Tuesday, October 14

19:00 - 20:00

Reception Dinner

Wednesday, October 15

07:30 - 08:30

Registration

08:30 - 08:40

Welcome Message

George Giakos, General Chairman, USA

Room: El Greco Ballroom

08:40 - 09:00

Message from Local Chair & Honorary Chair

Prof. Nikita Konstantina, CoChair, Greece & Prof. Mihalis Zervakis, Greece & Prof. Wuqiang Yang, UK

Room: El Greco Ballroom

09:00 - 10:00

Technical Coordinators: George Livanos, Technical University of Crete, Greece; Tannaz Farrahi, University of Virginia, USA

Lecture 5: Electrical Capacitance Processes for Imaging Industrial Processes

Wuqiang Yang, Ph.D., Professor, University of Manchester UK, Lihui Peng, Ph.D., Professor Tsingua University, China; Haigang Wang, Ph.D., Professor Chinese Academy of Sciences

Room: Ballroom B

Lecture 1: Defining the Cutting Edge: The use of molecular imaging to aid in tumor resections

James P. Basilion, PhD; Professor of Radiology, Biomedical Engineering, and Pathology; Case Western Reserve University; Case Center for Imaging Research

Room: El Greco Ballroom

10:00 - 11:00

Lecture 6: Dynamic Contrast Enhanced Imaging

Costas Balas, Ph.D., Professor, TUC/Electronic and Computer Engineering, Greece

Room: Ballroom B

Lecture 2: Dynamic and parametric whole-body Positron Emission Tomography (PET): A pathway to quantitative molecular imaging enabling theranostic applications and personalized treatment

Nicolas A. Karakatsanis, PhD; PET Instrumentation and Neuroimaging Laboratory Division of Nuclear Medicine; Hospital Faculty of Medicine, University of Geneva, Genève, Switzerland

Room: El Greco Ballroom

11:00 - 11:20

Coffee Break

11:20 - 12:20

Lecture 7: Image construction by using electromagnetic diffracted wavefields: Basic concepts, theory and applications

Matteo Pastorino, Ph.D., Professor, University of Genoa, Italy

Room: Ballroom B

Lecture 3: Instrumentation Design and Techniques in Drug Discovery Imaging and Characterization of the Pharmaceutical Effects of Drugs

George Giakos, Professor and Chairman, Ph.D, Electrical and Computer Engineering, Manhattan College; Suman Shrestha, University of Massachusetts Medical Center, USA; Tannaz Farrahi, University of Virginia; Aditi Deshpande, University of Akron

Room: El Greco Ballroom

12:20 - 13:20

Lecture 8: Analytic reconstructions for PET, SPECT, MEG and EEG

Athanasios Fokas, University of Cambridge, UK; George Kastis, Academy of Athens, Greece

Lecture 4: New look at Image Quality Assessment and Standardization Methods

Sos Agaian, Ph.D., Professor, The University of Texas Health Science Center, USA

Room: El Greco Ballroom

13:20 - 14:30

Lunch

14:30 - 15:30

Detection Process, Image Formation and Analysis

Room: Ballroom B
Chair: Yaniv Azar (New York University Polytechnic School of Engineering & NYU WIRELESS,

USA)

14:30 ***Polarimetric Backscattered Mueller Matrix Bidirectional Reflectance Distribution Function (MmBRDF) for Remote Inspection of Spacecrafts***

George C Giakos (Manhattan College, USA), Suman Shrestha (University of Massachusetts Medical School & University of Akron, USA), Tannaz Farrahi (University of Akron, USA) and Aditi Deshpande (The University of Akron, USA)

The polarization properties of light scattering from space materials, such as Mylar, is studied. The properties are measured using a Mueller matrix at various aspect angles. The measurement is performed using an in-house imaging polarimetric platform. The calibration results of the polarimetric system were performed using elements of known Mueller matrix like linear horizontal polarizer (LHP) and linear vertical polarizer (LVP). These results demonstrate the high quality of acquired measurements using the designed system. The outcome of the study indicates that polarimetric backscattered Mueller matrix would enhance the capabilities of the imaging platform to enhance and characterize unresolved space materials.

14:45 ***Fire Detection Using Stereoscopic Imaging and Image Processing Techniques***

Gang Lu (University of Kent, United Kingdom), Guodong Li (North China Electric Power University, P.R. China) and Yong Yan (University of Kent, United Kingdom)

This paper presents a stereoscopic imaging technique for fire detection. A low-cost binocular CCD camera is used to acquire the stereoscopic images of a controlled gas fire. Computer algorithms are developed to segment the fire zone in the HSV (Hue, Saturation, Value) color space and to determine the correspondence points of image pairs. The location, size and propagation of the fire are then determined from the perspective relationship between the fire and the camera. Experimental results under laboratory conditions show the effectiveness of the proposed approach for fire detection.

15:00 ***Empirical Mode Decomposition of Hyperspectral Images for Segmentation of Seagrass Coverage***

Mehrube Mehrubeoglu (Texas A&M University-Corpus Christi, USA), Lifford McLauchlan (Texas A&M University-Kingsville, USA), Christopher Trombley (Texas A&M University-Corpus Christi, USA), S. Elizabeth Shanks (Texas A&M University-Corpus Christi, USA) and Paul Zimba (Texas A&M University-Corpus Christi, USA)

Seagrasses are an integral part of the marine ecosystem, and can provide information about their environment based on their surface content. In particular, epiphytes and epifauna on seagrass blades are of interest to scientists. Empirical mode decomposition is applied to hyperspectral images obtained from seagrasses to separate hyperspectral data into component modes, and then to segment and classify the seagrass coverage. A sample spectrum is taken from the image for reference for each of the classes. Hypothesis testing on the higher modes for an entire image gives a semi-automated algorithm for classifying the contents of unknown spectra. A three-class classifier is developed to segment the seagrass hyperspectral images into seagrass (host), epiphyte, and tubeworm.

15:15 ***Detection of Falsification Using Infrared Imaging: Time Domain Moving Average***

Yaniv Azar (New York University Polytechnic School of Engineering & NYU WIRELESS, USA) and Matthew Campisi (New York University Polytechnic School of Engineering, USA)

In this paper I present continuation of previous research done on lie detection using infrared imaging. Previously it was shown that lie detection using infrared imaging is possible and is actually very accurate (with accuracy of up to 84%). This paper showed a different type of detection algorithm using the implementation of time moving average. All data for this experiment was collected from 11 subjects, which were asked to answer 15 questions in three different times. The first time they were asked to state the truth, the second time they were asked to lie, and finally they were asked to mix their answers and state when they lied and when they said the truth. Then three different post processing methods were used in order to attempt and detect lies. This paper presents the results of detection using the time moving average method. It was first shown that this method has the same characteristics that support the hypothesis, meaning the truth data does not have wide peaks, and the lie data has wide peaks. Then the accuracy of the time domain moving average was found to be 85%, which is greater than current polygraph and previous methods presented. Finally, it was concluded that this method is more efficient and these findings could lead to a new era in the lie detection industry due to this method's efficiency, accuracy, and cost effectiveness.

Remote Sensing and Imaging

Room: El Greco Ballroom

14:30 ***An Improved Technology for Target Detection in Images***

Gaoliang Li (Beihang University, P.R. China) and Yan Zhao (Beihang University, P.R. China)

It is difficult to detect the target area of the image which has complex gray scale information in the field of industrial detection. So in order to improve the accuracy of detection, this paper proposed improved image segmentation method based on the region of interest. In the proposed method, the authors extracted regions of interest from the detected image that remove the effects of the complex environmental condition. In addition, dynamic threshold algorithm is used which is appropriate for extracting the target area from the region of interest. To make the algorithm more precise, the paper use mathematical morphology method to process the result which is segmented by dynamic threshold algorithm. The experimental results show that target area of the image can be extracted very accurately across a large number of test-cases. This method can overcome the limitations of traditional segmentation algorithm effectively, and it has advantages of fast detection speed, stable robustness and high efficiency.

14:45 ***A Tight Multiframe Registration Problem with Application to Earth Observation Satellite Design***

Martin Rais (Universitat de les Illes Balears, France), Carole Thiebaut (CNES, France), Jean-Marc Delvit (CNES, France) and Jean-Michel Morel (Ecole Normale Supérieure de Cachan, France)

Image registration can play a key role to increase the SNR of Earth satellite images by fusing many successive noisy thin image stripes in real time, before transmitting to the ground the final fused image. Yet these stripes cannot be fused directly by addition because their position is altered by microvibrations and other geometric perturbations. These must be compensated using limited onboard computational resources with high subpixel accuracy and in real time. In this paper we study the fundamental performance limits for this problem and propose a real time solution that nonetheless gets close to the theoretical limits. We introduce a scheme using temporal convolution together with online noise estimation, optical flow and a non-conventional multiframe method for measuring global translation. Finally, we compare our results with the theoretical bounds and other state-of-the-art methods. The results are conclusive on the fronts of accuracy and complexity.

15:00 ***A Numerical Analysis Concerning Microwave Imaging in Lp Banach Spaces by Using an Inexact Newton Method***

Claudio Estatico (University of Genova, Italy), Alessandro Fedeli (University of Genoa, Italy), Matteo Pastorino (University of Genoa, Italy) and Andrea Randazzo (University of Genoa, Italy)

In this paper, we seek to find some guidelines for the selection of the main parameters of a recently proposed microwave imaging method developed in the framework of Banach spaces. In fact, its capability of reconstructing unknown targets better than the standard Hilbert space techniques has been already proven in various situations. However, in order to exploit the full potential of this method, it is of great importance to find some rules for the choice of the main parameters that characterize the reconstruction procedure. To this end, several numerical evaluations with canonical targets are presented and discussed, in order to provide optimal imaging conditions.

15:15 ***A Hybrid Image Reconstruction Approach for Ultra-Wide Band Microwave Tomography Featuring Radar Based and Iterative Methods***

Tareq F A Zanoon (Arab American University & AAUJ, Palestine) and Mohd Zaid Abdullah (Universiti Sains Malaysia & Engineering Campus, Malaysia)

This paper presents a hybrid approach that combines two distinct classes of solutions for microwave tomography; namely radar and tomographic approaches. In this case, the fast computational advantage of radar based methods are utilized in obtaining a more suitable initial guess that can be used as an input to the iterative tomographic process, thus yielding an accurate quantitative result that is less sensitive to the inherited nonlinearity of the inverse scattering problem. To achieve this, the radar based result is processed in two steps which require increasing the energy intensity discrepancy to remove possible artifacts, and remaping the energy levels to appropriate field value data (electrical permittivity) according to the priori information of the setup. The Experimentation on numerical results suggest the effectiveness of this approach especially with common imaging setups.

15:30 - 16:30

Instrumentation Design and Image Enhancement Techniques

Room: Ballroom B

15:30 ***Hardware Accelerator for Fast Image/Video Thinning***

Daniele Davalle (University of Pisa, Italy), Berardino Carnevale (University of Pisa, Italy), Sergio Saponara (University of Pisa, Italy), Luca Fanucci (University of Pisa, Italy) and Pierangelo Terreni (University of Pisa, Italy)

Image thinning algorithms are widely used in image processing to simplify elaboration preserving geometrical features. Standard approaches are based on iterative methods and on distance transforms. Both techniques are well known to be computationally intensive. In this work we propose a parallel, fast and flexible hardware architecture for image thinning to achieve real-time performance. The test case is the 720 x 576 PAL standard video at 25 frame per second (fps). Synthesis was performed for a Stratix II FPGA EP2S30 and for a standard cell 65nm CMOS technology. The former showed a usage of 4% slices and 1% registers, the latter gave an occupation of 5 kgates for the processing core. The execution time for one frame was 0.03 s on the FPGA and 0.009 s on the 65 nm, resulting in a maximum throughput of 33 fps and 111 fps, respectively.

15:42 ***On Improving Sub-Pixel Accuracy by Means of B-Spline***

Vania V Estrela (Universidade Federal Fluminense & IPRJ, Brazil), Sandro R. Fernandes (IF Sudeste de Minas Gerais & Campus Juiz de Fora, Brazil), Hermes Magalhães (Universidade Federal de Minas Gerais, Brazil) and Osamu Saotome (Instituto Tecnológico de Aeronáutica, Brazil)

Local perturbations nearby contours strongly perturb the final result of processing remotely sensed images. It is common to establish a priori data to aid the estimation process. One can move some steps forward by means of a deformable model, for example, the snake model. In up to date research, the deformable contour is represented via B-spline snakes,

which allows local control, concise depiction, and the use of fewer parameters. The estimation of edges with sub-pixel accuracy via a global B-spline depiction depends on determining the edge according to a Maximum Likelihood (ML) agenda and using the observed information likelihood. This practice guarantees that outliers present in data will be cleaned out. The data likelihood is calculated as a result of the observation model comprising both orientation and position data. Experiments where this procedure and the traditional spline interpolation have revealed that the algorithm introduced outperforms the conventional method for Gaussian as well as Salt and Pepper noise.

15:54 ***Bright and Dark Distance-based Image Decomposition and Enhancement***

Mehdi Roopaei (University of Texas at San Antonio, USA), Sos Agaian (, USA), Mehdi Shadaram (The University of Texas at San Antonio, USA) and Suhas Shridhar bagalkot (UTSA, USA)

High contrast images are common in the scenes with dark shadows and bright light sources. It is difficult to enhance the details in both dark and light areas simultaneous on most wide dynamic range images. Recently, several image enhancement methods have been proposed to solve this problem. However, most of them are not consistent, may produce un-natural looking images, and exhibit poor results if the images have wide dynamic range. In this paper, a novel method for contrast enhancement of a wide dynamic range images has been proposed based on the innovative image decomposition framework. Minimum cross-entropy between the bright and dark image components has been used to decompose an image into dark and bright image-components. The visual and quantitative extensive analysis shows that the proposed method outperforms the state-of-the-art algorithms, including well-known Retinex, Histogram equalization, and Gamma Correction methods. Moreover, the proposed algorithm can be applied by simple hardware and processed in real-time system due to its simplicity. It has various applications such as video door phone, security video cameras, and others. It is possible to be utilized in electronic products and image related instrumentation.

16:06 ***Optimizing Enhanced Hybrid Medical Imaging Through Dual-Mode Contrast Agents***

Claudia Sciallero (University of Genoa, Italy), Luca Balbi (Esaote S.p.A., Italy) and Andrea Trucco (University of Genoa, Italy)

Only recently, dual-mode agents able to combine ultrasound and magnetic resonance imaging have been proposed. In this paper, two types of innovative dual-mode contrast agents are investigated and compared in terms of imaging performance. Existing ultrasound contrast agents composed of gas-filled microbubbles covered by a polymeric shell were modified to obtain dual-mode contrast agents. Different densities of superparamagnetic iron oxide nanoparticles were anchored to the external bubble surface or physically embedded into the bubble shell. The goal of this paper is to individuate the setup parameters and imaging techniques able to optimize the microbubble detection with both imaging modalities. Moreover, the type of dual-mode agent and nanoparticle density that offer the best balance between magnetic resonance and ultrasound contrast enhancement is identified. In vitro imaging experiments were carried out by applying low magnetic field (0.25 T), low acoustic pressures (< 300 kPa) and low concentrations of dual-mode contrast agents. Modified microbubbles with nanoparticles loaded on the external shell surface were found to provide the best contrast both in ultrasound and magnetic resonance imaging.

16:18 ***A Novel Algorithm with FPGA Implementation for Action and Gesture Recognition Employing Spatiotemporal Gradient in the Transform Domain***

Ehab H. El-Shazly (EJUST University & EAEA, Egypt), Moataz Abdelwahab (EJUST, Egypt), Ahmed Medhat (EJUST, Egypt) and Mohammed Sayed (EJUST, Egypt)

In this paper, a novel human action/gesture recognition algorithm based on spatiotemporal gradients of moving points dealt with in 2D in the transform domain is presented. 2DPCA is used to obtain compact feature descriptor representing each action/gesture and Canonical correlation analysis is used to distinguish between testing and training descriptor. The proposed algorithm was tested to verify its robustness using multiple datasets where high accuracy, low storage and computational complexity were achieved. In order to accelerate the computations of our algorithm when being used with high definition HD real time applications, a hardware implementation using field programmable gate array (FPGA) is presented. The proposed architecture has been prototyped, simulated and synthesized on Xilinx Virtix-6 XC6VLX550T FPGA. At 395 MHz clock frequency, the proposed architecture processes 30 2K resolution (2048*1080) fps real time. The prototyped architecture utilizes 73.8% of the LUTs and 30.7% of the slice registers in Xilinx Virtex-6 XC6VLX550T FPGA.

Electric Capacitance Tomography

Room: El Greco Ballroom

Chair: Haigang Wang (University of Manchester, United Kingdom)

15:30 ***Sparse Representation in Electrical Resistance Tomography Based on Extended Sensitivity Matrix***

Jiamin Ye (Chinese Academy of Sciences, P.R. China), Haigang Wang (University of Manchester, United Kingdom), Guizhi Qiu (Institute of Engineering Thermophysics, P.R. China) and Wuqiang Yang (The University of Manchester, United Kingdom)

Electrical resistance tomography is a soft-filed tomography technique, i.e. the electrical field is changed everywhere in the sensing area with the change of conductivity in any pixel. To improve the image quality, an extended sensitivity matrix is designed in this paper. The base conductivity elements in the extended sensitivity matrix are consisted of a series of blocks with different number of pixels at all possible locations in the sensing region. Based on the new sensitivity matrix, a sparse representation method is implemented to reconstruct the conductivity distribution of cross-sectional area. Simulation results show that the proposed method based on the extended sensitivity matrix can reconstruct the image with a high quality.

15:45 ***Effect of Structured Packing on EIT Image Reconstruction***

Yunjie Yang (The University of Edinburgh, United Kingdom), Jiabin Jia (The University of Edinburgh, United Kingdom), Nick Polydorides (The University of Edinburgh, United Kingdom) and Hugh McCann (The University of Edinburgh, United Kingdom)

Broadly used in chemical engineering, structured packing is beneficial for maximizing liquid spreading. In this paper, image reconstruction for electrical impedance tomography (EIT) sensors with structured packing is investigated. To evaluate the effect of structured packing on image quality, characterization of EIT sensor with structured packing is firstly carried out. Furthermore, fringe effect in image reconstruction using these sensors is presented. Based on the study, it is found that compared with standard Tikhonov regularization and Landweber iteration, using 2-order difference operators, such as Gaussian-Laplace operator, can effectively decrease the degradation of image quality. The study also discusses the feasibility of using homogeneous sensitivity matrix in image reconstruction. Numerical analysis is carried out to demonstrate the validation of the study.

16:00 ***A Digital Demodulator Based on the Recursive Gauss-Newton Method for Electrical Tomography***

Shijie Sun (Beihang University, P.R. China), Lijun Xu (Beihang University, P.R. China), Zhang Cao (Beihang University, P.R. China) and Wenyang Jing (Beihang University, P.R. China)

In the paper, a digital demodulator based on the recursive Gauss-Newton method is proposed for Electrical Tomography. The digital demodulator can track the amplitude and phase of a noisy sinusoidal signal with known frequency directly. Compared with the traditional digital multiplication demodulation method, the proposed demodulator is more flexible. It is implemented in a recursive way and only part of a full period is required for demodulation. Therefore, the trade-off between the speed and precision can be made by using the proposed demodulator. The proposed demodulator was implemented in the software and possessed low computational complexity. Numerical simulation was carried out to prove its feasibility. The parameters in the demodulator were optimized.

16:15 ***Development of FPGA Based Electrical Capacitance Tomograph EVT4***

Jacek Kryszyn (Warsaw University of Technology, Poland), Waldemar T Smolik (Warsaw University of Technology, Poland), Tomasz Olszewski (Warsaw University of Technology, Poland) and Roman Szabatin (Warsaw University of Technology, Poland)

Electrical capacitance tomograph is used to image spatial and temporal distribution of electrical permittivity. It is attractive for use as a monitoring device in chemical and process engineering. To meet increasing requirements through the high frame rate to high sensitivity, the EVT4 tomograph is being developed by our group. In this paper the current progress in the design of EVT4 device was reported. The hardware design of 32 channels modular system based on FPGA chips was presented. The system consists of 8 front-end boards connected to capacitance sensor electrodes. The front-end boards - each with 4 channels - are extended by read-out boards. The control board is connected with read-out boards by a point-to-point Multi-Gigabit Transceivers using SATA physical layer. The control board is equipped with Xilinx FPGA (Spartan) and 32 bit (ARM CORTEX) processor. The architecture of control software embedded in PLD and ARM CORTEX was described.

16:30 - 16:45

Coffee Break

16:45 - 18:00

Automated Image Processing and Segmentation Techniques

Room: Ballroom B

Chairs: Mohammed A. M. Abdullah (Newcastle University, United Kingdom), Kui Yang (Beihang University, P.R. China)

16:45 ***A Study on Constant-Time Filtering Using Integral Images***

Kui Yang (Beihang University, P.R. China), Yan Zhao (Beihang University, P.R. China), Yafan Xu (Beihang University, P.R. China) and Nianmao Deng (Beihang University, P.R. China)

A uniform filter (also called a box filter) can be computed in O(1) time (also written as in constant time) using an integral image. In recent years, many extensions of the integral images, such as the kernel integral images, the cosine integral images etc., have been proposed to accelerate non-uniform filters. In this paper, we observe that these extensions share the same basic idea that they transform a non-uniform filter to a group of uniform filters by approximating the filter kernel with a high-dimensional dot product and then compute each uniform filter using an integral image. The main difference among these extensions is the way to construct the approximation. We also propose a novel approximation using the truncated singular value decomposition of the kernel matrix. Further study shows that our method is equivalent to the cosine integral images when accelerating symmetric spatial filters and performs better when accelerating other filters.

17:03 ***Fast and Accurate Method for Complete Iris Segmentation with Active Contour and***

Morphology

Mohammed A. M. Abdullah (Newcastle University, United Kingdom), Satnam Dlay (University of Newcastle, United Kingdom) and Wai Lok Woo (Newcastle University, United Kingdom)

The performance of iris recognition systems is significantly affected by the segmentation accuracy, especially in non-ideal iris images. This paper proposes a fast and accurate method for segmenting the iris using a combination of morphological operations and Chan-Vese active contour model. The morphological operations are used to determine a rough boundary of the iris region while the active contour is used to find the precise boundary. The proposed scheme is robust in finding the exact iris boundary and isolating the eyelids and the eyelashes of the iris images. Experimental results on the CASIA version 4.0 iris database have indicated a high level of accuracy using the proposed technique.

17:22 ***Blood Vessel Segmentation in Video-Sequences From the Human Retina***

Jan Odstrcilik (Brno University of Technology & St. Anne Faculty Hospital Brno - ICRC, Czech Republic), Radim Kolar (Brno University of Technology & Department of Biomedical Engineering, Czech Republic), Ralf Tornow (Universitatsklinikum, Germany), Jiří Jan (Brno University of Technology, Czech Republic) and Attila Budai (University of Erlangen-Nuremberg & International Max Planck Research School, Graduate School in Advanced Optical Technologies, Germany)

This paper deals with the retinal blood vessel segmentation in fundus video-sequences acquired by experimental fundus video camera. Quality of acquired video-sequences is relatively low and fluctuates across particular frames. Especially, due to the low resolution, poor signal-to-noise ratio, and varying illumination conditions within the frames, application of standard image processing methods might be difficult in such experimental fundus images. In this study, we tried two methods for the segmentation of retinal vessels - matched filtering and Hessian-based approach, originally developed for vessel segmentation in standard fundus images. We showed that modified versions of these two approaches, combined with support vector machine (SVM), can be used also for segmentation in experimental low-quality fundus video-sequences. The SVM classifier trained and consecutively tested on the database of high-resolution images achieved classification accuracy over 94 % and thus revealed a possible applicability of the proposed method on low-quality data. Then, testing on low-quality video-sequences revealed sufficiently large reliability in term of segmentation stability within the sequence with the inter-frame variability in image quality.

17:41 ***Identification and Retrieval of DNA Genomes Using Binary Image Representations Produced by Cellular Automata***

Konstantinos Konstantinidis (Centre for Research and Technology Hellas, Greece), Angelos Amanatiadis (Democritus University of Thrace, Greece), Savvas A Chatzichristofis (Democritus University of Thrace, Greece), Rafael Sandaltzopoulos (Democritus University of Thrace, Greece) and Georgios Sirakoulis (Democritus University of Thrace, Greece)

We have developed a novel method for the identification and retrieval of DNA sequences which are represented as binary images. This type of representation emanates from the evolution of one-dimensional nucleotide arrays abiding to a set of Cellular Automaton rules. A thorough investigation of these rules was performed in order to determine their efficiency. The presented method has been applied on short nucleotide sequences as well as on eleven complete genes of various origins. The technology presented offers a novel approach for the rapid and efficient sequence identification of nucleotide sequences in database repositories. The proposed framework will be practically useful for applications involved in virus recognition and personalized medicine which rely heavily on the processing of huge volumes of nucleotide sequence data.

Non-Invasive Biomedical Imaging

Room: El Greco Ballroom

16:45 ***Towards Intelligent Capsules for Robust Wireless Endoscopic Imaging of the Gut***

Dimitris Iakovidis (Technical Educational Institute of Lamia, Greece), Roberto Sarmiento (University of Las Palmas de Gran Canaria, Spain), Juan Silva (University of Cergy-Pontoise, France), Aymeric Histace (ETIS UMR CNRS 8051 & University of Cergy-Pontoise, ENSEA, France), Olivier Romain (University of Cergy-Pontoise, Cameroon), Anastasios Koulaouzidis (The Royal Infirmary of Edinburgh, Edinburgh, Greece), Catherine Dehollain (EPFL, Switzerland), Andrea Pinna (UPMC Univ Paris 06, Greece), Bertrand Granado (UPMC Univ Paris 06, France) and Xavier Dray (University of Cergy-Pontoise & Paris 7 University & APHP Hôpital Lariboisière, France)

Wireless capsule endoscopy (WCE) enables screening of the gastrointestinal tract by a swallowable imaging system. However, contemporary WCE systems have several limitations, which often result in low diagnostic yield. This paper introduces the concept of a next generation WCE system with embedded intelligence aiming to effectively minimize diagnostic errors. The proposed system is based on a novel wirelessly-powered hardware-software architecture integrating reconfigurable components that are optimized in terms of area-time complexity and power consumption. It integrates multispectral and 3D vision modules, and embedded intelligence for video quality control, accurate localization of the capsule and automatic detection of a broad spectrum of abnormalities. The feasibility of the proposed WCE system is qualitatively assessed with respect to the results obtained, and novel research directions are drawn.

17:03 ***Multistage Classification for Bacterial Colonies Recognition on Solid Agar Images***

Alessandro Ferrari (University of Brescia, Italy) and Alberto Signoroni (University of Brescia,

Italy)

The advent of laboratory automation in clinical microbiology is entailing a revolution in the way most common bacteriological clinical exams are accomplished. As an essential part of these systems, digital recording and processing of cultured bacteria images is expected to improve plate reading, with a key role of image analysis tools in guaranteeing cost-effectiveness, accuracy, flexibility and reliability of the clinical tasks. In this work, we propose an image analysis system capable to address the complex problem of different bacteria species identification on cultured agar plates. Our solution is based on a modular segmentation/classification pipeline where a chain of supervised classification stages provides solutions to a series of nested task issues, from foreground separation toward isolated colony detection and classification. Performance assessment, based on an experimental dataset obtained in standardized laboratory conditions, clearly demonstrates the feasibility and the potentiality of the proposed solution and favorably opens to generalizations as well as to clinical validation studies.

17:22 ***Placental Villous Tree Models for Evaluating the Mechanical Environment in the Human Placenta***

Yoko Kato (Tohoku Gakuin University, Japan), Michelle L Oyen (University of Cambridge, United Kingdom) and Graham J Burton (University of Cambridge, United Kingdom)

The human placenta has the fetal and maternal blood streams, which are in the villous tree and intervillous space, respectively. The villous tree has the contractile cells in the stem villi, and change the shapes of the intermediate and terminal villi by the oxygen environment. Considering the contraction of the villous tree, the villous tree would influence the mechanical environment of the placenta. In this study, the method to develop villous tree models for evaluating the mechanical environment in the placenta was proposed. The diffusion-limited aggregation model was used as the axis of the villous tree. The centripetal and centrifugal orders in each branch showed that the axis was unequally dichotomous as well as asymmetric. By changing the range of the centripetal order, 6 types of the axes were made. The size of the axis was modulated in order to keep the size of its bounding rectangle among the models. By curving the axis three dimensionally, and then dilating it, the villous tree model including blood vessels was developed. The component ratio was kept through these models. The surface area and volume in the smallest model were less than 30% of the largest one.

17:41 ***Gabor Filter Based Localization of Needles in Ultrasound Guided Robotic Interventions***

Mert Kaya (Ozyegin University, Turkey) and Ozkan Bebek (Ozyegin University, Turkey)

This paper presents an entropy based parameter tuning method for needle segmentation, and a probability map based needle tip estimation method using Gabor-based line filter. The proposed automatic parameter tuning method optimizes the threshold value that is used by the Otsu's thresholding technique to binarize the ultrasound image. A probability map is created to estimate the needle tip location using the Gabor filtered image and the binarized image. The pixel with the maximum probability represents the needle tip location. The proposed methods are experimentally tested in four different phantoms and distilled water. The image processing time is reduced by 24% using the proposed tuning method, and the needle tip location can be successfully estimated using the probability map.

19:30 - 21:30

Gala Dinner

Room: El Greco Resort

Thursday, October 16

09:00 - 10:00

Imaging Systems for Environmental Monitoring

Room: Ballroom B

Chair: Michalis Zervakis (Technical University of Crete, Greece)

09:00 ***Optimal Backoff Exponent Estimation for Environmental Monitoring IEEE 802.15.4 Star-Topology Sensor Networks***

Evangelos Chatzistavros (Democritus University of Thrace, Greece) and George Stamatelos (Democritus University of Thrace, Greece)

In the IEEE 802.15.4 standard, the Backoff Exponent(BE) index defines the duration of a node's backoff period during a transmission attempt. Here, we examine the effect on performance of the BE value. We show that the minimum and maximum assigned values have a considerable effect on system performance. We propose a method for calculating the appropriate index value as a function of packet size, data rate and the number of contending nodes is presented.We also provide a network calculus approach for throughput estimation on IEEE 802.15.4 star topology networks. The proposed performance model is evaluated through extensive simulations on different network configurations.

09:15 ***Solar Radiation Prediction Model Based on Empirical Mode Decomposition***

Petros-Fotios Alvanitopoulos (Democritus University of Thrace, Greece), Ioannis Andreadis (Democritus University of Thrace, Greece), Nikolaos Georgoulas (Democritus University of Thrace, Greece), Michalis Zervakis (Technical University of Crete, Greece) and Nikolaos Nikolaidis (Technical University of Crete, Greece)

Accurate solar radiation data are a key factor in Photovoltaic system design and installation. Efficient solar radiation time series prediction is regarded as a chalenging task for researchers both in the past and at present. This paper deals with solar radiation time series prediction. To date an essential research effort has been made and various methods are proposed that have different mathematical backgrounds, such as artificial neural networks, fuzzy predictors, evolutionary and genetic algorithms. In the present study the solar radiation time series prediction combines the Empirical Mode Decomposition (EMD) and Support Vector Regression (SVR) models. The EMD is an adaptive signal processing technique that decomposes the nonstationary and nonlinear signals into a set of components with a different spatial frequency content. It results in a small set of new time series that are easier to model and predict. The SVR is applied to the new solar radiation time series. Since support Vector Machines provide great generalization ability and guarantee global minima for given training data, the performance of SVR is investigated. Simulation results demonstrate the feasibility of applying SVR in solar radiation time series prediction and prove that SVR is applicable and performs well for solar radiation data prediction.

09:30 ***3D Photorealistic Scientific Visualization of Tsunami Waves and Sea Level Rise***

Alexandros Giannakidis (Culturplay, Greece), Giannis Giakoumidakis (Technical University of Crete, Greece) and Katerina Mania (Technical University of Crete, Greece)

A methodology is proposed for the photorealistic scientific visualization of a tsunami wave. The methodology is applied to the case of the tsunami occurring after the Mediterranean earthquake in 365 AD, provoking sea level rise in Heraklion port in Crete, Greece. The work presented in this paper puts forward a semi-automated workflow for parsing modeled data embedded in an animation software of choice. By scripting the manual work needed for the import and processing of geo-referenced time arrays, a 4 mins animation showcasing the automated workflow was created. The script implemented directs the automatic loading of geotif data and produces the required shapekeys needed for the final 3d animation. It minimized production costs for the sea level animation to a minimum and aided the quick visualization of large arrays of numerical models in geo-referenced 3D representing the impact zone. The 3D & animation data can then be handed out to the post processing team that will focus on special effects and photorealistic rendering, maintaining scientific accuracy in the final animation.

09:45 ***River Flow Estimation Using Video Data***

Konstantia Moirogiorgou (TUC/Electronic and Computer Engineering, Greece), Konstantinos Bacharidis (Technical University of Crete, Greece), Ioannis Sibetheros (TEI Athens, Greece), Andreas Savakis (Rochester Institute of Technology, USA) and Michalis Zervakis (Technical University of Crete, Greece)

An image-based framework for river flow monitoring based on a statistical estimation technique for fluid flow estimation is presented. This approach uses subsequent grayscale video frames along with a statistical estimation method to extract the optical flow. An average velocity estimate is computed using the velocity vectors of the main motion trend, which is extracted using classification methods. The corresponding real-world surface velocity is computed using velocity-area transformations. The use of only two subsequent video frames and the lack of tracers in the flow are the key features of this technique in order to extract an accurate estimate of the real surface velocity. We compare the real surface velocity estimate with traditional current meter measurements, which have been made on the site of Pinios river, Thessaly, Greece using the Q-liner 2 Doppler device.

Imaging Devices and Miniaturization

Room: El Greco Ballroom

Chair: Wuqiang Yang (The University of Manchester, United Kingdom)

09:00 ***Design Parameters of Nanocomposite Matrices Deposited on Silicon Substrates, in the Optical Domain***

George C Giakos (Manhattan College, USA), Suman Shrestha (University of Massachusetts Medical School & University of Akron, USA), Chaya Narayan (The University of Akron, USA), Tannaz Farrahi (University of Akron, USA) and Aditi Deshpande (The University of Akron, USA)

The purpose of the study is to optimize the design parameters of nanocomposites matrices deposited on silicon substrate, in the optical domain. Specifically, the interaction of polarized photons with several samples of nanocomposite matrices, consisting of different concentrations of gold nanoparticles dispersed into different concentrations of PVA (poly-vinyl alcohol), deposited on silicon substrates at different spin coating speeds, were studied. Backscattered photons, under co-polarized and cross-polarized transmitter-receiver geometries, were detected and the degree of linear polarization (DOLP) was estimated. The outcome of this study allow us to assess the optimal design parameters of nanocomposites in the optical domain. It is of paramount significance to determine how nanostructures can be effectively integrated into polymer matrices and what new information properties can be achieved.

09:15 ***A Simulation Study of a Miniature Parallel ECT Sensor***

Zhen Ren (University of Manchester, United Kingdom) and Wuqiang Yang (The University of Manchester, United Kingdom)

Electrical capacitance tomography (ECT) has been developed successfully for industrial applications. While most ECT sensors employ a circular structure with a closed sensing area, some other structures like square and parallel structure is needed for some particular applications. This paper describes a parallel structure ECT sensor, which can provide incomplete measurement data only. The performance of this parallel ECT sensor is discussed based on 2D simulation models. Images of different permittivity distributions are generated by linear back-projection (LBP) and Landweber iteration algorithms. The effect of the effective sensing area and distance of parallel plates are also discussed. Both relative capacitance residual and correlation coefficient are used to evaluate the image quality.

09:30 ***Novel Finger Vascular Pattern Imaging Device for Robust Biometric Verification***

R Raghavendra (Gjøvik University College, Norway), Jayachander Surbiryala (Gjøvik University College, Norway), Kiran B. Raja (Gjøvik University College, Norway) and Christoph Busch (Gjøvik University College, Norway)

The vascular pattern of the finger is emerged as a promising new biometric, characterized by very low error rates, good spoofing resistance and a user convenience when compared with other existing biometric modalities. In this paper, we present a new sensor design that is not only cost effective but also robust enough to capture the finger vascular (or finger vein) pattern. We evaluate the previously proposed finger vein verification approaches and also propose a new scheme that illustrates its superiority over existing approaches. The extensive experiments are carried out on the newly developed database constructed using our newly designed finger vein imaging sensor that comprised of 1780 finger vein samples corresponding to 89 unique fingers from 32 subjects that are collected in two different scenarios shows the efficacy of the proposed sensor as well as the proposed scheme.

09:45 ***Hybrid Active Pixel Sensor with High-Sensitivity and Extended Dynamic Range***

Sung-Hyun Jo (Kyungpook National University, Korea), Myunghan Bae (Kyungpook National University, Korea), Byoung-Soo Choi (Kyungpook National University, Korea), Hong-Bae Park (Kyungpook National University, Korea) and Jang-Kyoo Shin (Kyungpook National University, Korea)

This paper presents a hybrid active pixel sensor (HAPS) with high-sensitivity and extended dynamic range without any complex circuit. The photodetector (PD) of the proposed HAPS is composed of a gate/body-tied (GBT) PD for high-sensitivity and a conventional n-well/p-sub PD on the same focal plane for attaining normal image. The gain of the GBT PD is a hundred-times larger compared to the conventional n-well/p-sub PD. The structure of the proposed APS is similar to the conventional 3-transistor APS. Only two transistors are added for selecting each PD (GBT PD and n-well/p-sub PD). Adding the two transfer switches allows to have two modes: the high-sensitivity mode for low-light level detection and the normal mode for higher image quality. In order to reduce pixel size of the proposed APS, the row select transistor is eliminated. Dynamic range of the proposed APS is increased to approximately 86 dB. Its pixel size is 10 μm2 for testing pixel performance. The proposed APS is being fabricated by using 1-poly 6-metal 0.18 um standard CMOS technology.

10:00 - 11:00

Biomedical Optical Imaging

Room: Ballroom B

Chair: Mehrube Mehrubeoglu (Texas A&M University-Corpus Christi, USA)

10:00 ***Artificial Spectral Vision for Studying the Spectral, the Spatial and the Temporal Characteristics of Dynamic Optical Phenomena in Biomedicine***

Dimitris Iliou (Technical University of Crete, Greece), George Epitropou (Technical University of Crete, Greece), Vassilis Kavvadias (Technical University of Crete, Greece), Athanasios Tsapras (Technical University of Crete, Greece), Christos Rossos (Technical University of Crete, Greece), Costas Galaras (Technical University of Crete, Greece) and Costas Balas (Technical University of Crete, Greece)

In this paper we present a novel snapshot spectral imager with the distinct advantage of being able to display maps representing different spectral classes in a scene in video rates. The simultaneous capturing of spectral images through a common aperture is combined with spectral estimation algorithms for improving spectral resolution at no cost to the spatial resolution. The developed real time spectral mapper (RTSM) is validated in a pilot study as a blood oxygen saturation mapper, where its great value in studying the spatiotemporal characteristics of dynamic optical effects was clearly established.

10:15 ***3D Imaging of Arterial Wall Using Confocal Microscopy***

Mehrube Mehrubeoglu (Texas A&M University-Corpus Christi, USA), Stephen Greenwald (Barts & The London School of Medicine and Dentistry, QMUL, United Kingdom) and Christopher Evagora (Barts & The London School of Medicine and Dentistry, QMUL, United Kingdom)

Although smaller arteries have been imaged and well characterized, 3D imaging of larger arteries is more challenging due to the thickness of the walls preventing light penetration throughout. We investigated the use of single-photon confocal microscopy as a tool to create 3D images of cross sections of arterial walls to analyze their structural arrangement; 3D visualization of elastin and collagen fibers is of interest, as their structural properties and arrangement could potentially be correlated to a multitude of arterial diseases. Preliminary results reveal that confocal microscopy can be used to view the

pig carotid arterial wall up to 12 μm axially in the outer medial layer, and less than 40 μm in the inner medial layer, although details in the latter appear much fainter.

10:30 *Optical Projection Tomography and Light Sheet Microscopy for Imaging in Biological Specimens a Comparison Study*

Stylianos Psycharakis (Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Crete, Greece), Giannis Zacharakis (FORTH - IESL, Greece), Athanasios Zacharopoulos (Foundation for Research and Technology-Hellas (FORTH), Greece) and Jorge Ripoll (FORTH, Greece)

Recent advances in the field of optical imaging technologies have revolutionized the way we approach biological research and have unveiled several novel biological processes, mechanisms and functions. In the field of microscopic and mesoscopic imaging, novel approaches have been developed, which involve the innovative illumination schemes such as Optical Projection Tomography (OPT) and Light Sheet Microscopy or Selective Plane Illumination Microscopy (SPIM). In this work we present and compare the performance for a combined optical projection tomography and selective illumination microscopy system that is highly suitable for in vivo imaging of dynamic processes in the microscopic scale, with full multispectral capabilities.

10:45 *Multimodal Registration of High-Resolution Thermal Image Mosaics for the Non-Destructive Evaluation of Structures*

Michael Hess (University of California, San Diego, USA), Mohan M Trivedi (University of California, USA) and Falko Kuester (UC San Diego / Calit2, USA)

There are multiple areas of application for the fusion of visible and thermal images, but previously all of these applications required feature detection and matching in both ranges in order to register the two modalities . This paper proposes an approach that takes advantage of known relative camera positions in order to automatically register thermal images to the visible images. In the application domain of structural diagnostics, it is not guaranteed that corresponding features will be present in both ranges of the electromagnetic spectrum. The other characteristic of this application that makes it unique compared to other thermal-visible registration work is the scale at which the imaging is being performed. Non-destructive evaluation of structures could require the inspection of entire building facades which necessitate many thermal images to get a desirable level of resolution and detail. The acquisition of high-resolution thermal image mosaics generates the level of detail required and provides context for the entire target structure. A camera mount was custom designed and 3D printed in order to mount three visible web cameras around a thermal camera. Once the user calibrates the system with a set of images that contain corresponding features, the generation of each visible image mosaic will in turn automatically generate a registered thermal image mosaic. The benefit of this approach is that there is no reliance on features being present in the thermal image to match to the visible image.

Radars and Lidars Image Formation

Room: El Greco Ballroom

10:00 *Clutter Suppression in Through-the-Wall Radar Imaging Using Enhanced Delay-And-Sum Beamformer*

Nik Syahrim Nik Anwar (Universiti Teknikal Malaysia Melaka, Malaysia) and Mohd Zaid Abdullah (Universiti Sains Malaysia & Engineering Campus, Malaysia)

Through-the-wall imaging (TWI) is an emerging technology to help human see through walls in various critical situations. Adapting from Radar technology, TWI could be performed through beamforming of an array of ultrawide band (UWB) sensors. One of the challenges in designing a beamformer is to achieve high resolution and low clutter sensitivity. The resolution can be improved by increasing the aperture length at the expense of an increase in clutter sensitivity. An improved version of the standard delay-and-sum (DAS) beamformer, or EDAS has been developed and tested to suppress the clutter. An experiment has been performed and then images were reconstructed using DAS and EDAS. Comparison of the Target Clutter Ratio (TCR) of the images shows that EDAS had improved the TCR significantly.

10:15 *A Novel Full-Waveform Lidar Echo Decomposition Method and Simulation Verification*

Duan Li (Beihang University & Beihang University, P.R. China), Lijun Xu (Beihang University, P.R. China), Xiaolu Li (Beihang University, P.R. China) and Di Wu (Beihang University, P.R. China)

In this paper, a novel decomposition method of full-waveform Light Detection And Ranging (LiDAR) echo is proposed. This decomposition method includes four steps. In the first step, the noise mean value and deviation are estimated and noise threshold and fitting threshold are configured. In the second step, full-waveform echoes are smoothed using the Gaussian kernel function. In third step, maximum points and inflection points are detected aiming at filtered signal in the third step. Meanwhile, the number of echo component in full-waveform echo and initial parameters of each echo component are estimated based on the extreme points and inflection points and echo components are sorted depending on the source and area of echo components in the third steps. In the fourth step, the full-waveform echoes are addition fitted using Levenburg-Marquardt (LM) method based on sorted result and fitting threshold. At last, the correct rate and relative and absolute error of this decomposition method are simulation verified using MATLAB software based on randomly generated data. The result shows that the whole decomposition correct rate of this method is 82%, the maximal relative error of location is 0.18%, the minimum relative error of Full Width at Half Maximum (FWHM) is 1.13%, and the minimum relative error of fitting amplitude is 1.11%, the maximal absolute error of amplitude is 1.2157 millivolts, the maximal absolute error of location is 0.5548 nanoseconds, the maximal absolute error of FWHM is □2.219 nanoseconds. The decomposition correct rate and fitting accuracy show that fitting coefficients can be further used for target feature extraction and classification.

10:30 ***3-D Ghost Imaging with Microwave Radar***

Ran Xu (Xidian University, P.R. China), Yachao Li (Xidian University, P.R. China), Mengdao Xing (Xidian University, P.R. China) and Peng Shao (Xidian University, P.R. China)

In this paper, we demonstrate a new three-dimensional (3-D) radar imaging mechanism borrowing the concept of optical ghost imaging (GI). High range resolution is achieved by transmitting wideband electromagnetic (EM) signal, while high resolution in the orthogonal plane is obtained by correlating the echoes with radar antenna's stochastically fluctuating radiation pattern which can be generated with a 2-D phased array. This new concept of radar imaging takes no advantage of relative motion between the target and radar platform. Moreover, by combining the compressive sensing (CS) theory, our proposed imaging system is capable of realizing super-resolution with fewer data samples. Numerical simulation is given to validate the proposal.

10:45 ***Research on Sensing Matrix Characteristics in Microwave Staring Correlated Imaging Based on Compressed Sensing***

Yuanyue Guo (University of Science and Technology of China, P.R. China)

According to sparse objects in observation scene, a novel scheme of microwave staring correlated imaging based on compressed sensing (MSCI-CS) is proposed with its established imaging model. As an imaging basis and central element, the formation and specific meaning and characteristics of sensing matrix of stochastic radiation fields (SM-SRF) are analyzed, while a new average cross-correlation function of sensing matrix is defined to represent its whole correlation characteristics as well as the standard judgment condition of target reconstruction. The influence and restraint of radar parameters on SM-SRF are discussed emphatically, including emission signal waveforms, bandwidth, radar array scale and its configuration, its aperture etc. Finally, numerical simulation results verify the correctness of theoretical analysis of SM-SRF and its potentiality of sparse sampling and high-resolution imaging in proposed scheme.

11:00 - 11:20

Coffee Break

11:20 - 12:20

Industrial Inspection and Robotic Applications

11:20 ***Research on Image Processing Technology for On-line Oil Monitoring System***

Min Ma (Civil Aviation University of China, P.R. China)

Accurate wear debris classifying using on-line oil monitoring system plays an important role in aero-engine condition monitoring and fault diagnostics. However, there still exist imperfections in on-line oil monitoring system such as: motion blur of abrasive particles in the acquired images, low efficiency of the traditional image segmentation and recognition methods. Aiming to improve this situation, improved image restoration and segmentation algorithms are developed and different kinds of classifiers are designed in our work. Practical experimental results indicated that better recognition results of the abrasive particle images can be achieved via the improved methods, which offer an analysis basis for the fault diagnosis and detection of aircraft engine.

11:35 ***Hardware Implementation of an Optimized Scale-Invariant Feature Detector for Robotic Applications***

John Vourvoulakis (Democritus University of Thrace, Greece), John Kalomiros (Technological Educational Institute of Central Macedonia, Greece) and John Lygouras (Democritus University of Thrace, Greece)

A new architecture for the real-time detection of scale-invariant features in image sequences is presented. The system is based on a low-cost smart-camera custom board, developed to target robotic vision applications. Several optimizations of the SIFT detection procedure are proposed in order to achieve robust keypoint detection with high repeatability and recall values. As a result, a high accuracy and resource-efficient implementation of the SIFT detector is presented. The system is pipelined and streams pixel data using a 45 MHz clock, allowing keypoint detection at 150 frames per second, in video sequences with resolution 640x480. Integrating a commodity CMOS sensor, the prototype system displays keypoints at video rate, using only a fraction of the resources of a low-cost FPGA device.

11:50 ***Multispectral Edge Detection Algorithms for Industrial Inspection Tasks***

Maik Rosenberger (Ilmenau University of Technology, Germany)

Multispectral imaging technology enables a lot of possibilities in industrial imaging and automation. Especially parts which are complicated for inspection can be inspected using more than one or three wavelength channels. One challenge is the use of all channel information in the multispectral image for the edge detection. For this purpose different approaches were investigated. The results of the investigations in different edge detection models were applied for the segmentation of specific boundaries on composite pipes. With the presented multispectral imager and the investigated methods in multispectral image processing, the different layers on the pipe were segmented with subpixel accuracy as well as with pixel accuracy. Furthermore the challenges for illumination correction as well as geometric correction were discussed.

12:05 ***High-speed Micro-crack Detection of Solar Wafers with Variable Thickness***

Teow Wee Teo (Universiti Sains Malaysia & TTVision Technologies Sdn. Bhd., Malaysia), Zeinab Mahdavipour (Universiti Sains Malaysia & Engineering Campus, Malaysia) and Mohd Zaid Abdullah (Universiti Sains Malaysia & Engineering Campus, Malaysia)

A new approach for high-speed micro-crack detection of solar wafers with variable thickness is proposed. Using a pair of laser displacement sensors, wafer thickness is measured and the lighting intensity is automatically adjusted to compensate for loss in NIR transmission due to varying thickness. In this way, the image contrast is maintained relatively uniform for the entire size of a wafer. An improved version of Niblack segmentation algorithm is developed for this application. Experimental results show the effectiveness of the system when tested with solar wafers with thickness ranging from 125 to 170 μm. Since the inspection is performed on the fly, therefore, a high throughput rate of more than 3600 wafers per hour can easily be obtained. Hence, the proposed system enables rapid in-line monitoring and real-time measurement.

Cancer Modeling and Visualization

Room: Ballroom B

11:20 *Dual Energy Contrast Enhanced X-ray CT Characterization of Malignancies From Single Acquisition Data Sets*

George Zentai (Varian Medical Systems, USA), Larry Partain (Varian Medical Systems, USA) and Raisa Pavlyuchkova (Varian Medical Systems, USA)

Contrast agents in CT and MRI investigations have been used for obtaining better diagnosis, whether a nodule in the breast is benign or malignant. Cone beam CT images of breast cancer nodules have been taken with iodine contrast enhancement using two CT data sets, before and after iodine contrast injection. After the CT reconstructions, by subtracting the pre-contrast HU values from those obtained with iodine contrast at the nodules, the contrast enhancement values of the suspicious nodules were obtained. This article describes a method of determining mean "quantitative imaging biomarker" values such as calibrated mean contrast concentrations of enhancement agents (like iodine contrast agents in X-ray CT in segmented nodules identified using X-ray CT image data obtained in a single CT data set acquisitions instead of using two datasets (before and after contrast agent injection).

11:35 *A Multiresolution Analysis Framework for Breast Tumor Classification Based on DCE-MRI*

Alexia Tzalavra (National Technical University of Athens, Greece) and Konstantina Nikita (National Technical University of Athens, Greece)

In this paper, a multiresolution approach is proposed for texture characterization of breast tumors in dynamic contrast-enhanced magnetic resonance images. The decomposition scheme represented by the stationary wavelet transform (SWT) is investigated in terms of its' ability to discriminate between malignant and benign tumors. The mean and entropy of the detail subimages produced for the specific decomposition scheme are used as texture features. The extracted features are subsequently provided into a linear classifier in a leave-one-out cross-validation setting. The experimental results for the proposed features exhibit high performance, when compared to the existing approaches, with the classification accuracy approaching 0.91.

11:50 *Simulating Cancer Behavior Based on in Silico Modeling and in Vivo Molecular Imaging Approaches: Prospects and Limitations*

Vangelis Sakkalis (Foundation for Research and Technology (FORTH), Greece)

Computational Medicine efforts related to translating Cancer computational models to the clinical practice are focusing on identifying and testing ways to validate the models proposed in vivo before tumor resection. In real life this is actually difficult if not impossible, since patients are treated right away and there is no direct way of imaging the tumor growing. However, in this work, we attempt to validate the simulated outcome of a hybrid model with the actual tumor behavior in human cancer cell lines injected subcutaneously and grown as xenografts in immunodeficient mice by utilizing fluorescence molecular tomography performed in vivo. We show that knowing the initial spatial concentration of the viable cancer cell population, as well as hypoxia and vascularity significantly improves the in silico predictions. Such simulations provide patient specific details that play a significant role in the evolution of the tumor under study.

12:05 *Microcalcification Oriented Content-based Mammogram Retrieval for Breast Cancer Diagnosis*

Lazaros Tsochatzidis (Democritus University of Thrace, Greece), Konstantinos Zagoris (Democritus University of Thrace, Greece), Michalis Savelonas (Democritus University of Thrace, Greece), Nikos Papamarkos (Democritus University of Thrace, Greece), Ioannis Pratikakis (Democritus University of Thrace, Greece), Nikolaos Arikidis (University of Patras, Greece) and Eleni Costaridou (University of Patras, Greece)

Clustered microcalcifications (MCs) provide a significant early indicator of breast malignancy. This work introduces a machine learning-based scheme for malignancy risk assessment of mammograms containing MCs. The proposed scheme employs shape and texture features as input to a support vector machine (SVM) ensemble, in order to perform content-based image retrieval (CBIR) of mammograms. The retrieval performance of the proposed scheme has been evaluated on the basis of the morphology of the MCs, according to breast imaging-reporting and data system (BI-RADS). In our experiments, we use a set of 87 mammograms containing MCs, obtained from a widely adopted digital database for screening mammography. The experimental results demonstrate that the proposed machine learning-based scheme is capable of retrieving mammograms containing visually similar MCs, outperforming euclidean-based retrieval.

12:20 - 13:20

Image Analysis and Techniques

Room: Ballroom B

Chair: Konstantia Moirogiorgou (TUC/Electronic and Computer Engineering, Greece)

12:20 ***Tracer Response Using Single Harmonic Detection and Gradient Encoding in Magnetic Particle Imaging***

Przemysław Wróblewski (Warsaw University of Technology, Poland), Jan Szyszko (Warsaw University of Technology, Poland) and Waldemar T Smolik (Warsaw University of Technology, Poland)

The paper concerns the new emerging imaging diagnostic technique - Magnetic Particles Imaging (MPI). MPI enables visualization of spatial and temporal distribution of superparamagnetic tracer in examined object. The study of one dimensional localization of superparamagnetic iron oxide nanoparticles was performed using low level gradient field. The numerical simulation of single harmonic detection (3rd, 5th and 7th) was conducted. Monodisperse superparamagnetic nanoparticles with diameter of 30 nm were assumed. Using parameters selected in the simulation the real measurement was performed. The magnetic field gradient encoded nanoparticles response was measured. The experiments were performed using the scanner model being built by our group. In the experiments nanoPET's FeraSpin M superparamagnetic iron oxide nanoparticles were used (30 - 40 nm diameter). The measured nanoparticles response in function of position agreed with the numerical modeling.

12:35 ***Feature Analysis on River Flow Video Data for Floating Tracers Detection***

Konstantia Moirogiorgou (TUC/Electronic and Computer Engineering, Greece), Anastasia Pentari (TUC/Electronic and Computer Engineering, Greece), George Livanos (Technical University of Crete, Greece), Dimitra Iliopoulou (NTUA/Electrical and Computer Engineering, Greece) and Michalis Zervakis (Technical University of Crete, Greece)

This study focuses on an intermediate solution on a significant water quality problem as is the calculation of the distribution of suspended sediments in rivers. More specifically, we propose a method that performs tracking and motion estimation on river floating sediment tracers. The current work analyzes a river flow video sequence and isolates the sediment image information from the river flow video sequence in order to determine the temporal extend of the suspended sediment distribution during a flood event. The method is based on a combination of image processing techniques and is performed through hue and intensity analysis. The results present the river sediment tracers isolated from the river water flow and the river background as long as the river floating tracers velocity vector field.

12:50 ***Factorization Method for Electrical Resistance Tomography with Partial Boundary Measurements***

Zhang Cao (Beihang University, P.R. China), Chi Huang (Beihang Univ, P.R. China) and Lijun Xu (Beihang University, P.R. China)

Usually, the electrical resistance tomography is implemented by using measurements from all the available electrodes, i.e. all the boundary measurements. When the number of electrodes is very large, the reconstruction will be time consuming. The factorization method was generalized to the case of measurements on partial electrodes in this paper. The gray values in the vicinity of the partial measured electrodes were reconstructed and agree well with those calculated from all the electrodes. The computation complexity was also reduced as the matrix rank involved in the reconstruction was smaller. The simulated results validated the feasibility and effectiveness of the proposed method.

13:05 ***Subpixel Spatial Response of PMD Pixels***

Miguel Heredia Conde (Center for Sensorsystems (ZESS), University of Siegen, Germany), Klaus Hartmann (University of Siegen, Germany) and Otmar Loffeld (Center for Sensorsystems (ZESS), University of Siegen, Germany)

Time-of-Flight cameras based on the Photonic Mixer Device (PMD) emit modulated light and perform a correlation between the light signal reflected by the scene and a reference signal at the pixel level in order to estimate the difference of phase between the emitted and received signals. Well known issues of this technology are the low lateral resolution and the limited and scene-dependent depth accuracy. Superresolution algorithms have been proposed that combine several low resolution depth images to obtain an enhanced high resolution result, or make use of a higher resolution intensity image that can be registered with the depth image. To the best of our knowledge, methods in the related literature seem to ignore systematically the fact that the correlating pixels used for phase-based ToF imagers -e.g., PMD pixels- exhibit a complex structure that might lead to a non-trivial response function in spatial domain. This fact, which is irrelevant when working at pixel level due to the symmetry of pixel structure, becomes of capital importance when working at subpixel level. Ignoring it means assuming a wrong sensing model, which leads to false (or noisy) high resolution recovered images. The aim of this work is to characterize the response function of PMD pixels in spatial domain with micrometric resolution and gather novel and valuable information about the PMD sensing process within the pixel. The results of our experiments clearly confirm our hypothesis about a complex response function and give insights about the origins of noise. Additionally, we obtain a spatial characterization of the crosstalk.

PET/MRI Imaging Techniques

Room: El Greco Ballroom

Chair: Nicolas Karakatsanis (University of Geneva, Switzerland)

12:20 ***Generalized 3D and 4D Motion Compensated Whole-body PET Image Reconstruction Employing Nested EM Deconvolution***

Nicolas Karakatsanis (University of Geneva, Switzerland), Charalampos Tsoumpas (University of Leeds, United Kingdom) and Habib Zaidi (University of Geneva, Switzerland)

Whole-body dynamic and parametric PET imaging has recently gained increased interest as a clinically feasible truly quantitative imaging solution for enhanced tumor detectability and treatment response monitoring in oncology. However, in comparison to static scans, dynamic PET acquisitions are longer, especially when extended to large axial field-of-view whole-body imaging, increasing the probability of voluntary (bulk) body motion. In this study we propose a generalized and novel motion-compensated PET image reconstruction (MCIR) framework to recover resolution from realistic motion-contaminated static (3D), dynamic (4D) and parametric PET images even without the need for gated acquisitions. The proposed algorithm has been designed for both single-bed and whole-body static and dynamic PET scans. It has been implemented in fully 3D space on STIR open-source platform by utilizing the concept of optimization transfer to efficiently compensate for motion at each tomographic expectation-maximization (EM) update through a nested Richardson-Lucy EM iterative deconvolution algorithm. The performance of the method, referred as nested RL-MCIR reconstruction, was evaluated on realistic 4D simulated anthropomorphic digital XCAT phantom data acquired with a clinically feasible whole-body dynamic PET protocol and contaminated with measured non-rigid motion from MRI scans of real human volunteers at multiple dynamic frames. Furthermore, in order to assess the impact of our method in whole-body PET parametric imaging, the reconstructed motion-corrected dynamic PET images were fitted with a multi-bed Patlak graphical analysis method to produce metabolic uptake rate (Ki parameter in Patlak model) images of highly quantitative value. Our results suggest a considerable suppression of noise and partial resolution enhancement in both dynamic and parametric motion-degraded whole-body PET images after applying nested RL-MCIR method.

12:35 ***Assessment of Brain Ventricular Volumes From MRI Images***

Anna Fabijańska (Lodz University of Technology, Poland)

This paper considers the problem of assessment of brain ventricular volumes from 3D MRI brain scans. In particular, it aims at the measurement of each ventricle volume. Methods for segmentation of the brain ventricular system and separation of the ventricles are introduced. In particular the interactive segmentation approach based on the Random Walker segmentation algorithm is proposed. The introduced method firstly extracts the entire brain ventricular system. Next, it separates the ventricles from each other. Finally, method of assessment of ventricles volume is introduced. Results of applying the proposed approach applied to Brain Web MRI brain phantoms are presented and discussed.

12:50 ***A Digital Pulse Library for the Optimization of Signal Processing in PET***

Zheng Gu (University of California, Los Angeles, USA), David Prout (University of California, Los Angeles, USA), Yanisley Valenciaga (University of California, Los Angeles, USA) and Arion Chatziioannou (University of California, Los Angeles, USA)

In this work, we developed a comprehensive digital pulse library as a reference data set, against which the performance of pulse processing algorithms can be evaluated. The pulses are directly recorded from real measurements with scintillation detectors multiplexed by a resistor divider network. This way, the pulses better represent systematic variations of detection sensitivity for detector panels due to differences in light sharing, light collection and crystal scatter among other effects. The pulse shapes exactly represent the signals to be processed in the data acquisition and signal processing unit, but for which the ground truth regarding energy, position and timing can be known. A conventional pulse pileup rejection method called leading edge rejection (LER) was evaluated with the help of the pulse library. The simulated pulse library based results show that the LER method can effectively suppress most of the pileup caused mispositioned events, while it also trades off against sensitivity loss. Physical measurements agree with the pulse library simulation results. In conclusion, the proposed evaluation method based on digital pulse library can significantly reduce the time and effort invested in the development and optimization of various signal processing algorithms.

13:05 ***Initial Image Selection in Limited Angle Tomographic Imaging***

Metin Ertas (Istanbul University, Turkey), Mustafa E Kamasak (Istanbul Technical University, Turkey), Isa Yildirim (Istanbul Technical University & University of Illinois at Chicago, Turkey) and Aydin Akan (Istanbul University, Turkey)

In limited angle tomographic imaging, artifacts arise due to missing data during the acquisition. To deal with this problem, iterative image reconstruction algorithms have been developed. In iterative reconstruction algorithms, prior information which is often neglected is very crucial and plays an important role as it directly affects the convergence rate. This paper presents a comparison of three different initial images (zeroes image, average image, filtered back projected image) to observe their contribution to the convergence rate. Computer simulations are performed by using algebraic reconstruction technique (ART) with total variation (TV), (ART + TV). RMSE of a specific layer of interest (LOI) of a 3D phantom is used to compare the impact of appropriate prior image selection. For a better visual observation, structure similarity (SSIM) parameters are also compared.

13:20 - 14:30

Lunch

14:30 - 15:45

Medical Imaging Techniques

Room: Ballroom B
Chair: Metin Ertas (Istanbul University, Turkey)

14:30 ***Place Categorization Through Object Classification***

Konstantinos Charalampous (Democritus University of Thrace, Greece), Ioannis Kostavelis (Democtirtus University of Thrace, Greece), Frantzeska-Eirini Chantzakou (Democritus University of Thrace, Greece), Eleftherios-Stefanis Volanis (Democritus University of Thrace, Greece), Christos Emmanouilidis (ATHENA Research and Innovation Centre in Information, Greece), Philippos Tsalides (Democritus University of Thrace, Greece) and Antonios Gasteratos (Democritus University of Thrace, Greece)

This paper proposes a novel methodology for place categorization in mobile robots based on the presence of objects. In order to achieve such categorization, the robot is equipped with an RGB-D sensor. For a given time interval the sensor's measurements are combined with robot's localization data and reconstruct the 3D scene from the respective pointclouds. Afterwards, the method searches for dominant planes which are the most probable locations for finding objects. Given those planes, this work seeks and discriminates objects. The recognized objects, form a distribution which is given as input to a Naive Bayesian classifier in order to categorize the place.

14:45 ***An Iterative Reconstruction for Tomosynthesis Imaging Using Non-Local Means***

Metin Ertas (Istanbul University, Turkey), Isa Yildirim (Istanbul Technical University & University of Illinois at Chicago, Turkey), Mustafa E Kamasak (Istanbul Technical University, Turkey) and Aydin Akan (Istanbul University, Turkey)

This paper proposes a new 3D iterative reconstruction method for reducing out-of-focus slice blur in tomosynthesis imaging by combining two powerful denoising methods. The methods used in the reconstruction are based on Total Variation (TV) minimization and Non-Local Means (NLM) filtering. A new method (ART+TV)NLM is introduced by adapting both methods to Algebraic reconstruction technique (ART) which is one of the most commonly used iterative method in limited angle tomographic imaging.Simulations were performed on a designed 3D phantom. The method is shown to be more effective by keeping SNR higher and RMSE values lower compared to the ART and ART+TV reconstructions.

15:00 ***A Mathematical Model for Reducing the Likely Spectrum of Human Skin Tones in the RGB Color Space***

Rafael Divino Ferreira Feitosa (Federal University of Goiás & Federal Institute Goiano, Brazil), Leandro Luis de Oliveira (Federal University of Goias, Brazil), Dibio L Borges (University of Brasilia, Brazil) and Marcio Marino Navas Filho (Federal Institute Goiano, Brazil)

Skin detection techniques are widely applied to locate and track the human body for the purpose of further recognition. Some advantages of face detection based on skin color in relation to other techniques are faster processing and invariance. In this work there are presented experiments and a model that improves precision and processing time for human skin detection. The model found a more likely and reduced amplitude of spectrum of colors in the RGB system for detecting skin. Applied to 16,777,216 possible combinations of colors in the RGB system the 6 rules considered relevant by the proposed mathematical model allowed a 98.3657% reduction of the spectrum. Experimental results show the accuracy of the method for detecting human skin tones.

15:15 ***Investigating the Performance of a CADx Scheme for Mammography in Specific BIRADS Categories***

Ioannis Andreadis (National Technical University of Athens, Greece), George Spyrou (Academy of Athens, Greece) and Konstantina S Nikita (National Technical University of Athens, Greece)

A Computer Aided Diagnosis (CADx) pipeline has already been introduced to discriminate between benign and malignant clusters of microcalcifications (MCs). In this study, we evaluate the specific methodologies using cases from publicly available databases of mammograms, the MIAS database and the Digital Database of Screening Mammography (DDSM). Specifically, we investigate various subsets of regions of interest (ROIs) containing cluster of MCs, following the BIRADS assessment performed by radiologists who have participated in the preparation of the databases. The obtained results indicate that there are specific BIRADS categories where the proposed system provides high classification results. Furthermore, it seems that the best results are achieved in obscure cases, where the radiologists have doubts about their diagnosis and recommend extra medical examinations and short follow-up. The reported results indicate the potential of the proposed CADx system to assist the diagnostic task of radiologists by providing a reliable second opinion concerning the diagnosis of a cluster of MCs.

15:30 ***Digital Elevation Model Fusion Using Spectral Methods***

Evangelos Karakasis (Democritus University of Thrace, Greece), Loukas Bampis (Democritus University of Thrace, Greece), Angelos Amanatiadis (Democritus University of Thrace, Greece), Antonios Gasteratos (Democritus University of Thrace, Greece) and Philippos Tsalides (Democritus University of Thrace, Greece)

Acquiring and utilizing high quality Digital Elevation Model (DEM) data is very critical for various types of commercial and scientific applications such as environmental monitoring, topographic analysis and mapping, communication modeling and remote sensing. This paper presents the application of different spectral methods, like Fourier series and polynomial-

based expansions, to DEMs in order to fuse their content. Two different fusion techniques: 1) a filter-based one and 2) a weighted average of expansion coefficients, are examined. Their performance is evaluated by using both ground-truth lidar data as well as fusion quality measures. The results point out that polynomial-based spectral expansions perform better than the traditional Fourier approach.

14:30 - 15:30

Imaging Sensors and Techniques

Room: El Greco Ballroom
Chair: Matteo Pastorino (University of Genoa, Italy)

14:30 ***Simulation Based Collimator Design for X-Ray Diffraction Imaging Using the GATE Toolkit***

Simon Schlesinger (University of Wuppertal, Germany) and Hartwin Bomsdorf (University of Wuppertal, Germany)

Different approaches to the design of devices for Energy Dispersive X-ray Diffraction (EDXRD) Imaging are compared considering the characteristics of the actually employed x-ray collimation system. For the purpose of quantitative comparison, a time-efficient Monte-Carlo simulation procedure has been developed, by utilizing the GATE simulation toolkit. It serves to assess the influence of imperfections caused by energy dependent interactions of the incoming photons with the collimator material. In this contribution the concepts of the simulation program are described and a new EDXRD system based on a pencil beam topology is presented and compared to a 2D fan beam acquisition scheme.

14:45 ***Bubble Shape Estimation in Gas-liquid Slug Flow Using Wire-Mesh Sensor and Advanced Data Processing***

Eduardo N. Santos (Universidade Tecnológica Federal do Paraná, Brazil), Daniel Rodrigues Pipa (Universidade Tecnológica Federal do Paraná, Brazil), Rigoberto Morales (UTFPR, Brazil) and Marco Jose Da Silva (Universidade Tecnológica Federal do Paraná, Brazil)

Wire-mesh sensors produce three-dimensional data of void fraction distribution at high resolution thus being an appropriate tool to investigate two-phase gas-liquid flows. Slug flow is typically found in petroleum production lines. This type of flow is characterized by the intermittent occurrence of gas bubbles and liquid slugs along the pipe. In this paper we investigate two methods to estimate typical bubble shape of gas-liquid slug flow, which are based on ensemble mean and median approaches, for a set of identified bubbles in a given experiment. Results show that both approaches produce similar estimations, however since median is a type of robust estimator, contours of bubbles are better defined. Three-dimensional images of typical bubbles, for five different operational conditions, are generated and reveal some details about bubble shape.

15:00 ***Virtual Perspective Views for Real-Time People Detection Using an Omnidirectional Camera***

Lars Meinel (Chemnitz University of Technology, Germany), Christian Wiede (University of Technology Chemnitz, Germany), Michel Findeisen (Chemnitz University of Technology, Germany), André Apitzsch (Chemnitz University of Technology, Germany) and Gangolf Hirtz (Chemnitz University, Germany)

Considering the growing demand for public security systems the lack of availability of automated surveillance systems is a focal problem. Practical systems have to provide key features like: robust people localization, object detection and event decision, real-time processing and low overall system cost. In this paper we present a real-time indoor people tracking and surveillance system based on a single omnidirectional camera. The proposed approach utilizes linear-time algorithms in conjunction with a hardware-oriented implementation. The software was realized for an embedded microprocessor platform which acts as a smart sensor. The presented system aims at real-world scenarios and targets applications in surveillance, security, consumer electronics, home automation and ambient assisted living.

15:15 ***Dual-modality Impedance Wire-Mesh Sensor for Investigation of Multiphase Flows***

Eduardo N. Santos (Universidade Tecnológica Federal do Paraná, Brazil), Marco Jose Da Silva (Universidade Tecnológica Federal do Paraná, Brazil), Rigoberto Morales (UTFPR, Brazil), Sebastian Reinecke (Helmholtz-Zentrum Dresden-Rossendorf, Germany), Eckhard Schleicher (Forschungszentrum Dresden-Rossendorf, Germany) and Uwe Hampel (Forschungszentrum Dresden-Rossendorf, Germany)

For the investigation of multiphase flows, i.e. in oil production, there are only few suitable measuring techniques. For this reason, in this paper a new multichannel complex impedance measuring system using wire-mesh sensors is presented. The novel system measures amplitude and phase components of impedance (at single frequency) and is thus able to evaluate simultaneously the conductive and the capacitive parts of a fluid (complex permittivity). In the future this system can be employed for the investigation of dynamic processes in multiphase flow. The performance in measuring amplitude and phase of a signal is evaluated. First promising results for the three-phase flow are presented.

15:30 - 16:30

Image Enhancement and Features Extraction

Room: El Greco Ballroom
Chair: Thomas W Rogers (University College London, United Kingdom)

15:30 *Improving SNR in Susceptibility Weighted Imaging by a NLM-based Denoising Scheme*

Pasquale Borrelli (University of Napoli, Italy), Giuseppe Palma (National Research Council of Italy - Institute of Biostructures and Bioimaging, Italy), Enrico Tedeschi (University of Napoli, Italy), Sirio Cocozza (University of Napoli, Italy), Carmela Russo (University of Napoli, Italy), Marco Comerci (National Research Council of Italy - Institute of Biostructures and Bioimaging, Italy), Bruno Alfano (National Research Council of Italy - Institute of Biostructures and Bioimaging, Italy), Mark Haacke (The MRI Institute for Biomedical Research, USA) and Marco Salvatore (Università "Federico II", Italy)

Susceptibility-weighted imaging (SWI) is an imaging technique that allows enhancement of the contrast of magnitude MR images. SWI is based on susceptibility differences between tissues and background or surrounding tissues resulting in unique contrast. Although the combination of phase and magnitude information in SWI images provides a powerful method for diagnosis of different diseases, the high resolution required to obtain a proper contrast generation may lead to a reduced signal-to-noise ratio (SNR). In this context, the application of a denoising filter to produce images with higher SNR and still preserve small structures from an excessive blurring is extremely desirable. Moreover, as the distributions of magnitude and phase noise may introduce biases during image restoration, the application of denoising filter is non-trivial. In the context of image restoration filters, the Non-Local Means (NLM) denoising algorithm demonstrated high denoising performances by achieving both the improvement of image quality and the preservation of edges and tiny structures. At the best of our knowledge, noise removal algorithm in a SWI pipeline has never been investigated. Here we present a new NLM-based method (Imaginary Real-SWI, hereafter IR-SWI) to produce SWI images with high SNR and improved conspicuity of elusive brain structures. A visual comparison of IR-SWI results with the original (OR-SWI) and a standard NLM denoised version (NLM-SWI) of human brain images showed that IR-SWI fared consistently better than the other datasets. We therefore conclude that a proper handling of noise in the complex MR dataset may lead to visible improvement of the overall SWI quality.

15:45 *Cerebral Vasculature Extraction Using Classifier Fusion*

Ines Rahmany (Université de Tunis El Manar, Laboratoire de Biophysique et Technologies Médicales, Tunisia) and Nawres Khlifa (Université de Tunis El Manar, Tunisia)

The detection of cerebral aneurysms is of a paramount importance in the prevention of intracranial subarachnoid hemorrhage. The segmentation of intracranial vasculature presents a crucial step in the detection scheme. We propose in this paper, a new approach to extract cerebral vasculature in 2D-DSA images based on multiple classifier fusion. The classifiers used here are the FCM and the Fuzzy KNN. The main advantage of using multiple classifier fusion is that it emphasizes the strengths of individual classifiers and avoids its weaknesses, thus increasing classification efficiency and accuracy. The obtained results of the proposed method clearly reveals the contribution of fusing FCM-FKNN over the use of the individual classifier.

16:00 *Reduction of Wobble Artefacts in Images From Mobile Transmission X-ray Vehicle Scanners*

Thomas W Rogers (University College London, United Kingdom), James Ollier (Rapiscan Systems Ltd., United Kingdom), Edward J Morton (Rapiscan Systems Ltd., United Kingdom) and Lewis D Griffin (University College London, United Kingdom)

Detector boom wobble in transmission X-ray vehicle scanners is an unpredictable and currently uncontrollable problem, which lowers the quality of captured X-ray images. We propose (i) a method for image correction which is able to correct for 70% of boom wobble error given estimates of boom wobble, and (ii) a method of wobble estimation, based on the fusion of instantaneous wobble estimates with previous estimates, which is robust against non-Gaussian X-ray beam cross-sections and approaches ground truth accuracy. The combination of the two approaches provides a method for the reduction of wobble artefacts in images. The two methods have good potential for application in analogous scenarios in medical imaging, radiation physics, laser science and biophysics.

16:15 *Optimization of Radiation Doses in Panoramic X-Ray Examination Using Automated Image Processing*

Hamed Hamid Muhammed (School of Technology and Health STH, Royal Institute of Technology KTH, Sweden)

Radiological techniques based on X-rays are well established in medical diagnostics and there are known risks associated with the use of ionizing radiation like X-rays. That explains why the X-ray technology is constantly under development in the pursuit of new technologies that can contribute to reduce radiation dose to patients. Since the reduction of a radiation dose generally results in a poorer image quality, we have investigated whether the use of digital image processing can provide panoramic radiographs with enhanced image quality. An automated image processing algorithm was proposed and employed for this purpose. Panoramic X-ray examination is an important and common tool in dental radiology, used especially for children and teenagers. The technique is used to create an overview of a patient's jaw. The goal of this study is to obtain panoramic X-ray images with minimal radiation dose and sufficient diagnostic quality. A reference image acquired using the recommended parameters, were compared against 20 processed images acquired using reduced

radiation dose. 20 dentists evaluated these images with respect to how well different physiological structures were shown in comparison to the reference image. The study showed that the radiation dose can be reduced by 45% without lowering the quality of the diagnostic information. Furthermore, an image with a 34% reduction in radiation dose contains more diagnostic information than the reference image.

16:00 - 17:30

Poster Session

Room: Atrium

Chair: Angelos Amanatiadis (Democritus University of Thrace, Greece)

16:00 ***A Novel Adaptive Shape Support Window Based Cost Aggregation Method for Local Stereo Matching***

Yafan Xu (Beihang University, P.R. China), Yan Zhao (Beihang University, P.R. China), Kui Yang (Beihang University, P.R. China) and Mengqi Ji (The Hong Kong University of Science and Technology, Hong Kong)

Cost aggregation is the most important step in a local stereo matching algorithm. In this paper, a novel cost aggregation method based on Adaptive Shape Support Window (ASSW) is proposed. There are two main parts: At first we construct a local support skeleton anchored each pixel with four varying arm lengths decided on color similarity, as a result, the support window integral of multiple horizontal segments spanned by pixels in the vertical neighboring is established; then we utilize extended implementation of guided filtering to aggregate cost volume within the ASSW, which has better edge-preserving smoothing property than bilateral filter independent of the filtering kernel size. In this way, the proposed method can effectively reduce the number of bad pixels locating in the incorrect depth regions through finding optimal support window with an arbitrary shape and size adaptively. When the proposed cost aggregation method is implemented together with the remaining steps, the overall local stereo matching algorithm achieves more outstanding matching performance compared with other existing algorithms based on cost aggregation strategy on the Middlebury stereo benchmark, especially in depth discontinuities and piecewise smooth regions.

16:11 ***Two-Staged Image Colorization Based on Salient Contours***

Nektarios Anagnostopoulos (Democritus University of Thrace, Greece), Chryssanthi Iakovidou (Democritus University of Thrace, Greece), Angelos Amanatiadis (Democritus University of Thrace, Greece), Yiannis Boutalis (Democritus University of Thrace, Greece) and Savvas A Chatzichristofis (Democritus University of Thrace, Greece)

In this paper we present a novel colorization technique that manages to significantly reduce color bleeding artifacts caused by weak object boundaries and also requires only abstract color indications and placement from the user. It is essentially a two-staged color propagation algorithm. Guided by the extracted salient contours of the image, we roughly mark and divide the image in two differently treated image area categories: Homogeneous color areas of high confidence and critical attention-needing areas of edges and region boundaries. The method was tested with user drawn scribble images, but can be easily adopted by image exemplars employing techniques, as well.

16:22 ***Efficient Colour Sorting of Chios Mastiha***

George Pavlidis (ATHENA Research Center, Greece), Spyridon G. Mouroutsos (Democritus University of Thrace, Greece) and Vasileios Sevetlidis (ATHENA Research Center, Greece)

Mastiha is the natural aromatic resin extracted from the mastic tree, which grows on the island of Chios, Greece. It is grown traditionally in 24 mastiha villages producing about 150 tonnes annually. Producers collect and sort their mastiha production by hand. This work aims at providing a feasible and implementable solution of an optical sorting algorithm to Chios mastiha producers. The method is based on visual detection and sorting of mastiha samples in the visible spectrum within a controlled setup following a low-cost approach and was found to achieve sorting results of very high accuracy with even more categorisation possibilities.

16:33 ***FVTD-based Analysis of Brain Stroke Response in Microwave Imaging Systems***

Matteo Cerruti (University of Genoa, Italy), Matteo Pastorino (University of Genoa, Italy) and Andrea Randazzo (University of Genoa, Italy)

In this paper, a numerical analysis of the electromagnetic response of brain strokes when illuminated by the incident radiation used in microwave imaging systems is performed. In particular, a two dimensional simulator based on the Finite-Volume Time-Domain (FVTD) method has been used in order to efficiently solve the forward scattering problem in the presence of complex structures. Moreover, an anatomically realistic head phantom, obtained from Magnetic-Resonance images, has been used to simulate the biomedical configuration. The electromagnetic field propagation inside the head tissues has been investigated and the effects of the presence of the stroke on the scattered field (collected at the measurement points) have been evaluated.

16:44 ***Social Mapping on RGB-D Scenes***

Konstantinos Charalampous (Democritus University of Thrace, Greece), Christos Emmanouilidis (ATHENA Research and Innovation Centre in Information, Greece) and Antonios Gasteratos (Democritus University of Thrace, Greece)

The more the robotics technology tends to get established in human everyday life, the greater the necessity for robots to obtain social skills, facilitating their presence and behavior among humans. In order for robots to attain socially aware characteristics, their navigation strategy should comply with a set of certain criteria, such as the respect of spatial interactions. Towards this end, the paper in hand presents a framework that operates on a single RGB-D scene. Initially it seeks the human presence and defines respective bounding boxes. Then, within the 3D reconstructed scene the people in the bounding boxes are replaced by points following a Gaussian distribution. The latter results to a grading occupancy grid, which complies with the spatial human comfort zones.

16:56 ***Quick and Reliable Estimates of Velocity Profiles in Pipelines by a Simple Electromagnetic Inverse Scattering Technique***

Matteo Pastorino (University of Genoa, Italy), Mirco Raffetto (University of Genoa, Italy), Andrea Randazzo (University of Genoa, Italy) and Alessandro Fedeli (University of Genoa, Italy)

An electromagnetic approach for reconstructing the permittivity and the velocity profiles of axially moving cylindrical targets is proposed. The developed method is based on a two-step procedure, which have been found to provide good approximations of the profiles to be reconstructed in a very efficient way when the peak velocity is small with respect to the speed of light in vacuum. These features are obtained by neglecting the movement in the first step, which is devoted to the reconstruction of the geometric and dielectric properties of the cylindrical targets. Starting from these values, the velocities are then identified in the second step. The paper reports the mathematical formulation of the approach, as well as some numerical simulations concerning elliptic multilayer cylinders with axially moving layers.

17:07 ***An Artificial Neuronal Network Approach to Diagnosis of Attention Deficit Hyperactivity Disorder***

Sónia Pereira (University of Minho, Portugal), Sabino Gomes (University of Minho, Portugal), Henrique Vicente (University of Évora, Portugal), Jorge Ribeiro (Viana do Castelo Polytechnic Institute, Portugal), Antonio Abelha (University of Minho, Portugal), Paulo Novais (University of Minho, Portugal), Jose Machado (University of Minho, Portugal) and José Neves (University of Minho, Portugal)

On the one hand about 3% to 12% of school-aged children present Attention Deficit Hyperactivity Disorder (ADHD), a situation that is characterized by attention deficit, impulsiveness and restlessness, coming from a change in the neurotransmitters of the central nervous system, caused by psychological messes, environment effects or genetic characteristics. One the other hand, when one´s aim is the prediction of ADHD in children and teenagers, we need to be able to handle incomplete or default data, like the one in ActiGraph´s images that may exhibit potential disordered sleep patterns. Indeed, using a new approach to knowledge representation and reasoning based on Logic Programming, complemented with a computational framework based on Artificial Neural Networks, ActiGraph's pioneering actigraphy monitoring systems may deliver, on the fly, real world information about sleep/wake behavior, circadian rhythms, daytime physical activity, and environmental light intensity for the study and clinical assessment of sleep disorders and the relationship between sleep and chronic disease.

17:18 ***Fundus Image Based Cataract Classification***

Jin Zheng (Tsinghua University, P.R. China), Liye Guo (Tsinghua University, P.R. China), Ji-Jiang Yang (Tsinghua University, P.R. China), Lihui Peng (Tsinghua University, P.R. China), Jianqiang Li (NEC, P.R. China) and Qingfeng Liang (Beijing Tongren Hospital, P.R. China)

Cataract is one of the leading causes of visual impairment worldwide. People with cataracts often suffer a lot in many aspects of daily life. Although early treatment can reduce the sufferings of cataract patients and prevent visual impairment turning to blindness, people in less developed areas still can't get timely treatment because of poor eye care services or lack of professional ophthalmologists. Besides, the present commonly used methods for cataract diagnosis, clinical assessment and photographic grading, need to be operated at a slit lamp by ophthalmologists, which are complicated and expensive for many patients. So reducing the cost and simplifying the process of early cataract diagnosis is of great importance. In this paper, we proposed a fundus image based cataract classification method by using pattern recognition, which can be used in early screening of cataract. By calculating the 2-dimensional discrete Fourier transform of a fundus image and using the calculated spectrum as features, a cataract classification and grading method is carried out by using the linear discriminant analysis promoted with the AdaBoost algorithm as the classifier. A preliminary test is implemented on an image sample set including 460 fundus images that normal, mild, moderate and severe cataract images are 158, 137, 86 and 79 respectively. Correspondingly, the two-class and four-class classification accuracy for our proposed method are 95.22% and 81.52%. We believe that our proposed method has a great potential in practical applications.

16:30 - 16:45

Coffee Break

16:45 - 17:45

Electrical Impedance Tomography, Instrumentation, and Techniques

Room: El Greco Ballroom

Chair: Chang Liu (Beihang University, P.R. China)

16:45 ***Solving Inverse Problems Using Topological Change of Shape in Electrical Impedance Tomography***

Tomasz Rymarczyk (Net-art, Poland)

In this paper there was applied the application using the level set method for the topology optimization. The level set function is based on shape and topology optimization approach to the electrical impedance tomography problems with piecewise constant conductivities. The finite element method has been used to solve the forward problem. The proposed solution algorithm is initialized by using topological sensitivity analysis. Shape derivatives and topological derivatives have been incorporated with the level set method to investigate shape optimization problems. The coupled algorithm is a relatively new procedure to overcome this problem. Level set methods have been applied very successfully in many areas of the scientific modelling. These approaches based on shape sensitivity include the boundary design of elastic. There are two features that make these methods suitable for the topology optimization. The structure is represented by an implicit function such that its zero level set defines the boundary of the object.

17:00 ***Soot Volume Fraction Profiling of Asymmetric Diffusion Flames Through Tomographic Imaging***

Md. Moinul Hossain (University of Kent & IEEE, IET Member, United Kingdom), Gang Lu (University of Kent, United Kingdom) and Yong Yan (University of Kent, United Kingdom)

This paper presents the 3-D (three-dimensional)reconstruction of soot volume fraction of diffusion flames based on tomographic imaging and image processing techniques. Eight flexible imaging fiber bundles and two RGB (Red, Green and Blue) CCD (Charge-coupled Device) cameras are used to obtain concurrently the 2-D (two-dimensional) image projections of the flame from eight different angles of view around the burner. Algorithms which combine the tomographic and two-color pyrometric techniques are utilized to reconstruct the soot volume fraction distributions on both cross- and longitudinal-sections of the flame. A series of experiments were carried out on a gas-fired combustion rig for the determination of soot volume fraction using the algorithms proposed. Test results demonstrate the effectiveness of the developed algorithms.

17:15 ***One-dimensional Tomography of Axisymmetric Temperature Distribution with Limited TDLAS Data by Using Three-point Abel Deconvolution***

Chang Liu (Beihang University, P.R. China), Lijun Xu (Beihang University, P.R. China), Zhang Cao (Beihang University, P.R. China) and Fangyan Li (Beihang University, P.R. China)

In this paper, a three-point Abel deconvolution algorithm was employed to reconstruct one-dimensional axisymmetric temperature distribution of the flame with limited tunable diode laser absorption spectroscopy (TDLAS) data. To suppress the background noise and improve the sensitivity of measurement, the wavelength modulation spectroscopy (WMS) technique is adopted in TDLAS measurement at 7185.597 cm-1 and 7444.36 cm-1. Split by a 2□8 fiber-coupler, the collimated laser beams in eight parallel channels penetrate the axisymmetric flame generated by a porous burner. Detected by eight photodiode detectors, limited measurement data of eight projections is obtained and used to retrieve the one-dimensional axisymmetric temperature distribution by using three-point Abel deconvolution. Simulation results validated the feasibility of this approach.

17:30 ***The Multi-Frequency Responses and Sensitivity Calculation of Broadband Magnetic Induction Tomography System Using the Boundary Element Method***

Qian Zhao (Qufu Normal University, P.R. China) and Wuliang Yin (The University of Manchester, United Kingdom)

Magnetic induction tomography (MIT) is an imaging technique based on the measurement of the magnetic field perturbation due to eddy currents induced in conducting objects exposed to an external magnetic excitation field. The time- or frequency-domain profile of the signal on the receiving coil reveals characteristics of the target such as shape, permeability, and conductivity. For frequencies in the MIT range, the transmitted field penetrates the target slightly. Though slight, the effect of this penetration also typically has a nonnegligible effect on the scattered field. In this scenario, we use the Thin Skin Depth Approximation (TSA) just inside the target surface. Boundary Element Method (BEM) is an appreciative approach since meshes are only required on the surface of the object. In this paper, we analyse the responses of different frequencies on the receiving coil and compute four typical sensitivity maps between the coil pairs in MIT system due to a TSA model. Also, the real part and the imaginary part of the sensitivity of different frequencies are computed respectively. From the comparison we can know that the sensitivity maps derived by BEM are in good agreement with the theoretical solution. Overall, BEM is an effective way to calculate the multi-frequency responses and sensitivity distributions of broadband frequency MIT system.

17:30 - 18:00

Awards Ceremony

18:00 - 18:30

Closing Session

Room: Ballroom B