



CZECH TECHNICAL
UNIVERSITY
IN PRAGUE

SYSTEM I4Control®

from

**DEPARTMENT OF CYBERNETICS
CZECH TECHNICAL UNIVERSITY IN PRAGUE
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SYSTEM I4Control®

<http://cyber.felk.cvut.cz/i4c/>

Key Authors: Marcela Fejtová, Jan Fejt

Communication is ensured through an exchange of information, which can be achieved using different types of communication media. The way a man provides information to a technical system represents a very specific category of communication. Input information is mediated to a technical system through various peripherals, e.g. a keyboard, mouse, light pen or a punch tape for a computer. Whenever there appear some reasons, which restrain human users from using standard peripherals, we are facing a serious problem.

— There are some health problems that make usage of a personal computer rather difficult. Namely, this is the case of severe motoric handicaps, which make any sort of manipulation with fine objects impossible. Since grasping any small object becomes a challenge for the corresponding patients they are prevented from utilizing a computer mouse, the basic PC periphery, in a standard way. During the last ten years computers became so frequent and common instruments that one cannot do without them in everyday life. That is why it is necessary to search for new means, which will support man-computer communication.

— On the other hand, ICT can serve as a unique means of contact with the world for many handicapped persons. Computer can ensure number of services for challenged people: in the most severe cases ICT can substitute for some of their missing abilities and act as the main mediator of contact with the environment. ICT is ready to support education requirements as well as become a tool for training, rehabilitation and development of various abilities (e.g. memory or speech function). The choice of an appropriate computer periphery becomes a crucial question, which has to be resolved with respect to the complex needs of the specific challenged person also taking into consideration the financial aspect. The market offers numerous gadgets ranging from simple electromechanical switches and special trackballs or keyboards to special sophisticated systems for control of a cursor position.

— There were analysed various options how to design new computer peripherals and we have developed the system I4Control®, which offers a means to control a computer through eye movements. During the design phase priority was set on creation of an appliance, which is reliable but cheap, universal, easy to install and utilize. We have decided for videooculography (VOG) as the principal method used for gaze tracking, because this solution is sufficiently precise, relatively cheap and first of all it is non-contact, which this makes it user-friendly as there is no need to glue electrodes or to apply special contact lenses.



— The sensor input of the I4Control® system is ensured by a tiny camera, which is fastened to the head of the user using a spectacle frame. This ensures that the same type of image is obtained independently of the movements of the user (user's head does not have to be fixed). The main parameters for the choice of the camera have been its price and size. It was verified during the preliminary experiments that a simple black&white PAL camera with a CCD sensor (discrimination 208 x 156 points) fully meets our requirements.

— The second part of the I4Control® system includes the control module which processes the PAL signal from the camera. Here, the PAL signal is digitalized, the pupil is detected (using classic filtering), and its position is calculated and expressed in the appropriate coordinate system. The output of the control module provides information about the requested modification of a cursor position, namely the difference $[\Delta x, \Delta y]$. This value is transmitted using standard USB interface into a PC.



WORKING WITH THE SYSTEM I4Control®

At the beginning, the system I4Control® has to be correctly calibrated for a specific user. The user is asked to fix his/her gaze on the centre of the screen to specify the stable position – it is set and recorded by pressing the red switch of the control module. From now on, the user has two options: he/she can control the cursor position using eye movements only or both eye and head movements (if the handicap allows for that). The green switch of the control module ensures the choice between both these alternatives.

— The system does not transfer a position of the computer cursor directly on the spot, which is being observed by the user. It just ensures that the cursor flows in the same direction as eyes of the user with respect to a stable position set during the calibration phase. This means that the actual eye position does not effect the cursor position directly, but it changes the direction of cursor movement (in the same way as a joystick). The system evaluates the present position of the user's eye, compares

it to the stable position and consequently makes the choice of corresponding actions. It works in an incremental mode: as long as an eye is out of the stable position the system keeps sending signals instructing the cursor to move on in the corresponding direction (given by the actual position of an eye in the coordinate system of the camera), this is stopped once an eye is back in the stable position. There is another action, which can stop the cursor movement, namely when the user closes his/her eye. This is interpreted as a signal "to click" – one can emulate either click or double-click, the duration of the time interval with closed eyes distinguishes both options. This duration can be set for individual users so that spontaneous blinks can be filtered out.

TEXT EDITING USING THE SYSTEM I4Control®

The resulting system emulates a standard PC mouse. Such a choice facilitates simple installation since I4Control® can be connected to any PC through a standard USB interface. As soon as this is ensured the user can control through eye (sometimes complemented by a head) movements all installed computer programs communicating with a mouse. Consequently, handicapped users can work with a software keyboard, which is provided by many operation systems (e.g. from OS Windows 2000 up) and write the text. This tool opens new horizons for handicapped users, who can fully utilize text editors and get access to writing e-mails or to surfing the Internet.

GERTIE — AN EDUCATIONAL TOY

One has to get used to utilizing his or her eyes for control of foreign objects. The training can become a fun provided there are available appropriate tools. We have designed and created a special toy car called Gertie, which can be controlled by eye movements. It is intended to help the user to master the communication with a technical appliance through I4Control®.

— The toy is constructed from LEGO and it can be controlled using following simple signals provided by the user-driver: if he/she looks up the car goes forward, if he/she looks down the car goes back. The car turns left or right when the user-driver looks in the same direction. And sufficiently long eye blink is interpreted a directive to rotate the car locator.



ADVANTAGES OF THE SYSTEM I4Control®

- **Communication** – the appliance can be connected to any PC using standard USB interface
- **Emulation of a PC mouse** – this feature ensures that the user can work with any mouse-controlled PC applications installed on the used computer, the user can utilize all SW tools he/she is used to
- **Mobility** – the appliance is small, compact and easy to transport
- **Simple installation** – the appliance is as simple to install as the PC mouse
- **Straightforward utilization** – after initial calibration for the individual user, there is no need to repeat this process during later usage
- **Low price**

The system I4Control® has been tested in a number of experiments. The pilot testing was ensured in the Jedlička's Institute and School for Handicapped Youngsters. In the group of the first users there was a boy who lost his hand after an accident as well as a boy with muscular atrophy. The system I4Control® was very well accepted and the students were able to master it very quickly. It took them about ten minutes and they were able to "list through" special e-learning materials, write in a text editor as well as draw simple pictures.



CZECH TECHNICAL UNIVERSITY IN PRAGUE DEPARTMENT OF CYBERNETICS



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The **CZECH TECHNICAL UNIVERSITY IN PRAGUE** (CTU), founded in 1707, is one of the oldest technical universities in the world. It belongs to the leading technical universities in the Czech Republic with approx. 23 000 students enrolled in engineering courses. CTU with over 1500 members of academic staff is also one of the largest research institutions in the Czech Republic. Research is undertaken at CTU in all the basic disciplines taught at the university: i.e. in mathematics, physics, computer science, civil engineering, mechanical engineering, electrical engineering, nuclear and physical engineering, architecture, transportation science, biomedical engineering and in many interdisciplinary areas as well.

The **DEPARTMENT OF CYBERNETICS**, Faculty of Electrical Engineering (FEE) provides MSc. and postgraduate courses in technical cybernetics, artificial intelligence, computer-integrated manufacturing, computer vision, pattern recognition, and biomedical engineering. The department includes over 65 academic staff and researchers, and over 45 Ph.D. students.

All the activities undertaken in the Department of Cybernetics are directed to achieving the highest standards in research, and to providing a quality, and efficient learning environment at all levels of higher education. In 2000 the Department of Cybernetics, CTU received the award "**EU Centre of Excellence**" (with the acronym MIRACLE) by the European Commission.

The department became one of the founder members of the newly established Czech Centre of Applied Cybernetics supported through RTD programme of the Czech Ministry of Education.

The research is carried out in two co-operating centres: **Gerstner Laboratory for Intelligent Decision Making and Control** (GL) and **Centre for Machine Perception** (CMP), which are recognised as the leading Czech centres for research into computer vision and machine perception, data warehousing, industrial production system integration and production planning information systems, respectively. The centres have gained high international reputation in the respective fields as well.



GERSTNER LABORATORY for Intelligent Decision Making and Control

<http://gerstner.felk.cvut.cz/>

Head: Vladimír Mařík

The Gerstner Laboratory was founded in 1996 as an extension of the Joint Research Centre of CTU Prague and FAW Linz (Austria). It includes over 40 academic staff and researchers, and over 35 Ph.D. students.

— The Gerstner Laboratory carries out basic and applied research in the areas of distributed artificial intelligence, multi-agent systems, machine learning and system diagnostics, advanced database systems and data warehousing, data mining and decision support systems, evolutionary computing, intelligent robotics and biocybernetics.

— The laboratory is structured into 4 research groups:

- > Agent Technology Group
- > Intelligent and Mobile Robotics Group
- > Knowledge-Based and Software Systems Group
- > Nature Inspired Technology Group.

AGENT TECHNOLOGY GROUP

<http://agents.felk.cvut.cz/>

Head: Michal Pěchouček

The research mission of the Agent Technology Group (ATG) is to carry out the leading edge research in the field of theoretical foundations and applications of agent-based computing.

— The main strength of the ATG is in prototyping research that is aimed at validation and empirical analysis of the theoretical concepts on computational prototypes of large multi-agent systems. The key concepts of research investigated are social knowledge and acquaintance models, models of trust and reputation in multi-agent systems, modelling and solving agents communication inaccessibility, formal models and detection of agents' adversarial behaviour, distributed decision making, distributed planning, distributed coordination, coalition/alliance formation, negotiation and cooperation, meta-reasoning, monitoring, community intrusion, agents reflection and adjustable autonomy, scalable multi-agent simulations.

— In terms of applied research the ATG is mainly active in agent applications in manufacturing (e.g. production planning, control and simulation), supply chain management, logistics but also systems supporting agent-based defense and rescue operations. Recently the ATG also got involved in the domain of collective robotics, where various agent concepts are deployed for the autonomous coordination and deconflicting operations of unmanned land and aerial vehicles.



KNOWLEDGE-BASED AND SOFTWARE SYSTEMS GROUP

<http://krizik.felk.cvut.cz/>

Head: Zdeněk Kouba

The Knowledge-Based and Software Systems Group is interested in generic aspects of software design, in respect to the design of information systems and knowledge-based systems. The group's main attention is on data warehousing, transforming data between various models, and knowledge management.

— In the area of data warehousing the problem of extraction, transformation and load processes (ETL) is being studied. Interesting results have been achieved in the field of interoperability of data warehouses and generic geographical information systems. The generic method of transforming data between different data models is being studied with special focus on transforming data for purposes of populating/updating data warehouses and/or to data pre-processing phase of data different mining processes.

— The research in knowledge management is aimed at semantic annotation of documents for intelligently managing these documents. Ontology-based collaborative knowledge representation is studied with respect to professional and interest groups.

INTELLIGENT AND MOBILE ROBOTICS GROUP

<http://gerstner.felk.cvut.cz/mobile-robotics/>

Head: Libor Přeučil

The research conducted by the group is focused mainly on design and development of intelligent and mobile robots. The overall goal is to develop a highly robust cognitive control system able to navigate through and to create and keep a world model at the same time. Reaching this goal leads to solving core sub-tasks: sensing and sensor fusion, mobile robot localization and navigation, world map recovery in 2D and 2.5D, robot activity planning and scheduling for single and multi-robot systems, strategies for collective robot behaviour, etc. Preferably, robust solutions with no extreme demands on hardware implying cheap applications are chosen.

— Integration of human and robot entities is also researched. The activities are focused on development of personal assistance and personal navigation systems, Simultaneous Localization and Map Building (SLAM) techniques for human entities, mutual interfacing and knowledge sharing, and communication schemes. Moreover, techniques of cooperation and coordination of multiple systems are studied (e.g. rescue mission planning, cooperative environment mapping, and robot-soccer strategy development).

— Other research streams include industrial diagnostics of large systems, safety critical software development for transportation applications and software testing. Research in these topics focuses on support tools for fault-tolerant systems, runtime diagnostics of railway safety and control systems.



NATURE INSPIRED TECHNOLOGY GROUP

<http://gerstner.felk.cvut.cz/nit/>

Head: Olga Štěpánková

The group's fundamental research is concerned with the design and deployment of adaptive intelligent systems. In particular, the group is developing enhancements to traditional machine learning algorithms for building symbolic models of objects described by attribute values, and studying advanced techniques associated with learning models to explain relations between objects. The group is devising efficient implementations of the learning algorithms by using novel strategies for statistical searching in large spaces of possible models, as well as biologically inspired optimization procedures such as genetic algorithms and neural networks. The group deploys learning and data visualization algorithms as a tool for discovering novel, interpretable knowledge from databases.

— The group's applied research is focused on intelligent man-machine interfaces. A patent is pending for I4Control® – a specialized tool allowing someone to control a computer through the movement of the human eye. Dedicated medical decision support systems are being designed and developed in cooperation with medical institutions – most of them combine novel sophisticated methods for processing medical data (e.g. EEG, ECG data) and for knowledge acquisition with efficient knowledge representation and machine learning. Interesting results have also recently been achieved by applying machine learning to discover gene-disease associations from human gene expression data.

CENTER FOR MACHINE PERCEPTION

<http://cmp.felk.cvut.cz/>

Head: Václav Hlaváč



The Center for Machine Perception (CMP) is a research group active in the fields of computer vision, pattern recognition, and mathematical modelling of uncertainty. The CMP, established in 1996, is a part of the Department of Cybernetics of the Czech Technical University (CTU), Prague. CMP is funded partially by the CTU and a number of national, European and industrial grants. CMP comprises over 25 staff members and over 9 full time Ph.D. students.

— CMP main research interests are:

- > reconstruction of scenes from multiple images
- > omni-directional vision, non-classical cameras
- > reconstruction of 3D models from unorganised 3D points

- > stereo matching and surface reconstruction
- > multi-camera systems for recognition
- > object recognition
- > medical imaging
- > statistical pattern recognition and learning issues
- > mathematics of uncertainty, quantum and fuzzy logic.

Reconstruction of 3D Scenes

The aim is to reconstruct 3D model of the scene from multiple images. Images from standard projective or wide-angle cameras are used as the data source. Several problems are studied: features for wide-baseline matching, establishing sparse correspondences among images, estimating the position and parameters of cameras, finding dense matching between images, and finally reconstructing the 3D model.

Omni-directional Vision

The geometry of wide angle and non-standard omni-directional cameras is studied. Image-based virtual reality representations were developed.

Medical Image Analysis

Topics being studied include: Methods for computer aided diagnosis of thyroid gland diseases, methods for quantification of human breathing movement, measuring temporomandibular joint trajectory, 3D modelling of human face for neuropsychological studies, elastic tissue modelling from ultrasound sequences, deformable object registration from different modalities, brain activity reconstruction from MEG/EEG, lung noduli detection.

Pattern Recognition

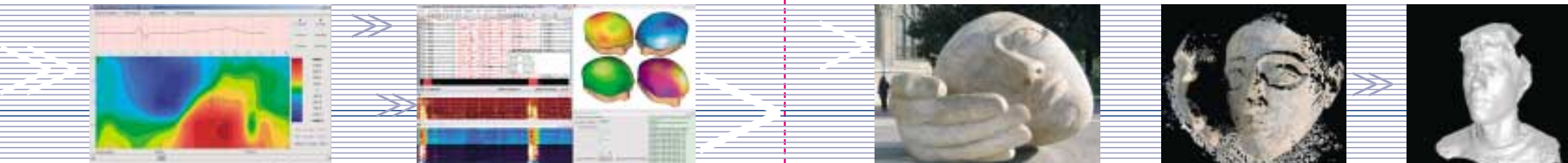
Both statistical and structural pattern recognition methods are studied. We study algorithms for large-scale quadratic optimization problems, algorithms for consistent labelling, sequential decision methods for fast object recognition. Results were applied to real-time face detection problem, on-line traffic sign recognition, license plate detection and reading, recognition of activity.

Multi-Camera Systems for Recognition

The *Virtual Editor* system was developed. The system processes multiple video streams and simultaneously analyzes action in the scene and produces a smooth output for a distant observer.

Quantum and Fuzzy Logic

Different theoretical aspects of fuzzy and quantum logic are being studied.



INDUSTRY COOPERATION

The Department co-operates with many international industrial partners and we are experienced in transferring results into industry through three spin-off companies: CertiCon a.s., ProTyS, a.s., and Neovision s.r.o. as well through the Czech Centre of Applied Cybernetics. The list of contracted industrial partners and fields of cooperation involves:

- > **Rockwell Automation, USA:** Multi-agent systems, machine learning and diagnostic algorithms, intelligent motor and pump diagnostics, expert systems, machine vision etc.
- > **Vitatron Medical, NL:** Intelligent testing of software for pacemakers
- > **Honeywell, USA:** Automatic video surveillance
- > **Grundfos, DK:** Intelligent pump design
- > **TeleDataElectronics, D:** Development of algorithms based on machine learning for gas consumption prediction
- > **Toyota Motor Europe, BE:** Computer vision applications for intelligent vehicles
- > **Samsung, KOR:** Face recognition in images
- > **Automation of Railways, CZ:** Software testing, safety critical software for line-block control
- > **Cadence, D:** Architecture of a planning and scheduling tool for IC designers
- > **Hitachi, JP:** Image processing and face detection in images, supply chain scheduling
- > **Porsche, D:** Computer-based sign recognition, data fusion for diagnostics
- > **Siemens-Transportation Systems, CZ:** Planning and scheduling for in-store logistics.
- > **Denso, JP:** On-board diagnostics of cars
- > **U.S. Air Force Research Laboratory, USA:** Coalition formation, meta-reasoning and inaccessibility in multi-agent systems, air-traffic control deconfliction
- > **Office for Naval Research, USA:** Agent-based techniques for optimization of logistics
- > **US Army Research Laboratory, USA:** Modelling in multi-agent systems, reflection and cognition
- > **IHMC/NASA, USA:** Agent-based root cause detection in hydrogen production
- > **Robert Bosch, D:** Diagnostics based on computer vision methods
- > **Boeing, USA:** Recognition of targets in images
- > **Gedas/Škoda Auto/Volkswagen, CZ:** Production planning system for motor assembling
- > **Texas Instruments, USA:** Control and interfacing of a digital camera.

IMPORTANT R&D RESULTS

SYSTEM I4Control®

The system I4Control represents a novel type of computer periphery which enables control of a personal computer through movement of eyes or head. This is achieved without setting any restrictions on its user. Since I4Control emulates computer mouse, it provides its user by a unique chance to communicate with all installed SW applications by means of his/her eye movements. The main advantages of the system are simple installation and usage, mobility as well as universality of the system, which can be connected to any computer through the USB interface. Last but not least merit is a low price of the system.

Authors: M. Fejtová, J. Fejt



SumatraTT®

SumatraTT is an original system supporting interactive design of data transformation schemas and its architecture has a character of Open Source software. The system is used mainly for initializing an update of data warehouse content and for the data preprocessing phase in the data mining process (information acquisition from data). It is used in several European research/development laboratories. The system was applied in tasks of decision making in number of areas: e.g. spas (LAURYN, v.o.s.), telecommunications (Atlantis Telecom s.r.o.), Czech Railways. SumatraTT® is a trademark of CTU in Prague filed in the Industrial Property Office of the Czech Republic with registration number 243786.

Authors: P. Aubrecht, Z. Kouba, P. Mikšovský, O. Štěpánková., L. Nováková



GOLAP – GEOGRAPHICAL ONLINE ANALYTICAL PROCESSING

GOLAP is an original method supporting geographical information real-time processing with use of data warehouse. This method was used for design and implementation of system for monitoring and prediction of drinking water consumption.

Authors: Z. Kouba, P. Mikšovský



EXPLANTECH/EXTRAPLANT

A production planning multi-agent system implemented in JADE, reconfigurable to different production planning cases, features planning and quotation agents, decomposition agents, resource agents modelling manufacturing actors. Extended to supply-chain management by means of extra-enterprise and enterprise-to-enterprise agents.

Authors: M. Pěchouček, J. Vokřínek, V. Mařík



A-GLOBE

A-globe has been developed as a novel open lightweight multi-agent platform for deployment of general purpose agents communities requiring physical and network migration, simulating changes (e.g. malfunctions) in the interaction infrastructure and open to massive scalability. Supported by US Air Force, A-globe has been used for modeling distributed decision making in humanitarian relief logistics and deconflicted operation of unmanned aerial vehicles.

Authors: D. Šišlák, M. Pěchouček, M. Reháč, D. Pavlíček



OPS – OPEN PREDICTION SYSTEM

Open Prediction System (OPS) solves the tasks of predictive nature and some data mining problems. Its main aim is prediction of consumption in distribution nets (water, gas, electric energy etc.) – the solution reflects the experience presented in the form of available training data. The OPS solution has been applied by the German company Teledata Electronics GmbH for prediction of gas consumption. Nowadays, it is in daily use at 4 regional gas distributors in Germany.

Authors: J. Kout, J. Kléma, O. Štěpánková

FACE DETECTION SYSTEM

A flexible real-time face detection system intended for surveillance and biometric applications. The system was developed for the company Samsung, Korea.

Authors: J. Matas, V. Franc, J. Šochman



GDS – GLOBAL DIAGNOSTIC SYSTEM

The Global diagnostic system designed for the Czech company AŽD Praha s.r.o. The system is an open software tool for build-up of highly distributed runtime diagnostics of control, safety and other technological systems of the Czech Railways. The system performs data gathering from diverse technological devices, data on-line storing, automated data pre-processing followed by system runtime state classification as well as data transfer to specified locations. Additionally, the system's functions enable data volume reduction and optimization of the transferred knowledge.

Authors: L. Přeučil, P. Štěpán

SAFETY CRITICAL SOFTWARE FOR RAILWAY LINE-BLOCK CONTROL

The software promotes new-generation of railway traffic control solutions in public transportation systems and is applied at the Czech Railways high-speed corridors. The developed control system is designed as self-recovering, 100% fault tolerant and/or ensures switching of the line-block into safe modes in cases of unrecoverable situations. This line-block control system was awarded Golden Medal at the 43rd International Engineering Fair in Brno 2001.

Authors: L. Přeučil, P. Štěpán

NEXT GENERATION TELEMATIC SYSTEM DESIGN

The system brings up breakthrough concepts and technologies (personal navigation system for indoor environments, standard for rescue maps) for building hybrid human-robot teams for semiautonomous and teleoperated applications. The investigated approach allows solution of telematic tasks where humans operate as inseparable members of robot communities and share common task. The developed test-cases (as results within the FET-IST research project PeLoTe, No. 38873) were experimentally verified showing substantial improvement in hybrid robot-man system performance with possible applications in security, rescue and surveillance tasks.

Authors: L. Přeučil, P. Štěpán, M. Kulich, R. Mázl, J. Pavlíček, J. Chudoba



CONTRIBUTIONS TO OMNI-DIRECTIONAL VISION

Omni-directional vision allows seeing all around. There are several principles allowing having very wide field of view. Our first contribution was in designing catadioptric camera from a hyperbolic mirror and an ordinary perspective camera followed by the formulation of the epipolar constraint for such cameras. Such cameras are manufactured and sold world-wide by the spin-off company Neovision s.r.o. The theory of non-central omni-directional cameras was developed.



Authors: T. Pajdla, T. Svoboda, B. Mičušík, H. Bakstein, V. Hlaváč

MSER-LAF OBJECT RECOGNITION SYSTEM

MSER-LAF is a generic object recognition system. Due to the affine invariance of the recognition method, the system requires only a single training image. Both the learning phase and recognition phase is near real-time. The recognition engine is a core technology used in a large traffic scene understanding project funded by Toyota. It was successfully deployed for detection of regions of interest in video sequences recorded on board of an airborne unmanned aircraft Sojka.

Authors: J. Matas, Š. Obdržálek

STEREO VISION AND CORRESPONDENCE PROBLEM

The contribution is in systematic mathematical analysis of correspondence problem which result into a methodology and tools allowing very precise 3D dense reconstruction with controlled amount of false positives.

Authors: R. Šára, J. Kostková, J. Čech

RECONSTRUCTION OF THREE-DIMENSIONAL SCENES FROM TWO-DIMENSIONAL IMAGES

Our method builds on ten years experience in 3D vision geometry. It is able to build a dense reconstruction from set of uncalibrated images without human intervention. The method consists of autocalibration, epipolar geometry estimation, dense matching, multiviews reconstruction coping with outliers and occlusions.

Authors: O. Chum, V. Hlaváč, D. Martinec, J. Matas, T. Pajdla, R. Šára, T. Werner



STORY FOUNTAIN

Story Fountain is a semantic web application developed in the mutual cooperation with the Knowledge Media Institute, Open University and the Department of Cybernetics, CTU in Prague within the European project CIPHER. The application supports global heritage exploration in virtual cultural heritage forums utilizing ontology driven dynamic personalized narratives.

Authors from CTU: Z. Kouba., K. Matoušek, P. Aubrecht, J. Uhlíř, P. Křemen, M. Žáková



STATISTICAL PATTERN RECOGNITION TOOLBOX IN MATLAB

It is a general purpose toolbox covering all aspects of statistical pattern recognition and learning. The toolbox is available free of charge for academic purposes and enjoys tenths of thousands downloads. It is probably the most often used statistical pattern recognition tool at present, see <http://cmp.felk.cvut.cz/~xfrancv/stprtool/>.

Authors: V. Franc, V. Hlaváč

MODELLING LIGHT PATH THROUGH CUT STONES

LADOK is a system which allows modeling of the light beam path through the transparent object bounded by planar surfaces such as jewellery stones. The resulting models can not only be used for prediction of the appearance of cut stones and their properties and thus for their better design but it could also be used for estimation of the shape of the actual stone, the information usable for better adjustment of manufacturing parameters. The latter functionality is a subject of a patent application. The development is done in cooperation with the major artificial jewellery stone manufacturer Preciosa, a.s.

Author: V. Smutný

AWARDS

- > **Nominee for the 2006 European IST Grand Prize for the I4Control® system:** a new type of computer periphery ensuring non-contact control of a personal computer through eye (or head) movements
- > **IEEE AIT 2005 Industry Track Best Demo Award** for the A-globe: Multi-agent Platform with Advanced Simulation and Visualization Support
- > **British Machine Vision Conference BMVC 2005 Best Science Paper Prize** to the paper by Š. Obdržálek, J. Matas: Sub-linear Indexing for Large Scale Object Recognition, Oxford 2005
- > **ICCV 2005 Vision Contest: Second Place** for the CMP team, 10th International Conference on Computer Vision, Beijing 2005
- > **CIA 2004 System Innovation Award** for the A-Globe lightweight multi-agent platform, 8th International Workshop for Cooperative Information Agents 2004, Erfurt, Germany
- > **2004 Special Award of the Jury in the National Competition "Česká hlava"** ("Czech Brain") to the system for PC control by eye movements, I4Control®. The "Česká hlava" project and related competition are aimed at supporting excellent research work and innovations in the Czech Republic.
- > **IEEE CVPR 2003 Best Paper Honourable Mention** to the paper by T. Werner: Constraint on Five Points in Two Images, IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Madison 2003
- > **2003 AgentCities Agent Technology Competition:** 2nd Main Prize for software development of X-Security package ("Communication Security in Multi-Agent Systems": a security plug-in into JADE multi-agent environment), Barcelona 2003
- > **Cybernetics and Systems 2002 Best Paper Award** to the paper by P. Aubrecht, F. Železný, P. Mikšovský, O. Štěpánková,.: SumatraTT: Towards a Universal Data Preprocessor, Austrian Society for Cybernetics Studies, 2002
- > **2001 Gold Medal Prize at the International Engineering Fair** awarded to the GL team and AŽD a.s. (Automation of Railways co., CZ) for railway Line Block development, Brno 2001
- > **CAIP 2001 Young Scientist Award** to the paper by V. Franc: A Contribution to the Schlessinger's Algorithm Separating Mixtures of Gaussians, 9th International Conference on Computer Analysis of Images and Patterns, Warsaw 2001

EU-FUNDED PROJECTS

Since 1990 the academic staff and researchers have successfully participated in many EU-funded research projects (e.g. ESPRIT, TEMPUS, TEN, EUREKA, INCO-COPERNICUS, 5th and 6th Framework programmes) and national projects. The following list represents the currently running 6th Framework projects:

- > **AgentLink III:** A Co-ordination Network for Agent-Based Computing (Coordination Action, 2004–2005)
- > **COSPAL:** Cognitive Systems using Perception-Action Learning (STREP, 2004–2006)
- > **ECOLEAD:** European Collaborative networked Organizations LEADership initiative (Integrated project, 2004–2009)
- > **EURON II:** European Robotics Network (Network of Excellence, 2004–2009)
- > **I*PROMS:** Innovative Production Machines and Systems (Network of Excellence, 2004–2009)
- > **NiSIS:** Nature-inspired Smart Information Systems (Coordination Action, 2005–2008)
- > **PRINCESS:** Principles of Dissimilarity-Based Pattern Recognition in Signals, Symbolic Sequences and Images (INTAS programme, 2005–2007)
- > **VISIONTRAIN:** Computational and Cognitive Vision Systems: A Training European Network (Marie Curie actions, 2005–2009)

PROJECTS UNDER FINAL NEGOTIATION WITH THE EUROPEAN COMMISSION

- > **CoGAIN:** Communication by Gaze Interaction (Network of Excellence, 2005–2009)
- > **CzechVMXT:** Czech IT Project Process Improvement for Dependable-Systems Research based on the Novel V-Model XT Approach (Marie Curie Transfer of Knowledge scheme, 2006–2009)
- > **DIRAC:** Detection & Identification of Rare Audio-Visual Cues (Integrated project, 2006–2010)
- > **eTRIMS:** eTraining for Interpreting Images of Man-Made Scenes (STREP, 2006–2009)
- > **K4CARE:** Knowledge-Based Homecare eServices for an Ageing Europe (STREP, 2006–2009)
- > **PANDA:** Collaborative Process Automation Support using Service Level Agreements and Intelligent dynamic Agents in SME clusters (STREP, 2006–2008)
- > **SEVENPRO:** Semantic Virtual Engineering Environment for Product Design (STREP, 2006–2008)



INTERNATIONAL CONFERENCES

The Department is proud of organizing several international conferences of various types:

- > **ETFA 2006:** 11th IEEE International Conference on Emerging Technologies and Factory Automation, Prague, September 20–22, 2006
- > **DIS 2006:** IEEE SMC Workshop on Distributed Intelligent Systems, Collective Intelligence and its Applications, Prague, June 15–16, 2006
- > **E-Golems 2005:** Czech-Argentine Biennale workshop, an accompanying event of the IFAC World Congress 2005, Prague (92 participants)
- > **ECCV 2004:** European Conference on Computer Vision, Prague, 2004 (700 participants)
- > **DEXA 2003:** International Conference on Database and Expert Systems Applications, Prague, 2003 (650 participants)
- > **HoloMAS 2003 & 2005:** International Conference on Industrial Applications of Holonic and Multi-Agent Systems, Prague 2003 & Copenhagen 2005 (80 & 60 participants)
- > **CEEMAS 2003:** International CEE Conference on Multi-Agent Systems, Prague, 2003 (105 participants)
- > **BASYS 2002:** 5th IFIP International Conference on Information Technology for Balanced Automation Systems in Manufacturing and Services, Cancun, 2002 (125 participants)

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