Summaries

IMAGE PROCESSING FOR MEDICAL AND INDUSTRIAL APPLICATIONS

Jacek Chodak, Tomasz Kryjak: **Calibration Methods of Eye Movement Acquisition Devices** • Automatyka 2010, t. 14, z. 3/1

In the present paper several calibration methods for eye movement acquisition devices: simple linear, linear with two calibration points, second order polynomial, linear neural network and radial based functions neural networks were described and tested. The methods were tested in two experiments: following eye movements on an elliptical trajectory and gaze fixations in randomly placed points on the screen on six subjects. Results of the experiments were described and discussed.

Keywords: *point of gaze, personal calibration methods, neural networks, remote gaze estimation*

Sławomir Cichoń: **Inverse Quantization Implementation in Reprogrammable System for the Purpose of Intraframe Video Decoding** • Automatyka 2010, t. 14, z. 3/1

Video data quantization is present, in different variations, in almost all video compression algorithms. Its purpose is to reduce less important data, while at the same time increase the efficiency of video compression, in the consecutive variable length coding process. In this paper preliminary scaling and quantization algorithms used in digital video standard (DV – *Digital Video*), will be described in details. Implementation of inverse quantization algorithm in the pipeline architecture, as one of processing elements in complete DV decoder, will be presented.

Keywords: *quantization, video decompression, reprogrammable system*

Mirosław Jabłoński, Daniel Pociecha: **Automatic Annotation of Pin Markers in Tube Pilger Cold Rolling Process** • Automatyka 2010, t. 14, z. 3/1

A system of automatic calculation of characteristic points in the process of tube cold rolling process has been presented. The very basic problem that has been addressed in this paper was a method of segmentation of particular regions in high resolution images i.e. reference board, tube area, and cooper pin-markers. Three methods of adaptive thresholding have been examined for each type of

object. Through application of computer vision algorithms duration of annotation phase has been greatly reduced in comparison to manual method.

Keywords: *computer vision, segmentation, adaptive thresholding, high resolution images*

Łukasz Jopek, Laurent Babout, Marcin Janaszewski, Michał Postolski: **A New Method to Segment X-Ray Tomography Images of Lamellar Microstructure in Titanium Alloys Based on Gray Level Gradient** • Automatyka 2010, t. 14, z. 3/1

This paper presents a new approach to segment heavily 3D textured images such as the one of lamellar titatnium alloys obtained from X-ray tomography. The presented method considers gradient from gray-level value and clusterization method to recognize class in order to label image. The method is tested on 2D and 3D digital images, but also on real microstructure images of the above mentioned material.

Keywords: *texture segmentation, gradient from gray-level value, clusterization*

Tomasz Kryjak, Jacek Chodak: **Exploitation of the Bright and Dark Pupil Effect in Video Oculography (VOG)** • Automatyka 2010, t. 14, z. 3/1

This paper presents a video-based eye-tracking device that exploits the dark and bright pupil effect and has a 50 Hz sampling frequency. The design of an infrared illuminator, which allows to obtain the dark and bright pupil effect on the even and odd fields of the video signal. Details considering used segmentation and determination of the center of the pupil algorithms, which allow to generate gaze trajectories, were presented.

Keywords: *video-based eye-tracking, dark and bright pupil effect, pupil segmentation*

Piotr Pawlik, Zbigniew Bubliński: **Fast Detection of Bronchial Tree Subdivisions** • Automatyka 2010, t. 14, z. 3/1

The paper presents an algorithm for fast detection of bronchial tree subdivisions on images obtained during bronchoscopy examination. Localization of these subdivisions could be very helpful to

physicians while reviewing collected data. The time of the detection should be as short as possible, especially when large sets of data were gathered during examination. The presented algorithm works in real time and is characterized by a very high level of specificity.

Keywords: *bronchoscopy, biomedical images analysis*

Michał Postolski, Marcin Janaszewski, Łukasz Jopek, Laurent Babout: **3D Skeletonization of Pulmonary Airway Tree Structures** • Automatyka 2010, t. 14, z. 3/1

Quantitative analysis of the human airway trees is a challenge in image processing and analysis. Results obtained in previous work on this subject are still not sufficient and they need improvements. Quantitative description of an airway tree consists in application of several steps: segmentation of the tree, skeletonization, decomposition and anatomical labelling, cross section generation and finally quantitative measurements. Each step needs to use different kinds of image processing algorithms. The most works were performed on different segmentation strategies, however skeletonization algorithms are still not enough tested and they require attention. Moreover, skeleton has very large impact on the quality of quantitative measurement of a bronchial tree. In the paper authors tested three skeletonization methods which are based on thinning – the most popular skeletonization approach. However, each algorithm uses different thinning strategy. The paper presents basic concepts of the algorithms and discussion about their primary features based on acquired results from real human CT images.

Keywords: *skeletonization, airway tree, cubical complex, thinning*

Dominik Sankowski, Sławomir Jeżewski, Piotr Duch, Zbigniew Stolarski, Sylwester Błaszczyk: **Autofocus Algorithm in Vision System of Mobile Robot** • Automatyka 2010, t. 14, z. 3/1

Algorithms DCT and Tenenbaum are presented in this paper. Those algorithms were used to find focus in image from cameras mounted on the mobile robot head. Lens position is very important to find depth map using stereovision cameras. Authors discus time of focus calculation by those algorithms.

Keywords: *autofocus, mobile robot, stereovision*

Joanna Sekulska-Nalewajko, Jarosław Gocławski, Ewa Gajewska, Marzena Wielanek: **An Algorithm to Extract First and Second Order Venation of Apple-Tree Leaves Stained for H_2O_2 Detection** • Automatyka 2010, t. 14, z. 3/1

In the paper an algorithm for the extraction of first and second order leaf venation has been presented. The algorithm applies to apple tree leaves specially stained to reveal the areas of H_2O_2 appearing in the leaf blade as brown spots of different size and intensity. In the considered case they represent the defence reaction of plant's tissue to a bacterial infection called fire blight. Examined leaf images in-clude visible leaf veins with colour hue and brightness similar to the H_2O_2 spots. They are often superimposed on leaf veins and make serious distortions for the process of their extraction. In these conditions typical algorithms for the detection of venation patterns usually fail, so a new method of primary and secondary veins detection has been proposed. The vein extraction is based on the step-wise tracking of each vein axis using polygonal line with the line segments of fixed size. The optimal direction for each step is obtained through the minimization of the proposed cost function depending on the prediction angle. The algorithm has been written in the M-language and executed in MATLAB environment. The experiments of leaf vein tracking carried out for the series of images gave promising results accepted by the biologists.

Keywords: *leaf venation, fire blight, segmentation, morphological opening, curve tracking, cost function*

Adam Sędziwy: **Agent Environment in Syntactic Pattern Recognition** • Automatyka 2010, t. 14, z. 3/1

A computational complexity of parsing is the major limitation of syntactic pattern recognition methods applicability. That complexity may be decreased only by using grammars having weaker expressive power. ETPL(k) graph grammars, having quadratic complexity, are a compromise between complexity and descriptive power. For problems having large sizes however it's necessary to parallelize computations by distributing them over a multiagent system. Effectiveness of a system may be additionally boosted by even knowledge distribution enabling a balanced workload of agents. The knowledge consists of given subgraphs and grammar productions.

Keywords: *distributed graph transformations, multiagent systems, GRADIS syntactic pattern recognition*

Artur Sierszeń, Łukasz Sturgulewski, Michał Dubel, Tomasz Marciniak, Adam Wójciński: **Network Behavior-Analysis Systems with the Use of Learning Set and Decision Rules Based on Distance** • Automatyka 2010, t. 14, z. 3/1

Network Behavior Analysis is an ability to identify traffic patterns which do not occur during normal operation of a network. In other words, it is an attempt to identify irregularities in a network, an attempt which goes beyond simple settings concerning exceeding parameters for traffic of a given type. In the article the authors present a concept of using Pattern Recognition, i.e. a learning set and decision rules based on neighbor rule.

Keywords: *management of computer networks, monitoring of computer networks, Nearest Neighbor Rule, Network Behavior Analysis, Pattern Recognition*

SIGNAL PROCESSING FOR IDENTIFICATION AND CONTROL SYSTEMS

Marcin Bąkała, Krzysztof Strzecha, Tomasz Koszmider, Anna Fabijańska: **Automation of Vision and Transportation Modules, Implemented in the Thermo-Wet System** • Automatyka 2010, t. 14, z. 3/1

In this paper, a case-study of the Thermo-Wet surface tension measurement and contact angle are presented. This article shows the results of measurements of physical-chemical properties at high temperatures using cameras with different resolutions. The concept of Thermo-Wet modernization has been presented.

Keywords: *image analysis, vision system, wetting*

Lidia Byczkowska-Lipińska: **Biological Mechanisms as Data Transmission and Processing Systems** • Automatyka 2010, t. 14, z. 3/1

Living functions of organisms are strictly related with transmutation of matter and energy. All biochemical processes within cells are accompanied by energy transmutations. An example of biological system is auditory system presented in this work, in which energy transformation takes place. Other systems fulfil the role of processing and transmitting information, allowing efficient functioning of living organisms. Biological systems of transmission

are also systems of vision, auditory, smell, vestibular organs, receptors of external environment (taste, skin receptors) and receptors of internal environment (chemical and physical).

Keywords: *biological, data transmission*

Anna Fabijańska, Krzysztof Strzecha, Tomasz Koszmider, Marcin Bąkała: **Refining Edges to Sub-Pixel Level in Images of Molten Metals and Alloys** • Automatyka 2010, t. 14, z. 3/1

In this paper problem of edge detection in images of heat-emitting objects is regarded. In the considered images edges are significantly blurred due to the thermal effects. The method for improving quality of edge detection is introduced. The proposed approach determines edges with sub-pixel accuracy. The main concept of the proposed method is to create continuous functions out of the image derivative values. Results of applying the proposed method to images of heat-emitting specimens of metals and alloys are presented and discussed.

Keywords: *image analysis, edge detection, sub-pixel accuracy*

Andrzej Frączyk, Piotr Urbanek, Jacek Kucharski: **Correction Algorithms in Computerized Power Control System for Induction Heating** • Automatyka 2010, t. 14, z. 3/1

The prototype of induction heating system of the rotating cylinder, being developed in Computer Engineering Department TUL, comprises six inductors fed by high frequency generators. These are thyristor generators with series resonant circuit working in the half-bridge resonance mode. The accuracy of the temperature control depends, among others, on static and dynamic properties of mentioned above generators. In order to ensure good control accuracy some of disadvantageous properties of generators have to be eliminated or at least reduced. It can be successfully performed by software procedures realized within computerized data acquisition and processing system which is an inherent part of the considered device.

Keywords: *high frequency thiristor generators, static and dynamic properties, computer-based power control system*

Maciej Garbacz, Mieczysław Zaczyk: **Fuzzy Logic Algorithms in Wheel Mobile Robot Navigation** • Automatyka 2010, t. 14, z. 3/1

In the article an obstacle avoidance algorithm for mobile robot Khepera III based on fuzzy logic is presented. In this application

Matlab/Simulink system is used. Proximity sensors are used to detect obstacles. Presented fuzzy logic algorithm calculate control of robot using information from proximity sensors.

Keywords: *path planning, mobile robots, obstacle avoidance, proximity sensors, fuzzy logic*

Sławomir Jeżewski, Maciej Łaski, Robert Nowotniak: **Comparison of Algorithms for Simultaneous Localization and Mapping Problem for Mobile Robot** • Automatyka 2010, t. 14, z. 3/1

This paper presents a comparison of selected algorithms for simultaneous localization and mapping (SLAM) problem in mobile robotics. Results of four general metaheuristics, Simple Genetic Algorithm, Particle Swarm Optimization, Quantum-Inspired Genetic Algorithms and Genetic Algorithm with Quantum Probability Representation, have been compared to results of classical, analytic method in this field, Iterative Closes Points algorithm. In the experiments the same objective function, drawn from Iterative Closest Points algorithm, has been used. Two situations have been considered: local and global localization problems of mobile robot. Both problems are import and often critical for successful navigation of robot in environment.

Keywords: *mobile robots, simultaneous localization and mapping problem, iterative closest points, genetic algorithms, metaheuristics, evolutionary computing*

Daniel Pociecha, Mirosław Jabłoński: **Metal Deformation Trace Vision Station in Plastic Cold Forming Process** • Automatyka 2010, t. 14, z. 3/1

The paper presents metal deformation trace vision station, in cold tube pilger rolling process. Aluminium tube was prepared, with cooper grid on their surface. Measurement of metal deformation is possible, when grid point's displacement is traced. During rolling process, photos were taken. Using those photos, three-dimensional coordinates of tube grid points were determinate. Stereophotogrammetric method was used to point’s coordinate's calculation. Before stereophotogrammetric calculation, annotation of all points which are visible on photos is essential. Two methods of point annotation – manual and automatic – are presented in paper.

Keywords: *pilgering process, vision deformation measurement, stereophotogrammetric method*

Andrzej Romanowski, Jakub Betiuk, Zbigniew Frątczak: **Method for Automatic Driver Notification about Detection of the Emergency Vehicles** • Automatyka 2010, t. 14, z. 3/1

Aim of this paper is to describe the method for detection of privileged vehicles in operation in the urban areas. Main purpose of the system is to recognize the sound of emergency vehicles sirens and alarming that fact to the driver. This solution is based on the utilization of the powerful microcontroller capable of performing basic DSP operation. The prototype device is based on audio signal processing, in order to detect the emergency signals, and afterwards producing valuable output information. The implementation of this idea would make operation of emergency vehicles faster, and improve overall traffic safety. Device consists of the external microphone for analogue signal acquisition, analog-to-digital converter responsible for sampling and digitalizing of the signal, microcontroller performing the processing and a diode signaling occurrence of the right-of-way vehicle. The implementation was done with use of programmable microcontroller AT32UC3A0512 together with the ATMEL's Software Framework 1.2.1 and AVRONE! device that enabled on-chip debugging of the code. The paper describes an idea and process of development of the safety device, which major purpose is to alert the driver of incoming emergency vehicles. Following device is build to record the ambient sounds and process them in order to recognize certain patterns that are associated with privileged vehicle.

Keywords: *emergency vehicles sound signal detection, audio processing*

Dominik Sankowski, Marcin Bąkała, Rafał Wojciechowski, Andrzej Albrecht: **Liquid Braze Surface Tension Determination Algorithms Implemented in Brazeability Analysing System** • Automatyka 2010, t. 14, z. 3/1

In this article, the methods of surface tension determination implemented in Brazeability Analysing System are shown. The authors have presented methodology and analytical concept of surface tension measurement using two methods: plate- and maximum pressure in gas bubble method. The construction of automated system for carrying out measurement experiments and calculating quantity result of surface tension is shortly discussed. The results of example experiments for Sn60Pb40 and SnAg3,5 brazes are presented.

Keywords: *industrial system, measurements automation, material engineering, brazing, surface tension*

Dominik Sankowski, Sławomir Jeżewski, Piotr Duch, Sylwester Błaszczyk: **Detection of Moving Objects Base on Data Information from Distance Sensors in Mobile Robot** • Automatyka 2010, t. 14, z. 3/1

Concept of moving detection algorithm base on data from infrared sensors is represented in this paper. The proposed algorithm can complement information required for building environment map for mobile robot. Authors discus accuracy of proposed algorithm. Results of experiments proof that proposed algorithm gives reliable information about robots current speed.

Keywords: *moving detection, mobile robot, infrared sensor*

Dominik Sankowski, Sławomir Jeżewski, Maciej Łaski: **Real Time Mobile Robot Localization Based on Laser Rangefinder** • Automatyka 2010, t. 14, z. 3/1

This papers presents description of algorithms used in real time mobile robot localization procedure. Main problem is to optimize nearest neighbour algorithm used by localization method using characteristics of data received from laser rangefinder. The Iterative Closest Point (ICP) algorithm has been used, as it is a classical method in localization problem.

Keywords: *mobile robots, Iterative Closest Points, ICP, Simultaneous Localization and Mapping, SLAM, kd-tree*

Dominik Sankowski, Sławomir Jeżewski, Adam Wulkiewicz: **Generic Model of Distance Measuring Sensor for a Mobile Robot's Operating System** • Automatyka 2010, t. 14, z. 3/1

Design of an operating system for PC computers was one of the most important reasons, why they are now that popular and easy to use. It is natural to design an operating system for a mobile robot to increase easiness of use. Authors presents generic model of distance measuring sensor which can be used in the mobile robot's operating system to handle existing sensors.

Keywords: *SLAM, sensor, localization, map, robot*

Krzysztof Strzecha, Marcin Bąkała, Anna Fabijańska, Tomasz Koszmider: **The Evolution of Thermo-Wet – the Computerized System for Measurements of Surface Properties** • Automatyka 2010, t. 14, z. 3/1

The evolution of Thermo-Wet measurement system was presented. Its history and current state were described. The paper

focused mainly on the new ideas in the high temperature computerized measurements of wetting angle and surface tension. The main goals of given ideas are to expand the usability of measurement stand and to improve the accuracy and repeatability of the measurement results.

Keywords: *image processing, image analysis, high temperature measurements, wetting angle, surface tension*

Piotr Urbanek, Andrzej Frączyk, Jacek Kucharski: **Algorithm for Movement Control in Multi-Inductor Heating System** • Automatyka 2010, t. 14, z. 3/1

Fixed, placed at regular intervals inductors for induction heating of a rotating steel cylinder do not provide for required modern technology, sufficiently uniform temperature profile along cylinder axis. The article examines the influence of moving inductors along the cylinder axis to reduce the pick-to-pick temperature amplitude. Several types of motion inductors and the selection of the length of zones of motion have been simulated. The simulation results were compiled and assessed for suitability to the practical implementation methods.

Keywords: *induction heating, move of inductors, multi-dimension systems*

IMAGE ANALYSIS AND RECOGNITION

Marta Chodyka, Włodzimierz Mosorow: **Identification of TV Programs Based on Provider's Logo Analysis** • Automatyka 2010, t. 14, z. 3/1

This article presents a method involving the automatic identification of the Internet TV program by examining the logo sign of the program provider. Such identification of the provider's logo will allow to control access to video programs of specific broadcasters in order to block access to multimedia content with inappropriate themes for underage persons. A new algorithm to recognize the Internet TV program from the video stream in real time has been prepared and developed.

Keywords: *image analysis, pattern identification, Internet TV, and Internet and a child*

Szymon Grabowski, Cezary Draus, Wojciech Bieniecki: **Recognizing Non-Translatable Symbols in a Multi-Lingual Computer-Assisted Translation System for DTP Documents** • Automatyka 2010, t. 14, z. 3/1

The paper is devoted to the problem of computer-assisted translation of catalogues and advertising brochures (DTP documents), where the text to translate consists of many short separated snippets. One of the issues that may facilitate the translation process is to recognize the phrases which should be copied verbatim, no matter what the target language is. These include technical data with units of measurement, abbreviations, numbers etc. but also trademark symbols. As for the first problem, the presented algorithm uses statistical analysis of the characters inside a character sequence within each segment of the considered phrase, where segments boundaries are marked by special characters, like hyphens or slashes. If at least one of the segmented is labeled "non-symbol", the whole phrase should be handled by the human translator, otherwise it is considered non-translatable and copied verbatim, hence saving the translator's work. For the trademark start boundary recognition problem, we proposed a simple but seemingly robust solution based on similarity of word suffixes preceding ® and similar characters in a given phrase, together with heuristic rules based on character case of those words.

Keywords: *Computer-Assisted Translation (CAT), text processing*

Tomasz Jaworski, Jacek Kucharski: **The Use of Fuzzy Logic for Description of Spatial Relations between Objects** • Automatyka 2010, t. 14, z. 3/1

The goal of this article is to present a review of major methods and algorithms for assessing directional spatial relations between fuzzy and crisp objects in 2D image. The types of relations mentioned are: point – point, point – object, crisp object – crisp object, fuzzy object – fuzzy object. Presented article also takes into account further research on use of fuzzy directional spatial relations for dynamical process modeling on base of tomograms and thermograms.

Keywords: *fuzzy logic, spatial relations, directional spatial relations*

Jaromir Przybyło: **Hand Tracking Algorithm for Augmented Reality Systems** • Automatyka 2010, t. 14, z. 3/1

Augmented Reality (AR) technology can be applied to wide range of application domains. Particularly education is an area

where this technology could be especially valuable. The work presented here is part of the larger project of building vision-based Augmented Reality system dedicated to educational presentations. The main contribution of this paper is robust hand tracking algorithm which utilizes color and motion information.

Keywords: *Augmented Reality, hand tracking, image processing and analysis*

Sebastian Stoliński, Wojciech Bieniecki, Jacek Stańdo: **Automatic Detection and Evaluation of the Spline Function Plot** • Automatyka 2010, t. 14, z. 3/1

In this paper the image processing algorithm for automatic recognition and evaluation of drawn-by-hand function plot is presented, which enables processing of the scanned examination sheets. The student is to draw the plot in a printed coordinate system. Because the plot is drawn manually, the teacher checks if the drawn curve crosses some characteristic "lattice" points. In a case of complex plot (few curves or lines – spline function) the curve may be discontinuous and the student should mark the endings of the segments. The computer program compares the model plot to the query plot and as the result it returns the degree of compliance between the plots. The algorithm works in the following steps: extraction of the coordinate system area from the sheet (for query and model solutions), extraction of the plot segments from the coordinate system (for query and model solutions), comparison of the extracted plots with respect of some tolerance.

The algorithm has been successfully tested upon a group of 50 sheets. Some errors occurred for solutions with strike-throughs, amendments, lines drawn by mistake. Big amount of unrecognized plots has impact on the relative errors.

Keywords: *e-marking, image processing*

Jakub Swacha, Szymon Grabowski: **Self-Extracting Compressed HTML Documents** • Automatyka 2010, t. 14, z. 3/1

Data compression is a natural means to overcome some issues with textual data, in particular, it can accelerate the transfer of web data. Although the number of possible solutions to compress HTML and other web documents is not small, it makes practical sense if the compression scheme is transparent for the user and pre-

ferably does not require any plug-ins or other modifications of a standard web browser. In this paper we present a substitution-based HTML compression algorithm with a JavaScript decompression stub which is launched upon page load and restores the original data, thus working transparently for the client, if only JavaScript execution is turned on. Experiments show that together with visually lossless HTML preprocessing, HTML can be shrunk to about the half of their original size.

Keywords: *data compression, HTML, JavaScript, web page delivery*

Marek Zachara, Cezary Piskor-Ignatowicz, Lidia Dutkiewicz, Katarzyna Grobler, Patryk Orzechowski, Dariusz Pałka: **Assessment of the Ergonomic of Polish Major News Portals Based on Analysis of People's Behaviour while They are Browsing for Information** • Automatyka 2010, t. 14, z. 3/1

This paper focuses on the ergonomics of Polish major news portals. The advantages and disadvantages of the portals are considered with the emphasis on the easiness of use. The ergonomics of the portals is evaluated by the time users needed to complete certain tasks, tracking of users gaze while they are watching the web pages and also by post experiments interviews. Certain attributes of the page layout that benefit usability will also be discussed. The assessed easiness of use is also compared with the portals' market share.

Keywords: *web portals, web page ergonomics, usability*