Summaries

IMAGE PROCESSING FOR MEDICAL
AND INDUSTRIAL APPLICATIONS

Anna Fabijańska, Dominik Sankowski: **Calibration of CCD Camera Vision System for High Temperature Measurements of Surface Propreries** • Automatyka 2007, t. 11, z. 3

This paper presents a technique for calibration of CCD camera system for digital image quantitative analysis applications. Especially high temperature measurements of surface properties are considered. The calibration process is focused on correction of these defects that arise from CCD chip imperfections and can influence on accuracy of object shape projection.

Keywords: CCD camera calibration, image enhancement, instrumental background, hot & dead pixels

Anna Fabijańska, Krzysztof Strzecha, Dominik Sankowski: **The New Approach to Noise Removal Using Median Filtration** • Automatyka 2007, t. 11, z. 3

In the paper, algorithm for removal of noise was presented. Proposed algorithm is based on median filter and it works in two stages: in the first stage, there is built map of point, which brightness level should be changed in the second stage. Deep analysis of the algorithm was provided.

Keywords: image processing, image filtering, median filter

Jarosław Gocławski, Joanna Sekulska-Nalewajko, Patryk Anioł: **The Segmentation Method of Microscopic Images of Radiographically Labelled Plant Cells for the Determination of Nuclei DNA Synthesis Level** • Automatyka 2007, t. 11, z. 3

This paper presents the segmentation algorithm for autoradiograms of microscopic slices made of radish (*Raphanus sativus*) root meristematic cells stained with the Feulgen method. The segmentation purpose is the separation of isotopic marked agglomeration areas, what makes the base for subsequent quantitative discrimination of nucleic acid (DNA) synthesis level. The speed of genetic material multiplication can indicate the distortions of plant growth caused by various factors harmful for the environment. The investigated autoradiographic microscopic images are mapped from RGB to HSV colour space, median filtered, processed by mor-

phological operations and finally thresholded to find the searched marker objects and nuclei surfaces. These operations enable image background equalization and artefact reduction. Two different paths of processing have been applied to extract small and big marker agglomerations. The proposed algorithm has been developed in MATLAB 7 environment and segmentation results for the series of 10 autoradiograms have been positively verified by cytologists.

Paweł Gryboś, Sławomir Mikrut: **Using „OpenCV 1.0” Library's Functions to Automatic Matching of Air Images** • Automatyka 2007, t. 11, z. 3

In this paper the way of using functions from "open source" library to image processing in matching algorithm is presented. The correlation algorithm which use library functions useful to image matching is describe, take into problems and advantages came from air images. During the experiments optimal size of template and value of correlation coefficient decided if matching is correct were established. The research was done on real images and different texture. The method of the generated before grid was tested too. Matching points covered the area of stereograms and are located evenly on the stereograms, which is necessary in relative orientation process.

Marcin Janaszewski, Laurent Babout: **Bridge Detection in 3D Images of Stress Corrosion Cracks of Stainless Steel** • Automatyka 2007, t. 11, z. 3

This paper presents an algorithm to identify bridges in 3D objects represented with a set of connected voxels. The notion of a bridge can be defined as a part of a material with higher resistance to stress corrosion. Therefore if a crack meets a bridge it splits itself into two branches, which surround the bridge and merge when it finishes. Thus from the 3D image analysis point of view a bridge can be treated as a hole in a volumetric object which represents a crack. The literature analysis shows that usually detection of holes is carried out based on the object skeleton and localization of loops in the skeleton as each loop implies occurrence of a hole. Unfortunately, due to unprecedented complexity of tested images, commonly used skeletonization algorithms fail. Therefore authors

decided to construct a new algorithm of whole detection which consists of two stages. The first one lies in the application of a voxel coding technique to make a transformation of an object into a set of clusters, where a cluster is a set of connected voxels. The set of clusters gives important information about the object topology. In the second step the algorithm extracts and analyses clusters to detect holes. The algorithm was satisfyingly tested on several 3D crack images from a stress corrosion cracking experiment on a stainless steel sample. The discussion of obtained results and propositions for future works are also included in the paper.

Keywords: microtomography, 3D image analysis, voxel coding, hole detection

Jacek Nowakowski: **Algorithms of Mobile Robot Navigation in Movable Obstacles Scenery** • Automatyka 2007, t. 11, z. 3

This paper presents selected aspects of mobile robot navigation. Literature review of mobile robot navigation in changing environment is presented. Robot localisation methods and trajectory planning are presented. Results of research of mobile robot navigation in environment with moving obstacles are presented.

Keywords: mobile robots, moving obstacles

Jacek Nowakowski, Adam Mencwal, Paweł Kośla: **Scene Reconstruction Performed by Stereovision System of Mobile Robot** • Automatyka 2007, t. 11, z. 3

The paper presents application that reconstructs neighbourhood of mobile robot based on analysis of stereovision image. Theoretical background of stereovision image processing were presented. Concept of disparity was explained. Graphical user interface as well as performance issues of designed application were presented.

Keywords: mobile robot, stereovision system, image processing

Piotr Pawlik, Sławomir Mikrut: **Comparision of the Accuracy of the Matching Points Method on Air Photography** • Automatyka 2007, t. 11, z. 3

To solve the problem with two corresponding points on digital air images some different algorithms were developed. In this paper the authors tried to compare some methods. The method such as: SIFT, Harris, Hesjan were tested and implemented. The experiments were based on real air images (air photography), which have

been taken in two different scales. To estimation the accuracy, the parameters such as : mean parallax on the model, number of matching points and their position, were used. The results show the similarity between the methods, but depending on kind of photography (the texture of the image).

Keywords: *photogrammetry, aerial photographs, relative orientation, matching*

Marcin Pietroń, Paweł Russek, Kazimierz Wiatr: **Methodology of Hardware Acceleration in High Performance Computing** • Automatyka 2007, t. 11, z. 3

In the area of high performance computing hardware acceleration is relatively new method. Undoubtly utilization of custom hardware is well known and widely used in several areas of digital systems. Beside that constant progress in the field of reconfigurable devices and EDA tools enhancement lead to the opportunity to use reconfigurable hardware based acceleration techniques in the area traditionally occupied by general purpose processors. This paper presents some methods used by authors to get higher computation power in scientific computation thanks to custom hardware implemented in programmable devices.

Keywords: *computing acceleration, programmable devices, high performance, computing systems*

Łukasz Tomczak, Joanna Chałubiec: **Parameters of Gas Bubbles Measurement by Using Image Processing and Analysis Techniques** • Automatyka 2007, t. 11, z. 3

In this paper we try to develop a novel methodology for 3D reconstruction and measurement such parameters of gas bubbles as area and capacity, using image analysis techniques. Grey-scale image captured by a CCD camera consists of two sub images presenting two views in two planes of analyzed gas bubbles. The angle between them is equal 90 degrees. Thanks to it we are able to do bubbles reconstruction in 3D. Each of sub gray-scale image is processed separately. To receive their binary version we use: median filtration, edge detection, thresholding and morphological operation. In the next step algorithm fixes bubbles from two images to receive table containing two views of each analyzed bubble. In the next step each view of the bubble is approximated using ellipse

to get parameters of ellipsoid which represents bubble in 3D. Finally each bubble is visualized in 3D and its area and capacities are calculated.

Keywords: image analysis and processing, parameters of gas bubbles measurement, 3D reconstruction

Roman Vorobel, Magdalena Stobińska: **Image Transformation and Its General Relative Contrast** • Automatyka 2007, t. 11, z. 3

The analysis of known approaches to evaluation of image general contrast after nonlinear statistical transformations is carried out. The method for computing of image general relative contrast after nonlinear statistical transformations is proposed. It is shown that the contrast does not depend on input image contrast, image content and the function of gray level density distribution or its histogram, but it is a characteristic of this transformation.

Keywords: image, nonlinear image transformation, relative contrast, general contrast

SIGNAL PROCESSING FOR IDENTIFICATION AND CONTROL SYSTEMS

Marcin Bąkała, Tomasz Koszmider: **Vision System for Brazing, Spreading Measurement** • Automatyka 2007, t. 11, z. 3

In this paper, a case-study of the automated brazing spreading measurement is described.

Keywords: brazing, spreading, vision system

Przemysław Korohoda: **Hemodialysis Modelling Based on the Measurement Data – Optimization Procedure for the Two-Compartmental Model** • Automatyka 2007, t. 11, z. 3

In the paper a multistage optimization procedure has been proposed. The technique had been designed to make possible the computation of the cellular clearance based only on the data measured during hemodialysis treatment. The iterative structure of the proposed algorithm allows subtle corrections on the values of the urea generation and recirculation. The description has been illustrated with some resulting examples and also with the summary data. The technique proved to be convergent for measurements performed

during 91 dialysis sessions, while introducing the relative error into modelled external compartment urea concentration with the mean value 0.51% and standard deviation 2.80%.

Keywords: *hemodialysis modelling, two-compartmental model, cellular clearance, optimization*

Przemysław Korohoda: **Computation of the Equivalent Representation for Nonstationary Discrete Filtering – Introductory Study** • Automatyka 2007, t. 11, z. 3

The paper presents reasoning leading to computation of the equivalent stationary discrete filter, along with relevant new transformation, so that the nonstationary discrete filtering process originally based on the Discrete Fourier Transform may be performed in the manner typical for the stationary filtering. The new basis, resulting from the computed transformation, together with the new filter characteristics in this transform domain form a relevant data set to describe the DFT-based nonstationary filtering in the unified form, typical for the stationary filtering. The reasoning has been illustrated with two examples.

Keywords: *nonstationary filtering, equivalent filter, generalized convolution*

Artur Sierszeń: **Modification of Chang's Algorithm with the Method of Finding the Mutually Nearest Points** • Automatyka 2007, t. 11, z. 3

The modification of Chang's algorithm consisting in replacement of the original method of determining the distance to the nearest point from the same class with modified methods of finding the mutually nearest points causes a great acceleration of the computational phase. Results of experiments show that the presented method does not significantly decrease the quality of classification.

Keywords: *pattern recognition, the modification of Chang's algorithm, acceleration of the computational phase, k-NN rules, set: Glass, Iris, Pima, Wine*

Mariusz Świder: **Influence of Digital Filtering on Prediction of Copper Futures Exchange Rates** • Automatyka 2007, t. 11, z. 3

This article describes improvement capabilities of copper exchange rates prediction using digital filtering. It is considered as a preliminary step which eliminates signal's upper harmonics

treated as a random noise. Having finished copper stock exchange quotation's spectral analysis the most appropriate sampling frequencies and two best suitable digital filter types were chosen. Both original and filtered signals were used for exemplary prediction with GARCH method. This method is widely used in the econometric and financial modeling area because of its good results when dealing with heteroscedastic signals like exchange transactions. Finally prediction errors comparison took place. There are satisfactorily low errors for the first 200 data samples of filtered signals. They are comparable with prediction error obtained with original copper exchange rate time series.

Piotr Urbanek, Jacek Kucharski, Aleksander Olczyk: **Identification Algorithm of Dynamic Properties of Temperature Sensors by Two-Chain Correction Method** • Automatyka 2007, t. 11, z. 3

In the paper the identification algorithm of dynamic properties of temperature sensors by two chain correction method has been presented. Principles and practical applications of the correction method within computerized measuring system were discussed. Experimental results obtained for the time-varying gas temperature measurements performed using miniature temperature transducers in the turbocharger pipe supplied with pulsating gas flow have been given.

Paweł Wołoszyn: **Web Browser Interface Based on Pointer Movement Analysis** • Automatyka 2007, t. 11, z. 3

This paper presents an experimental web browser provided with user interface based on analysis of mouse pointer movements. The intent of this interface is to improve browser accessibility for users with disabilities. The application was evaluated by healthy, fully dexterous users, who were then asked for opinion about comfort and efficiency of the interface. In the paper the users' opinions are presented along with conclusions concerning future development of this kind of interface.

Piotr Zięcik: **Hardware Platform Choice for Mobile Cardiologic Monitoring System** • Automatyka 2007, t. 11, z. 3

In article presented deliberations about choice of hardware platform for mobile cardiologic monitoring system taking the technical aspect and ergonomics into considerations. Also three example devices for practical system implementation was presented. Their common features are low energy consumption and high processing power, which makes possible advanced ECG signal analysis on light and small mobile device.

Keywords: ARM, ECG, embeded systems, remote monitoring

IMAGE ANALYSIS AND RECOGNITION

Mirosław Jabłoński: **Smart Camera - Subsystem of Automatic Color Calibration** • Automatyka 2007, t. 11, z. 3

Along with development of advanced image sensors and specialized digital cameras a new domain of machine vision emerged. Smart sensors and smart cameras embedding light sensors and processing elements enable applications of video signal analysis and image recognition into single compact device. The focus of described work is to explore robust operation of the device prototype in varying light conditions, especially when color information is critical for image analysis. Enhanced algorithm for automatic white balance has been developed to enable non-intrusive calibration of the device in run time without any assistance of the maintenance. The model based on advanced digital camera and PC has been used to verify functionality of automatic white balance in real conditions.

Keywords: smart camera, automatic white balance, camera calibration, accommodation to varying light conditions

Jaromir Przybyło: **Feature Tracking for Facial Recognition System** • Automatyka 2007, t. 11, z. 3

Multimodal systems have developed rapidly during the past decade. They have diversified to include new modalities including facial gestures. Efficient facial feature localization and tracking is a basic functionality needed for vision-based face gesture recognition system. This paper addresses the problem of tracking facial

features using low-quality video cameras. We describe influence of noise and human actions on tracking efficiency. We propose two feature selection criteria, based on texture diversity and measuring noise level, which improve tracking accuracy.

Keywords: multimodal interfaces, facial action recognition, feature tracking

PROCESS TOMOGRAPHY

Robert Banasiak, Łukasz Mazurkiewicz, Radosław Wajman: **Novel Algorithm for Electric Potential Distribution Calculation for 3D Capacitance Tomography Based on Charge Simulation Method** • Automatyka 2007, t. 11, z. 3

Typically a forward problem for 3D ECT tomography has been solved using finite elements method. The crucial requirement for this technique is to divide reconstructed process space into finite number of tetrahedrons: each of them with homogenous material permittivity. The main drawback of FEM method is a very time consuming especially for 3D problem. The electric potential distribution is computed using linear equations to approximate Laplace and Poisson equations which is quite difficult and significantly affect on-line non-invasive imaging possibility. Differently authors propose a new approach which defines material permittivity for nodes and to approximate permittivity distribution inside finite elements with linear function. Authors presents an algorithm for forward solution based on Charge Simulation Method which is better suited to presented assumption about node-based permittivity distribution than FEM 3D. New approach is significantly reducing of computational time and flexibility improving while keeping FEM 3D accuracy.

Keywords: 3D capacitance tomography, forward problem, reconstruction, charge simulation method

Krzysztof Grudzień, Zbigniew Chaniecki, Andrzej Romanowski, Robert Banasiak, Radosław Wajman, Wuquiang Yang, Dominik Sankowski: **Capacitance Tomography Systems Comparison Methodology** • Automatyka 2007, t. 11, z. 3

The paper presents an approach to establish a methodology for comparison of tomography systems measurement properties. Conducted experiments tested tomography systems under a number of different, proposed criteria concerning measurement capabilities.

There was the same sensor used for both tomography types employed. Both systems allow a number of configuration modifications, which was deployed only in a very short range, but this property can be exploited deeper in further research. The analysis of obtained results is the first stage of the work on the objectives procedures of the tomography systems comparison. It can be very helpful in the choice of the adequate tomography system relatively to its industrial applications. Additionally the presented methodology allows better understanding between hardware constructors and process investigators.

Keywords: capacitance tomography, comparison, static measurements, long-term measurement

Włodzimierz Mosorow: **Time Window Determination for Calculation of Flow Parameters in Electrical Tomography** • Automatyka 2007, t. 11, z. 3

An algorithm of time interval determination for calculation of flow parameters such as velocity and mass is proposed. The algorithm can be simply applied in an automatic tomographic system performing the monitoring of multiphase flows.

Keywords: electrical tomography, time window, flow

Rafał Przywarski, Krzysztof Grudzień, Andrzej Romanowski, Mariusz Rząsa, Radosław Wajman: **Sensitivity Maps Determination Methods for Optical Tomography Systems** • Automatyka 2007, t. 11, z. 3

Image reconstruction is a first stage of deriving information about the industrial process state for majority of process tomography applications. Therefore, image preparation on the base of tomography modality-specific properties, is the most important step in phenomena investigation with use of tomography. For optical modality, visual properties of the medium present in an explored space are deployed. Measurement space are illuminated with a few beams of visible light rays, and after traveling through the examined region, the incident light is sensed with detectors. Based on differences in medium transparency level and some other phenomena like reflection, refraction, etc., the image corresponding to a given space. The process of image reconstruction utilizes the sensitivity matrix. The paper presents two methods of sensitivity matrix deter-

mination. The first one assumes the light rays to be segments. The other one makes an assumption of the fixed width of light beams. Both methods are using the concept of light tracking from source to detector. The comparison of both methods identifies advantages and disadvantages of the two solutions. The study was conducted with use of numerical simulation and multiphase (gas/liquid) flow experiments in vertical column.

Keywords: optical tomography, image reconstruction, sensitivity matrix

Mariusz Rząsa, Krzysztof Grudzień, Andrzej Romanowski, Radosław Wajman: **Five-Projections Optical Process Tomography System** • Automatyka 2007, t. 11, z. 3

The paper presents the optical tomograph in which a tested object is illuminated from five locations. Measurement of luminous intensity is changed into a discrete signal (0 or 1) in the detectors including 64 optical sensors. Next, the measuring results are subjected to reconstruction according to a matrix algorithm of reconstruction. A detailed description of the measurement sensor is presented in the paper. The paper covers a discussion on the principle of operation of the electronic system for changing a light signal received by the detector into a discrete electronic signal. The authors describe a path of the light beam, taking into account optical phenomena occurring at the phase boundary while light is passing through the sensor wall and phenomena inside the measurement space. A method of the sensor calibration is analyzed and a way of technical realization of the presented problem is discussed, as well. The presented idea was elaborated in order to test two-phase, gas-liquid flows however, it can be also applied in tests of other objects with a distinct phase boundary.

Keywords: optical tomography, multiphase flow, image reconstruction

Jarosław Włodarczyk, Sławomir Lewandowski: **The Advantages of Dual Modality Tomography vs. Classical Gamma Tomography** • Automatyka 2007, t. 11, z. 3

This paper presents comparison of images quality obtained from classical gamma-ray tomography system and dual modality tomography system. Dual modality system was made by combining gamma-ray tomograph and electrical capacitance tomograph.

Keywords: gamma tomography, electrical tomography, dual tomography

NEURAL NETWORKS

Anna Czechowicz, Zbigniew Mikrut: **Utilization of the Kohonen Neural Networks for the Selection of Sub-Images for Aerial Photographs Matching Purposes** • Automatyka 2007, t. 11, z. 3

Automatic relative orientation is one of the key problems in photogrammetric processing. This paper concerns the application of the representation based on the gradient distribution and Kohonen neural networks for the selection of sub-images for aerial photographs matching purposes. The examinations were conducted over 904 sub-images of the aerial photographs of the Krakow's surroundings with different land cover, grouped into three categories: advantageous, nondescript and disadvantageous in respect of searching features for relative orientation. The 2D histogram was acquired for every sub-image and on this basis the representation in form of the vector of maximum values for gradient direction has been determined. This representation was utilized for the classification of areas with Kohonen network. The correctness of the obtained classification, compared to manually done, achieved the level of 68,3%.

Keywords: photogrammetry, aerial photographs, relative orientation, gradient representation, 2D gradient histogram, SOM, Kohonen network

Joanna Grabska-Chrząstowska, Jan Kulpa, Urszula Rychlik: **Neural Networks Implementation to Survival Prediction in Ovarian Carcinoma** • Automatyka 2007, t. 11, z. 3

Ovarian carcinoma is one of the most malignant carcinomas within women patients. The patients' survival is estimated at 30–50% depending on the advancement of the disease. A proper prediction of the patients' survival chances is crucial from the clinical point of view due to the possibility of introducing additional treatment after the obligatory chemotherapy. On the basis of initial research results during the primary surgery and the results received after the first step chemotherapy artificial neural network may predict a 24-month survival of particular patients with a high level of certainty.

Keywords: neural networks, survival prediction, ovarian carcinoma

Zbigniew Mikrut: **Generation of the Aerial Image Representations Using PCNN-Like Neural Networks** • Automatyka 2007, t. 11, z. 3

The goal of presented work was to verify that image signatures can be used in rough selection of the aerial subimages. The selection process is necessary to determine if the aerial image is suitable for next stages of photogrammetric processing, especially for matching. More than 900 image signatures (of length 25 and 50) was generated by the ICM network. The backpropagation network was used for classification. After learning the recognition rate of the test set was 73%. As the next step three recognition reliability thresholds was tested. After data rejection both recognition reliabilities and recognition rates were improved (~80%).

Keywords: photogrammetry, aerial images, image representation, PCNN, Pulse-Coupled Neural Networks, ICM, Intersecting Cortical Model, image signatures

Patryk Orzechowski, Zbigniew Mikrut: **Learning Schemes that Improve the Neural Network Effectivity** • Automatyka 2007, t. 11, z. 3

This article presents the results of experiments carried out before and during the learning process of artificial neural network (backpropagation), used for handwritten digits recognition. Some unconventional techniques are described, such as an algorithm of slant correction and two variants of sequential learning, basing on the recognition reliability of the specific digit and statistical confusion matrix.

Keywords: backpropagation, handwritten digits, image recognition, sequential learning, learning schemes

Paweł Wołoszyn: **A Model of Neural Network Capable of Counting Image Elements** • Automatyka 2007, t. 11, z. 3

The paper presents a model of neural network based on the idea of multiagent dynamic system. The characteristics of model are based on some real biologic neuron properties. The goal of the system is to count separate objects contained in an image presented to the network. Simulations carried out with various images indicate that proposed model is able to perform its role to some extent with limitations analogous to erratic human behaviour occuring in similar context.

Keywords: neural network, image processing, counting objects

BUSINESS INFORMATION SYSTEMS

Ewa Dudek-Dyduch, Edyta Kucharska, Lidia Dutkiewicz: **Algorithm for Task Schedulig Problem with Cost Estimation in Local Criterion** • Automatyka 2007, t. 11, z. 3

The article presents a problem connected with a proper creation of local criterion in a solution search method with information gathering for a control purpose. Two opposite requirements are discussed: using possibly the biggest amount of information and getting possibly the smallest computational complexity. There are presented local criteria using different amount of information designed for a drift driving problem. This problem belongs to class of task scheduling problems on multiple machines with retooling depending on process state. Some results of experiments are also described.

Keywords: heuristic algorithms, algebraic-logical model, local optimization

Lidia Dutkiewicz, Edyta Kucharska: **Two-Level Algorithm for Problem of Preparing Access to Exploitation Fields** • Automatyka 2007, t. 11, z. 3

The aim of the paper is to present two-level algorithm based on a heuristic method named substitution task method. Main concept of the algorithm is creation and than realization of so-called intermediate goals. Presented algorithm is applied for NP-hard problem of preparing access to exploitation fields. This is a task scheduling problem where resources depend on process state. An outline of algebraic-logical model for this problem is given in the paper. Some results of experiments are also described.

Keywords: algebraic-logical model, task scheduling, substitution task method

Bogusław Filipowicz, Joanna Kwiecień: **Modeling of Advertisement Effectiveness** • Automatyka 2007, t. 11, z. 3

Advertisement as a one of marketing elements absorbs part of firm's budget. Measuring the advertisement effectiveness as regards its range and noticeability is very essential. This article presents methods, which could be successfully applied to modeling of advertisement effectiveness. The modeling of press advertisement effectiveness depending on number of running and pace of range's drop in the case of advertisement repeats is also presented.

Keywords: advertisement effectiveness, Land–Doig method, Wolfe's method, genetic algorithm

Szymon Grabowski, Sebastian Deorowicz: **Web Log Compression** • Automatyka 2007, t. 11, z. 3

Web log data store client activity on a particular server, usually in form of one-line "hits" with information like the client's IP, date/time, requested file or query, download size in bytes etc. Web logs of popular sites may grow at the pace of hundreds of megabytes a day, or even more. It makes sense to archive old logs, to analyze them further, e.g. for detecting attacks or other server abuse patterns. In this work we present a specialized lossless Apache web log preprocessor and test it with combination of several popular general-purpose compressors. The test results show the proposed transform improves the compression efficiency of general-purpose compressors on average by 65% in case of gzip and 52% in case of bzip2.

Keywords: lossless compression, database compression, web logs, Apache

Bartłomiej Gudowski, Jarosław Wąs: **Some Scheduling Algorithms Based upon Example of Tram Terminus Operation** • Automatyka 2007, t. 11, z. 3

In the article some algorithms of trams scheduling has been described. Trams arrive to terminus, where several platforms are available. The article focuses on solutions with low computational complexity. Presented algorithms has been tested using simulation and exemplary results has been included.

Keywords: simulation, scheduling

Maciej Szmit, Izabela Politowska: **Information Security Metrics and Selected Compuer Crimes** • Automatyka 2007, t. 11, z. 3

In the paper we present a short review of information security metrics and selected computer crimes.

Keywords: computer crimes, information security

COMPUTER SCIENCE IN EDUCATION

Joanna Kwiecień, Paweł Wołoszyn: **Students' Expectations toward E-Learning Systems** • Automatyka 2007, t. 11, z. 3

E-learning becomes more and more significant in contemporary Information Society. This paper presents results of survey carried

out among students. The purpose of this research is to investigate students' knowledge about e-learning, their expectations and to determine factors influencing the use of e-learning tools. The conclusions are also presented.

Keywords: e-learning, distant learning, opinion polls

Dominik Sankowski: **New Information Technologies in the Education Services** • Automatyka 2007, t. 11, z. 3

The article presents the use ot the Information Technologies in the education services. Special attention is put on the distance learning. It is prooved that this training technique fulfills both learning method, self-learning and an excellent way of updating the gathered knowledge. Such a technique allowes to teach significantly cheaper than the classical one, greatly increasing the effectiveness of teaching. The possibility to use the computer in experiments in teaching physics and mathematics are also indicated. The internet technology allow the disabled people beter access to the education and development of theirs proffesional acitivities are pointed out in the article.

Keywords: information technology, e-learning