacturing LPKF:
- plotter ProtoMat S100
- placer ZelPlace BGA
- metallization MiniContac RS
- frame printing ZelPrint LT300
- reflow soldering oven ProtoFlow S
- press for multilayer circuits MultiPress S
- soldering station for manual assembly

KEYWORDS

- PCB
- designing printed circuit boards

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FACULTY OF COMPUTING

Information on the selected test equipment at the Faculty of Computing, Poznan University of Technology
Chair of Computer Engineering

Control Systems Laboratory

APPLICATION:

- The laboratory set enables to design and analyze control systems for electromagnetic devices. It provides possibility to identify, model and control various industrial devices. Additionally, it gives possibility to analyze the electric motor performance.
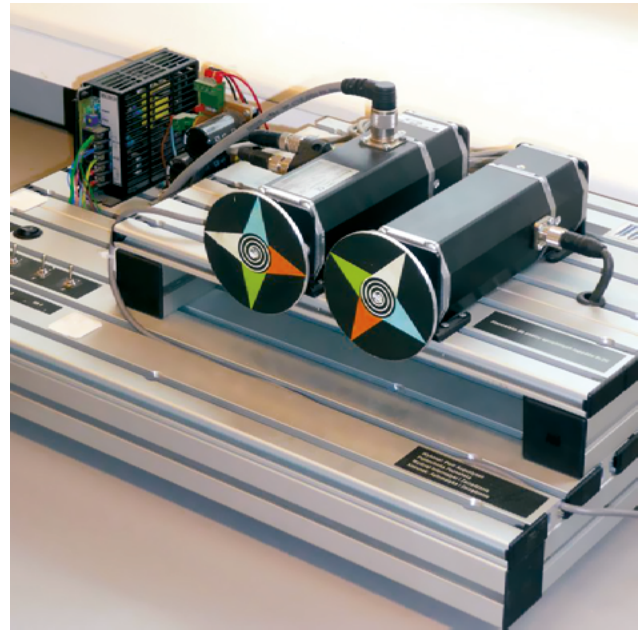
The laboratory sets are as follows:

- rol kits: XY robot, quadrocoptera, CNC machine, magnetorheological brake, electroactive polymers, pneumatics
- electric motors kits (AC, BLDC, DC and PMSM)
- sensors kits (encoders, inclinometers, induction position system, torque and force sensors)
- software to model and design control systems
- software to analyze electromagnetic devices.
- mechatronics cont

KEYWORDS

- control system
- electromagnetic devices
- electroactive polymers

Embedded
Systems Laboratory

The laboratory sets are as follows:
- embedded systems design laboratory sets
- OMAP 8000 DevKit
- Xilinx Zynq-7020 Dual ARM Cortex-A9
- Blackfin ADSP-BF609
- Linux OS

APPLICATION:

- Laboratory equipment enables the design of drivers for embedded systems based on Linux operating system. With the development platforms it is possible to design, test and port new versions of embedded systems. Xilinx development platforms enable design of hardware accelerators enable and their fast validation by means with use of a FPGA matrices.

KEYWORDS

- embedded systems
- Linux
- Android
- ARM

FACULTY OF **COMPUTING**

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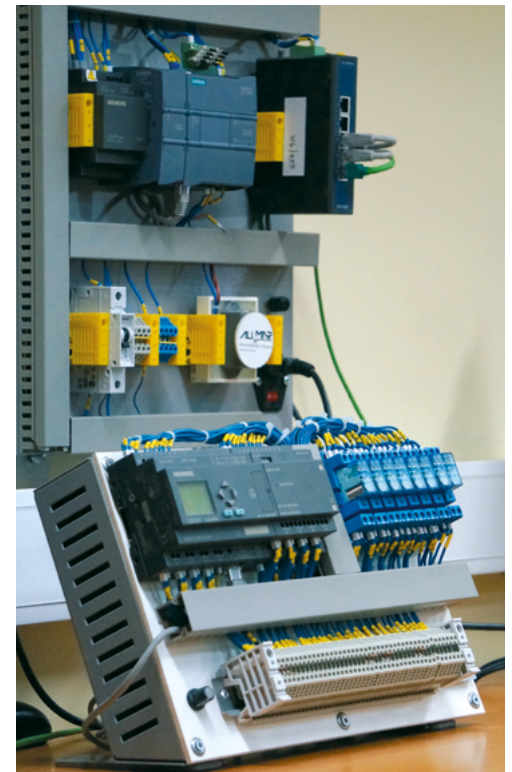# Laboratory
# of PLC controllers

The laboratory includes:

- Siemens S7 PLC controllers 1200 (10 seats) with the following parameters:
- working memory 25 KB
- 8 digital inputs
- 6 digital outputs
- 2 analog inputs
- integrated ETHERNET PROFINET

PLC Phoenix Contact (6 positions ILC130, 1 position ILC 350) with the following parameters:

- IntegratedI / O 8/4
- time work in 1000 commands 90 us (bit data types)
- program memory/data 192 kB/192 Kb
· residual data memory 8 Kb
· supply voltage 24 V

APPLICATION:

· PLC controllers can be connected to real devices such as motors, encoders, sensors, displays, touch panels, and industrial robots. Position based on controllers from Phoenix Contact are supported by the international platform eduNET. Software available in the lab allows to create advanced HMI applications in all standards and languages allow you to create applications according to IEC 61-131. It is possible to run dedicated open courses for the public.
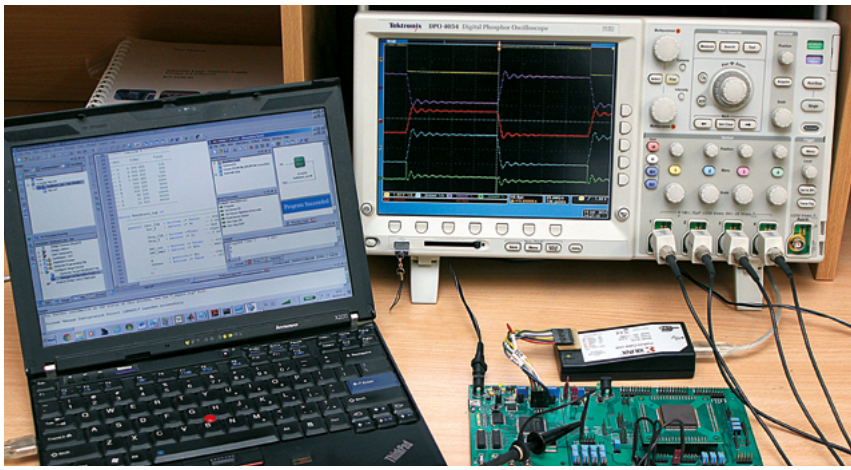
KEYWORDS

· PLC cotrollers
· industrial automation
· control systems
· industrial networks
· HMI
· WinCC

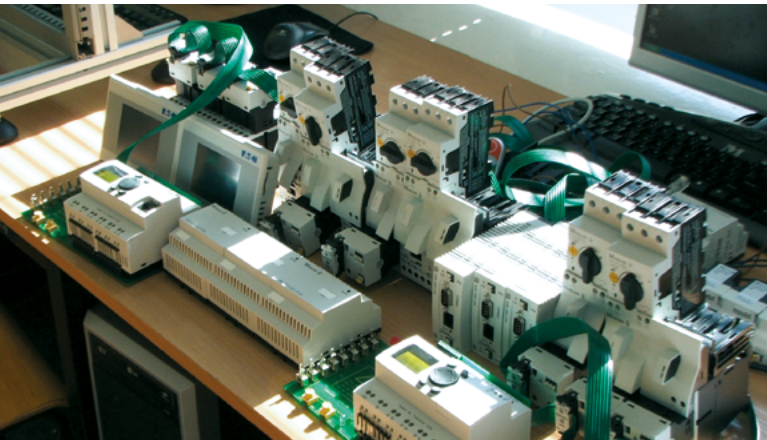# Laboratory for CMOS circuit design and testing

APPLICATION:

- The laboratory allows design automation of digital as well as some analog integrated systems. It concerns mainly current mode analog circuits. Implemented directly in standard digital CMOS technology. The full design track, from behavioural description to layout generation, is possible with the use of available expert systems.

The laboratory contains:

- Mentor Graphics: environment for design and simulation of analog and digital integrated systems
- gC-Studio: an expert system for design filters, filter pairs and bank filters
- SI-Studio: an expert system for implementation of current mode circuits in advanced CMOS technology
- achievable technologies: STM 28nm, TSMC 65nm, 90nm, 189nm, 250nm, AMS 350nm
- scopes, function generators, measuring instruments for electronic circuits

KEYWORDS

- electronic design automation (EDA)
- filters
- converters
- CMOS technology
- layout generation

FACULTY OF **COMPUTING**

Information on the selected test equipment at the Faculty of Computing, Poznan University of Technology
Chair of Computer Engineering

Laboratory
of Industrial Networks

APPLICATION:

- Laboratory of Industrial Networks are modern PLCs and network components available on the market, which allows you to create the perfect base for the fulfillment of research in the field of industrial networks, SCADA and PLCs

KEYWORDS

- industrial networks
- PLC
- industrial automation

Base Hardware Laboratory of Industrial Networks has been adapted to the realities on the automation market, resulting in the following sets:

- farm family of robots Bioloid (systems of remote programming using the ZigBee protocol, the environment RoboPlus and their implementation in Visual Studio C ++)
- remote control of the industry in PELCO-D and PELCO-P supported access from the network control panel, own software and video server
- controlling a stepper motor using a laser transmission of the control signal
- network-coupled system of compact PLCs from Phoenix Contact series NanoLine
- model sewage pumping station on the basis of modern controller HMI PLC Unitronics V280 (measurement columns of liquid through the conductivity probe, differential pressure sensors, etc.).
- model industrial automation control using the control panel Satel Integra
- the use of PLC Eaton Control digital control bus Darwin, dedicated electric drives and control signals
- programming controllers Easy Control and touch-screen display Series XV Eaton's Galileo
- three-phase motor control using modern inverter Lenze 8400 series with a dedicated touch panel
- network-coupled sets of drivers Siemens (S7-300, S7 1200 WinCC, SIMATIC STEP 7 Basic, etc.).
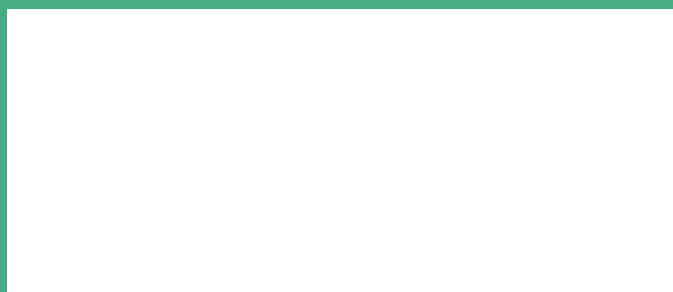
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