

**Workshop on  
Bio-Medical Instrumentation and related Engineering  
and Physical Sciences**

*organized by the  
Department of Medical Instruments Technology, TEI of Athens*

**Technological Educational Institute of Athens,  
Friday 6 July 2012  
<http://biomep.teiath.gr/>**

**PROCEEDINGS**

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**Oral Sessions (9:30 – 17:30)**

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**9:30 – 10:50 Oral Session 1**

*Session Chairmen: A. Tzavaras, PhD and C. Michail, PhD*

**1.1 Scintillation Screen Preparation for Use in Digital Medical Imaging Systems**

**I. Valais<sup>1</sup>, C. Michail<sup>1</sup>, I. Seferis<sup>2</sup>, G. Fountos<sup>1</sup>, N. Kalyvas<sup>1</sup>, I. Kandarakis<sup>1</sup> and G.S. Panayiotakis<sup>2</sup>**

<sup>1</sup> Department of Medical Instruments Technology, Technological Educational Institute of Athens,

<sup>2</sup> University of Patras, Dept. of Medical Physics, Medical School

**Keywords:** Scintillation Screens, Powder Phosphors, Digital Medical Imaging

***Abstract***

*Radiation detectors, employed in X-ray medical imaging, consist of a scintillating (fluorescent) screen emitting visible light coupled to optical sensors. Screens are fabricated by specially developed scintillators (phosphors). Up to now scintillation screens were prepared by sedimentation on fused silica substrate (spectrosil B) in a form of transparent disk 30mm in diameter and 3mm in thickness. A new sedimentation method is proposed by deposition of scintillation powders on rectangular Borosilicate glass substrate 22x22 mm<sup>2</sup> with thicknesses of 0.13-0.17 mm (Waldemar Knittel-GmbH). The optical properties of the substrate were examined in terms of light absorption and transmission in the range between 200-800nm (visible range) and found adequate for use with the common scintillation powders (transmissivity 95%). New screens of various coating thicknesses were examined under medical X-ray irradiation, placed in direct contact with a CMOS (RadEye) optical detector. The overall light efficiency was found higher than the corresponding thicker substrate screen coating thickness. Due to the rectangular shape of the screens, images taken from the prepared screens are indicative for their potential use in the X-ray digital medical systems.*

**Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme

**1.2 CMOS Detector Calibration using Light Sources**

P. Kortidis, I. Stathopoulos, I. Kandarakis and I. Valais

Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** Digitization, Contrast Detail

**Abstract**

*CMOS photosensors are currently available in X-ray imaging. One of their prerequisites is the measurement of its response under optical photon excitation for purposes of design optimization and system calibration. The purpose of this work is the design of an experimental setup for the calibration of a CMOS sensor with respect to optical photon flux and energy. This requires the total elimination of ambient light so as to diminish background signal. In order to achieve this, a custom made black box was designed and constructed. In one side of the black box an optically shielded opening was added to help in the positioning of the instrumentation used. All inner surfaces were coated with black non-reflective paper, to eliminate internal light scattering and reflectivity. The optical signal source, used for the calibration, was positioned outside the apparatus and the light was driven in the black box via an optical fiber. Inside the apparatus support bases for the fiber optic and the photosensor were adapted so as to achieve experimental conditions reproducibility. At the beginning a light source was put inside the apparatus. Since no light was observed out of it, its optical shielding was established. A CMOS sensor was then exposed to optical photons of different energies and fluxes. It was found that the CMOS relative response was comparable to its theoretical value obtained by its service manual.*

**Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme.

**1.3 Effect of Film Digitization of Mammographic Image Quality**

N. Kalyvas, A. Dimou, K. Tsinoukas, G. Fountos, C. Michail, I. Valais and I. Kandarakis

Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** film digitization, Contrast Detail

**Abstract**

*The modern hospital environment uses PACS (Picture Archiving and Communication System) instrumentation for storing and process digital images. Breast cancer is of the highest causes for women death. Routinely mammography examinations are performed for the early detection of breast cancer and reference purposes. The purpose of this study was to evaluate the image quality of digitized films which might be incorporated in digital hospital environment.*

*The CDMAM Artinis type 3.4 phantom, was placed in contact with 40mm PMMA slabs and irradiated with Mo/Mo and Mo/Rh typical X-ray mammographic spectra. The derived films were digitized with an AGFA Duo Scan medical scanner with 8bit pixel depth and 1000ppi resolution. The optical density of the film was in the linear part of the scanner transfer curve. For the analysis of the digitized images the Image J software (<http://imagej.nih.gov/ij>) was used. The contrast detail curve to both the analog and the digitized films was calculated according to the CDMAM instructions. It was found that the 25kV mammogram was presented better contrast detail than the other exposure conditions. If the 28kV is consider the image quality of the film depends upon the position of the phantom with respect to the film. In most cases the digitized film presents worse contrast detail.*

#### 1.4 Image Quality Assessment in CMOS and CR Medical Imaging Systems

C. Ntales<sup>1</sup>, N. Kynatidis<sup>1</sup>, C. Michail<sup>1</sup>, I. Seferis<sup>2</sup>, I. Valais<sup>1</sup>, N. Kalyvas<sup>1</sup>, G. Fountos<sup>1</sup> and I. Kandarakis<sup>1</sup>

<sup>1</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens,

<sup>2</sup>Department of Medical Physics, University of Patras, Medical School

**Keywords:** CMOS, CR, Image Quality, MTF.

##### **Abstract**

*Fundamental imaging performance in terms of Modulation Transfer Function (MTF) was investigated for a high resolution CMOS based imaging sensor and a commercial Computed Radiography (CR) unit. The CMOS device consists of a  $33.91 \text{ mg/cm}^2 \text{ Gd}_2\text{O}_2\text{S:Tb}$  scintillating screen, placed in direct contact with a CMOS photodiode array. The CMOS photodiode array, featuring  $1200 \times 1600$  pixels with a pixel pitch of  $22.5 \mu\text{m}$ , was used as an optical photon detector. The MTF was measured using the slanted-edge method (measuring the Edge Spread Function-ESF), as well as by using pin-hole phantoms (measuring the Point Spread Function-PSF). The experimental procedure was performed under the representative radiation quality (RQA) settings, RQA-5 (70 kVp digital-radiography) and RQA-M2 (28 kVp digital-mammography) recommended by the International Electrotechnical Commission Reports 62220-1 and 62220-1-2 respectively. It was found that the detector response function was linear for the exposure ranges under investigation. MTF for the pin-hole method was found to increase by diminishing pin-hole size up to the detector pitch ( $22.5 \mu\text{m}$ ). Additionally, our results showed that for the same RQA quality, MTF was comparable in the whole spatial frequency range by both ESF and PSF ( $50 \mu\text{m}$ ) methods. MTF of the CMOS imaging sensor was found better compared to the CR unit as well as compared to previously published data for other CCD and CMOS sensor.*

##### **Acknowledgment**

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#### 1.5 A Theoretical Approach for Optimum Dual Energy Selection in the Quality Assessment of Bone in Osteoporosis Diagnosis

P. Sotiropoulou<sup>1</sup>, V. Koukou<sup>1</sup>, N. Martini<sup>1</sup>, G. Fountos<sup>2</sup>, C. Michail<sup>2</sup>, I. Valais<sup>2</sup>, I. Kandarakis<sup>2</sup> and G.C. Nikiforidis

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<sup>2</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** Dual energy, Osteoporosis, CV, Ca/P, HAp/Collagen

##### **Abstract**

*Dual energy methods have been used to help in the diagnosis of osteoporosis using two different energies generated by X-ray tube. By measuring parameters that characterize bone quality, such as Ca/P or HAp/Collagen ratio, more efficient diagnosis in potential bone fracture is expected. In this study, a theoretical framework using analytical model was developed and the numerical computations are described. The coefficient of variation (CV) of the method was calculated for every energy combination between 15 to 120 keV using the photon attenuation equations and the error theory. The optimum combination in a specific area for low energy (LE) and high energy (HE) was 24 and 76 keV (CV=0.315%) for Ca/P ratio and 25 and 75 keV (CV=0.494%) for HAp/Collagen ratio. For the implication of the LE and HE, using polyenergetic X-ray spectra, seven different lanthanide filters (Ce, Nd, Sm, Eu, Gd, Er, Yb) and various combinations of these were applied. Spectra were obtained from Boone et al (1997 Med. Phys. 24 1863–73) for Tungsten (W) anode. For each energy filtered spectrum, during the selection process of kVp and filtering, limitations concerning the Full Width at Half Maximum (FWHM), the total counts and the mean energy were applied. The best combination was at 120 kVp with added beam filtration of  $400 \mu\text{m}$  Nd (CV=0.146%) for Ca/P ratio assessment, while for the HAp/Collagen ratio was at 120 kVp with  $400 \mu\text{m}/400 \mu\text{m}$  of Ce/Nd filters (CV=1.103%).*

**Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme.

**1.6 Experimental Evaluation of a CMOS Based Detector Coupled to a Custom Made Gd<sub>2</sub>O<sub>2</sub>S:Eu Screen for Medical Imaging**

I. Seferis<sup>1</sup>, C. Michail<sup>2</sup>, I. Valais<sup>2</sup>, G. Fountos<sup>2</sup>, N. Kalyvas<sup>2</sup>, I. Kandarakis<sup>2</sup> and G.S. Panayiotakis<sup>1</sup>

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**Keywords:** CMOS, Gd<sub>2</sub>O<sub>2</sub>S:Eu, Medical Imaging, X-Ray Imaging, Digital Radiography, MTF, DQE

**Abstract**

*Modulation Transfer Function (MTF), Noise Power Spectrum (NPS) and Detective Quantum Efficiency (DQE) were investigated for a CMOS based imaging sensor. The device consists of a 65.1mg/cm<sup>2</sup> Gd<sub>2</sub>O<sub>2</sub>S:Eu scintillator screen, produced by sedimentation and placed in direct contact with a CMOS photodiode array. The RadEye, CMOS photodiode array, featuring 1200×1600 pixels with a pixel pitch of 22.5 μm, was used as an optical photon detector. The MTF was measured using the slanted-edge method while the Normalized NPS (NNPS) was determined by two-dimensional (2D) Fourier transformation of uniformly exposed images. Measurements were performed using the standard IEC-RQA5 radiation beam quality (70 kVp). The DQE was assessed from the measured MTF, NPS and the direct entrance surface air-Kerma (ESAK) obtained from X-ray spectra measurement with a portable cadmium telluride (CdTe) detector. It was found that the detector response function was linear for the exposure ranges under investigation. Our results showed that the measured MTF, were not significantly affected by ESAK. MTF was found higher and DQE was found comparable to previously published data for a 45 μm CMOS sensor, while the NNPS appeared to be higher in the frequency range under investigation (0–10 cycles/mm).*

**Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme.



**14:30 - 15:50 Oral Session 2***Session Chairmen: S. Kostopoulos, PhD and D. Glotsos, PhD***2.1 A Pattern Recognition System for Brain Tumour Grade Prediction Based on Histopathological Material and Features Extracted at Different Optical Magnifications**C. Konstandinou<sup>1</sup>, E. Maneas<sup>1</sup>, D. Glotsos<sup>2</sup>, S. Kostopoulos<sup>2</sup>, P. Ravazoula<sup>3</sup> and D. Cavouras<sup>1</sup>Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, Greece,<sup>2</sup>Medical Image and Signal Processing Laboratory, Department of Medical Instruments Technology, Technological Educational Institute of Athens, 12210, Egaleo, Athens, Greece,<sup>3</sup>Department of Pathology, University Hospital of Patras, 26504, Rio, Patras, Greece**Keywords:** Astrocytomas, brain cancer, biopsy, grade, supervised, diagnosis, pattern recognition**Abstract**

*The purpose of this study is to develop a computer-assisted diagnosis system for improving diagnostic accuracy in brain cancer classification into grades of malignancy. The clinical material comprised biopsies of patients with confirmed brain cancer. Images were digitized from the original material using a digital light microscopy imaging system (LEICA Axiostar plus coupled with a LEICA DFC 420C camera, Leica Microsystems GmbH). The digitized images were processed for the separation of nuclei from the surrounding tissue using edge detection techniques. Then, features were extracted from segmented nuclei at different optical magnifications to describe each sample-patient malignancy status. Moreover, samples were examined by an expert pathologist (P.R.), who assessed qualitative a number of crucial histological characteristics that are used by the World Health Organization as criteria for tumours' grading. These features comprised the input to a pattern recognition system, which was designed in order to predict the risks of malignancy of each tumour. The system was structured using the Probabilistic Neural Network (PNN) and Support Vector Machine (SVM) classifier alternatively. Using the leave-one-out method, the PNN resulted in 94.4% accuracy, while the SVM showed 96.3%. To assess the generalization of the system to unknown data, the external cross validation was used and gave 77.8% prediction for both classifiers. Results show that computer-assisted diagnosis offers a valuable tool providing second opinion consultancy to expert physicians, which contributes towards a better and more accurate diagnostic conclusion.*

**2.2 Assessment of the Pressure Developed between Scoliosis Brace and Patient's Body and Evaluation of the Effective Time of Treatment**P. Tsialios<sup>1</sup>, I. Loukos<sup>2</sup>, G. Koulouras<sup>3</sup> and I. Valais<sup>3</sup><sup>1</sup>University of Patras, Dept. of Medical Physics, Medical School,<sup>2</sup>National & Kapodistrian University of Athens, Medical School,<sup>3</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens**Keywords:** Scoliosis, DDB, brace's effective time**Abstract**

*The aim of the present work is to confirm the effective time of use of the brace, for an accurate assessment of treatment from the therapist. Experiments were performed on a Dynamic Derotation Brace (DDB). Two*

devices have been designed, a data holder and a reader which give to the therapist the opportunity to certify the achievement of the brace's effective time. The accuracy of the recorded time is immunized by a system of switches, which are not placed at appropriate points without giving direct access to the patient. The DDB together with the embedded data holder applied in 50 patients. After six months from the first application, the therapist using the data reader is able to read and verify the exact time of use of the brace. Forty four patients had fully followed the treatment for the time period set by the therapist. Three followed the treatment to a satisfactory degree and the rest applied the treatment for a shorter period of time than prescribed by the therapist. The two devices offer great potential in the way of making more effective the treatment of scoliosis and may be to achieve control of pressure in the desired points of the body.

### 2.3 EEG Sleep Spindle Components Localization using Independent Component Analysis and sLORETA

E. Ventouras<sup>1</sup>, M. Thanaj<sup>1</sup>, S. Marini<sup>1</sup>, H. Tsekou<sup>2</sup>, T. Paparrigopoulos<sup>2</sup> and P.Y. Ktonas<sup>2</sup>

<sup>1</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens,

<sup>2</sup> Sleep Study Unit, 1<sup>st</sup> Psychiatry Clinic, Eginition Hospital, University of Athens

**Keywords:** sLORETA, EEG, Spindle Components

#### **Abstract**

The purpose of the present study was to use the Standardized Low Resolution Brain Electromagnetic Tomography (sLORETA) source localization technique, which tends to compute spatially focused solutions, for investigating the cortical sources underlying Spindle Components (SCs), corresponding to slow and fast spindle types. Sleep spindles are characteristic sleep electroencephalogram (EEG) rhythmic oscillations. They are used in sleep staging. Their involvement in learning, information processing and consolidation of memory is actively investigated. The elucidation of their cortical sources will help understand both physiologic and pathologic processes in sleep. Results indicate separability and spatial stability of sources related to SCs, reconstructed from distinct IC groups. Source distributions using sLORETA tended to be more focused, in comparison to LORETA, furthermore strengthening indications about the correspondence of sources of slow and fast spindles to anterior and posterior cortical regions, respectively.

### 2.4 An Android-based Pattern Recognition Application for the Characterization of Epidermal Melanoma

E. Mikos<sup>1</sup>, I. Sioulas<sup>1</sup>, K. Sidiropoulos<sup>2</sup> and D. Cavouras<sup>1</sup>

<sup>1</sup> Department of Medical Instruments Technology, Technological Educational Institute of Athens,

<sup>2</sup> Brunel University West London, UK)

**Keywords:** Melanoma, Pattern Recognition, Android Application

#### **Abstract**

Malignant melanoma is currently one of the leading cancers among white-skinned populations around the world, mainly due to the changes in life styles and the significant increase in ultraviolet radiation. Although the mortality rate due to melanomas was about 70%, forty years ago, nowadays, a survival rate of 70% is claimed, which is attributed to early diagnosis. Hence, early stage detection of melanoma is of major significance for increasing chances of long term survival of affected patients. The most effective method for early detection is skin self-examination, a procedure often underestimated by individuals, resulting in poor prognosis. Therefore, the aim of the present study is to address the need for early and accurate characterization of skin lesions through the design and implementation of an Android application that enables users identify areas on their skin that may need attention from an expert physician. The proposed application uses the phone's camera feature to take a picture of a skin lesion/mole, communicates with a remote specialized pattern recognition system, via a set of XML Web Services, and within seconds receives a risk analysis of their uploaded image being a melanoma. The proposed system was trained using an image database from New Zealand Dermatological Society, and was reviewed by an expert dermatologist.

## 2.5 Single and Two-View CADe performance in Diagnostic Full Field Digital Mammography

M. Kallergi, M. Kondili and N. Kiriazi

Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** CAD, FFDM, Mammography, microcalcification

### **Abstract**

*PURPOSE:* This work aimed at determining the performance of a commercial computer-aided detection (CADe) system in diagnostic full field digital mammography (FFDM) and in evaluating how performance may impact mammographers' training and clinical acceptance. *MATERIALS & METHODS:* A commercial CADe system (iCAD's SecondLook Digital - version 7.2) was applied to 84 diagnostic mammograms acquired with a GE Essential FFDM system. The set included 36 mammograms with benign lesions (14 microcalcification clusters and 22 masses) and 48 mammograms with cancer (22 microcalcification clusters and 26 masses). All lesions were visible on both breast views. The sensitivity of the CADe system was determined in two different ways: (a) by considering each mammographic view as independent image (single-view analysis) and (b) by considering both craniocaudal and mediolateral oblique views of the same breast (two-view analysis). In the former case, which is the current standard analysis, a true positive (TP) detection was one where the CADe outlined the true lesion in at least one view. In the latter case, a TP detection was one where the CADe outlined the true lesion on both views. *RESULTS:* The single-view analysis showed that the commercial CADe system had an overall sensitivity of 89% (85% for cancers and 92% for benign lesions). The system had the best detection performance for the benign masses (95%) and the worse detection performance for the cancers with microcalcification clusters (82%). The two-view analysis yielded significantly different results. In this case, the CADe system had an overall sensitivity of 49% (46% for cancers and 53% for benign lesions). The system had the best detection performance for the benign calcification cases (64%) and the worse detection performance for the benign masses (41%). The specific system performed better on left breast mammograms than right and seemed to be tuned for the detection of small calcifications corresponding to ductal carcinoma in situ and masses corresponding to invasive ductal carcinomas. *CONCLUSIONS:* Based on current standards, the commercial CADe system performed as well on diagnostic FFDM as on screening FFDM and screening screen/film mammography (SFM). TP rates were high for both calcifications and masses based on single-view analysis. However, the CADe performance dropped dramatically when the two breast FFDM views were analyzed. The reason is that, as in SFM, the current commercial CADe algorithms for FFDM consider each view independently and do not employ two-view or case features. The clinical outcome of this may range from poor clinical acceptance to a slow learning curve for the mammographers to erroneous interpretations. The need for specific and extensive training of the mammographers with multiple CADe examples is necessary for optimum integration of the CADe systems in the clinical practice.

## 2.6 Insight into the Biological Effects of Non-Ionizing Radiation Through the Properties of the Electromagnetic Waves

A. Skouroliakou<sup>1</sup>, A.F. Fragopoulou<sup>2</sup>, I.K. Giannarakis<sup>2</sup>, A. Manta<sup>2</sup>, M.P. Ntzouni<sup>2</sup>, A. Papopoulou<sup>3</sup> and L.H. Margaritis<sup>2</sup>

<sup>1</sup>Department of Physics and Chemistry, TEI of Athens,

<sup>2</sup>Department of Cell Biology and Biophysics, Faculty of Biology, Athens University, Greece,

<sup>3</sup>Department of Medical Instruments Technology, TEI of Athens)

**Keywords:** Non-Ionizing Radiation, Wi-Fi, CW Emission

### **Abstract**

*General information:* The widespread wireless technology initiated several decades ago has gradually occupied nearly all daily activities of the modern society. The major sources of this non-ionizing radiation (NIR) include cell phones (6 billion users worldwide), mobile phone base stations (thousands in a crowded city), FM and TV broadcast stations, wireless phones, Wi-Fi routers and units in i-phones, i-pads, notebooks, laptops. *Objective:* We consider that in order to study the biological/human effects of NIR, it is

*necessary to know exactly the radiation source properties (frequency -single or multiple frequencies-, repetitive or discontinuous emission and precise knowledge of the peak and average values). Given the controversy of the existing so far published data, we intend to explore the issue of different biological effectiveness from simple exposure (CW emission) to the more complex pulsed radiation using two major model systems; mice and insects. So far results: We have shown, in mice, memory impairment, stress induction and changes in brain protein expression and in insects, fecundity decrease and apoptotic cell death increase following microwave (MW) radiation. In addition, by using the NARDA SRM 3000 spectrum analyzer we have performed a mapping of frequencies and E field intensities near base stations and other radiation sources. As a first attempt we have exposed flies, according to our established protocol, to FM wide band 100 KHz modulation of 100 MHz frequency for 30 min daily during the first 4 days of their adult phase. Electrical field density of 0.8 V/m was used in a specially constructed Faraday cage to protect flies from incoming FM/TV/GSM/UMTS radiation existing in the area of the experimental setup. We found similar to the so far data: a) decrease on reproduction and b) increase in apoptotic cells death although at a lower degree compared to mobile phone signals. The work shall continue with more frequencies and modulation schemes in insects and afterwards in mice where other parameters shall be examined including memory performance, proteome response and oxidative stress status.*

**Acknowledgement**

This study is supported by the European Social Fund – European Union and National Resources – “THALES - UoA MIS 375784” grant coordinated by LHM.





**16:20 - 17:30 Oral Session 3***Session Chairmen: S. David, PhD and S. Tsantis, PhD***3.1 2D Gel Electrophoresis Classification between Chronic Lymphoid and Chronic Myeloid Leukemia using Pattern Recognition Methods**A. Theodosi<sup>1</sup>, S. Kostopoulos<sup>2</sup> and D. Cavouras<sup>2</sup><sup>1</sup>University of Athens, Greece,<sup>2</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens**Keywords:** 2D Gel Electrophoresis, Pattern Recognition, Biomarkers, Myeloid Leucemia, Lymphoid Leukemia, PNN**Abstract**

*A significant advantage of two-dimensional polyacrylamide gel electrophoresis of proteins images (2D-gel electrophoresis), is the plethora of proteins presented on a single gel, whereas at the same time this fact may be a tremendous difficulty in order to detect proteins-spots of extremely high significance-possible biomarkers. Thus, processing such images is still an object of particular interest. This paper presents the design and development of an image processing and analysis system for the detection of 2D gels spots that can effectively distinguish between Chronic Myeloid Leukemia (CML) and Chronic Lymphoid Leukemia (CLL) patients. A free international online data base\* of 2D-gel images was used. These images were produced by scanned 2D electrophoretic gels and the particular spots of interest were given by the database. According those spots, Regions Of Interest (ROIs) were manually selected, and texture and morphological features were extracted by those ROIs. The workflow of the system as well as feature reduction with statistical methods and classification results using pattern recognition techniques are presented in this paper and are part of a Master Thesis*

*\*The LECB 2-D PAGE gel images database, was developed by the U.S. National Cancer Institute's Laboratory of Experimental and Computational Biology, now organized as the CCR Nanobiology Program..*

**3.2 Brachytherapy Simulations of Ir192 MicroSelectron Source using GATE Monte Carlo Toolkit**P. Papadimitroulas<sup>1,2</sup>, E. Pappas<sup>3</sup>, S. Spirou<sup>1</sup>, G.C. Kagadis<sup>2</sup>, G. Tsakiris<sup>3</sup> and G. Loudos<sup>1</sup><sup>1</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens,<sup>2</sup>Medical School, University of Patras,<sup>3</sup>Department of Radiology, Technological Educational Institute of Athens**Keywords:** GATE, Radiotherapy simulations, MC simulations**Abstract**

*GATE is a Monte Carlo simulation toolkit that is well-validated and widely used for numerical simulations in medical imaging (mainly PET and SPECT). The latest release of GATE (v6.1) has extended its capabilities for radiotherapy (RT) simulations. In this study a first validation of GATE v6.1 was performed for dose calculations close to a High Dose Rate 192Ir brachytherapy source (Nucletron microSelectron). The source active core and stainless steel encapsulation geometry were accurately described into the code. The "dose actor" tool was used for recording the absorbed dose in a 3-D Cartesian 0.25 mm resolution dose matrix. 5×10<sup>8</sup> primary particles were individually tracked. The transport of primary photons, scattered photons, secondary electrons and beta particles emitted from the source were simulated. The simulation performed in dry-air in order to calculate the air-kerma strength was implemented taking into account the impact of x-ray fluorescence so that maximum calculation accuracy can be achieved. The results derived in this work are presented according to the AAPM-TG-43 dose calculation formalism and were compared against corresponding well-validated MC calculations. A good agreement between*

corresponding datasets was observed. Therefore, GATE seems to be a promising and valid MC simulation platform for brachytherapy dose calculations.

### 3.3 Supporting on-line the Certification of a Surgical Department in a Hospital

E. Nassioka, A. Tsouni, K. Lefteriotis, A. Tzavaras and B. Spyropoulos

Biomedical Technology Laboratory, Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** Web-based support system, ISO-9000, Surgery-QMS

#### **Abstract**

*Objective:* The aim of this paper is to present the design and implementation status of a Web-based system, supporting the ISO-9000 Certification and Accreditation of the Surgical Department(s) of a Hospital, facilitating the acquaintance of the personnel with the associated documentation of processes, equipment, directives etc. needed for setting-up a Quality Management System (QMS). *Method:* This "Certification and Accreditation Consultant", promotes the optimization of the documentation of the routine processes, in the main Surgery Department and other associated Surgical Units. It provides for a "scaffold of expertise", comprising of managerial knowledge, subject-related standards, legislation, and relevant medical directives and guidelines, issued by the pertinent scientific Societies. *Results:* The system comprises all major procedures, in each surgical functional entity: Administration, responsibility, jurisdiction and communication. Human resources management and continuous Education. Quality Assurance of Clinical, Laboratory and Administrative activities. Equipment, surgical instruments, drugs, disposable etc. procurement & management. Documentation and management of the QMS and reporting of patient adverse-effects. Improvement of quality indicators, internal evaluations and periodical inspections. Support for the preparation, maintenance, and updating of the Quality Manual. *Conclusions:* The developed system offers a certification-tool, supporting the installation, maintenance and updating of a Surgery-QMS.

### 3.4 Development Status of a Quasi-Visualizing Lung-Monitoring Method based on Acoustic Response Alteration Measurements

P. Afentoulidis, A. Tzavaras and B. Spyropoulos

Biomedical Technology Laboratory, Department of Medical Instruments Technology, Technological Educational Institute of Athens

**Keywords:** Respiration, Lung Ventilation, Acoustic Response, Lung-MTF.

#### **Abstract**

*Background:* Airflow in the lungs during the respiration-cycle causes audible mechanical vibrations that propagate through the lung-tissue. Pathological alteration of the lungs, influence their vibration frequencies, and they affect the overall thoracic Acoustic Response (AR). *Objective:* The purpose of this paper is to report the development-status of a low-cost system, quasi-visualizing pathological alteration of the lungs, based on investigating their AR modification, during spontaneous respiration or mechanically assisted Ventilation. *Methods:* The AR measuring system includes, first, a 5x3-array of crystal-transducer microphones, mounted on copper-electrodes, able to record both, AP/PA pulmonary sounds and ECG, second, a sound frequency generator (1Hz-5kHz), and finally a 16-channel amplifier with A/D converter. *Results:* For the AR investigation, pre-conditioned lung-sound waveforms are normalized, their corresponding power-spectra mean-values are calculated (MatLab) and through an interpolation algorithm, a graphical visualization of the approximated Lung-Modulation Transfer Functions (MTF) is accomplished. We have simulated supported ventilation of the upper airways, by employing a custom-made water phantom. The acquisition process was repeated, for different resistance (R) and compliance (C) settings, on an adjustable lung simulator and sound-signals reconstructed images of the phantom-area (Y-piece) have been produced. *Conclusions:* The developed method could become a low-cost alternative continuous-imaging approach, for Lung-monitoring of ICU-patients.

### 3.5 Correlation of Technical and Clinical Characteristics of Whole Body and Dedicated, High-Resolution, Head-Neck FDG PET/CT Imaging of Thyroid Cancer

M. Kallergi<sup>1</sup>, A. Tzimas<sup>1</sup>, E. Roussos<sup>1</sup>, A. Georgakopoulos<sup>2</sup>, N. Pianou<sup>2</sup>, M. Metaxas<sup>2</sup> and S. Chatziioannou<sup>3</sup>

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**Keywords:** WB-PET, HN F-18 FDG PET/CT, Thyroid Carcinoma.

#### **Abstract**

**PURPOSE:** The purpose of this study was twofold: (a) Determine the characteristics of standard whole body (WB) and high-resolution, dedicated head-neck (HN) F-18 FDG PET/CT images acquired for the detection and diagnosis of patients with recurrent differential thyroid cancer. (b) Correlate the scans' image features to the clinical characteristics that were studied with an observer ROC study. **MATERIAL & METHODS:** Forty-three patients (18 males and 25 females) suspected for recurrent thyroid cancer were examined with a standard F18-FDG PET/CT WB scan and an additional, high-resolution HN test. The mean age of the patients was 50 years with a standard deviation of 15.8. 86% or 37 out of 43 patients were originally diagnosed with papillary or follicular thyroid carcinoma and only 14% (6 out of 43 patients) had originally medullary thyroid carcinoma. All had undergone surgery and I-131 treatment and were followed up for recurrence. Based on clinical and surgical follow-up, 23 of the patients (12 male and 11 female) were negative for recurrence while 20 (6 male and 14 female) were positive. Among the 23 negative for cancer patients, 6 had inflammatory disease so they presented positive PET/CT scans. The clinical characteristics of the two scans were evaluated with an ROC study where the WB scan was compared to the combination of WB+HN scan. The technical characteristics of the two scans were determined by analyzing corresponding transverse PET slices and measuring features such as lesion diameter, area, volume, and gray values, tumor margins and contrast, and standard uptake values (SUV). Bivariate correlation and linear regression analysis was used to correlate features between scans and explore the relationship between ROC responses and image feature values. **RESULTS:** The ROC study showed that the combination of WB and HN FDG PET/CT imaging yields significantly better detection and diagnostic performances for thyroid cancer. The analysis of the images supported the clinical findings. Specifically, the values of all parameters were significantly different between the WB and HN scans with correlation coefficients around 0.3 in almost all data pairs. The regression coefficients of determination ranged from 0.60-0.85 suggesting that the predictive value of the HN image features could be significant and, hence, valuable in the development of automated diagnostic algorithms. **CONCLUSIONS:** The addition of a high resolution HN scan to the standard WB FDG PET/CT imaging improves readers' detection and diagnosis of thyroid cancer. It also yields new image features of significant diagnostic and prognostic value that could be used in the development of computer aided diagnostic tools for this modality.



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## Round Table (11:20 – 12:50)

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11:20 –12:50 **Round Table:** “Departments of BioMedical Technology in Greece, Present and Future”

*Round Table Chairpersons: George Fountos and Ioannis Valais, TEI of Athens*

### **i. The Clinical Engineer in the National Health System**

*G. Saatsakis, MSc. Biomedical Engineer, Head of Biomedical Engineering Department of Aretaieio University Hospital*

*Main topics covered: What is a clinical engineer, mission and role of the clinical engineer, clinical engineer in healthcare, partnerships in healthcare, forces affecting the future of clinical engineer and key steps for future preparation*

### **ii. Replacing of Biomedical Technology: When and why?**

*A. Gaitanis, PhD Biomedical Engineer, Head of Biomedical Engineering Department of BRFAA*

*An efficient way to evaluate the life cycle of medical technology and the decision of its replacement is to analyze various parameters of the equipment’s usage. The replacement of medical equipment is the last phase of its life cycle. The aim of this lecture is to determine whether and when the equipments must be replaced, based on specific criteria. These criteria can be divided into three categories; safety standards, maintenance problems, technology obsolescence and financial issues. Also, based on the above criteria, a replacement planning should be discussed taking into considerations the new financial standards of Greek hospitals. Finally, the replacement’s policy of the Biomedical Research Foundation of the Academy of Athens (BRFAA) was presented.*

### **iii. Application of Quality Management System at Biomedical Engineering Departments in Public Sector: Advantages, Difficulties, Prospects**

*E. Moyssidoy, Biomedical Engineer, General Secretary of Hellenic Association of State Biomedical Engineers*

*Main topics covered: Main aspects of implementing a Quality Management System at Clinical Engineering Departments, concise analysis of the resulting advantages throughout the public health sector, commentary of the objective difficulties and estimation of the expected advancement in Clinical Engineering Department’s contribution to the improvement of health services quality and safety*

### **iv. Pre-Purchase Evaluation of Medical Devices in the Private Sector of the Health System - Taking into Account Patient Safety**

*T. Psichis, Director of Biomedical Engineering Department, Euroclinic of Athens & Euroclinic Pediatrics*

*Main topics covered: Arranging clinical trials of medical devices before purchase. acquisition of new medical devices (replacement of old devices or hospital expansion), investigating safety related to incidents, spare device (due to law requirements), follow up after purchase of new medical devices, planning and supervising of preventive maintenance by outside vendors and biomedical engineering department and new technology improving patient’s safety*



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**Poster Session (9:30 – 17:30)**

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**The Contribution of Ultra Sound Gestational Control after 32th Week in Prevention of Perinatal Mortality**

M. Adamopoulou, E. Kounadi, P. Sakellariou, M. Rekkas and M. Sampatakakis.  
Ministry of Health in Greece, SEYYP, Pireos 205, 118 53 Athens Greece

**Keywords:** Electrocardiography, Gestational Control, Perinatal Mortality.

**Abstract**

*The aim of this announcement is to show the significant submitting in ultrasound control after the biophysical embryonic profile of 32th gestational week, in order to restrict perinatal mortality.*

*During preliminary examination to discover the cause of a newborn death which was born at 40th gestational week and weight 2.606 gr. Its mother was smoker (10-12 cigarettes/day) for more 12 years until the moment she knew that she was pregnant. The ultrasound control at 12th, 26th and 32th gestational week and the electrocardiography examination during the pregnancy and during birth was normal. The parturient who had submitted epidural analgesia, gave birth after 8 hours. The delivery was not laborious and the woman's clinical condition during birth was always stable. After newborn's birth it was apneic, pallid and without reflexes. In toxicological analysis was not found toxic substances or drugs in newborn's blood. Histological examination showed cerebral edema with meninges', level's, spleen's, reins' and adrenal's congestion. At pulmonary level was found alveoli's partial expansion. The placenta was not sent to examination. The conclusion of forensic report was that the newborn was born alive and died by perinatal asphyxia. Comparing the expecting newborn's weight and its weight of birth, we examed the development's curves and were found statistical significant deference between the newborn's weight and the expecting birth weight. The baby was suffering growth retardation due of placenta's pathology. In case of ultrasound control after 32th gestational week, the intrauterine hypoxia probably would have discovered and baby would be survived if it was born 2 or 3 weeks ago by caesarean.*

**Development of a Small Field of View Gamma-Ray Imager using a LuAG:Pr Scintillator**

S. David<sup>1</sup>, M. Georgiou<sup>2</sup>, E. Fysikopoulos<sup>3</sup>, I. Seferis<sup>4</sup>, G. Panayiotakis<sup>4</sup>, P. Liaparinos<sup>1</sup>, I. Valais<sup>1</sup>, I. Sianoudis<sup>5</sup>, A. Aravantinos<sup>5</sup>, G. Fountos<sup>1</sup>, C. Michail<sup>1</sup>, N. Kalyvas<sup>1</sup>, G. Koulouras<sup>6</sup>, C. Antypas<sup>7</sup>, A. Gektin<sup>8</sup>, I. Kandarakis<sup>1</sup> and K. Kourkoutas<sup>5</sup>

<sup>1</sup>Department of Medical Instruments Technology, Technological Educational Institute of Athens, Greece, <sup>2</sup>Department of Nuclear Medicine, Medical School, University of Thessaly, Greece, <sup>3</sup>School of Electrical and Computer Engineering, National Technical University of Athens, Greece, <sup>4</sup>Department of Medical Physics, Medical School, University of Patras, Greece, <sup>5</sup>Department of Physics Chemistry & Materials Technology, Technological Educational Institute of Athens, Greece, <sup>6</sup>Department of Electronics, Technological Educational Institute of Athens, Greece, <sup>7</sup>Department of Radiotherapy, Aretaieion Hospital, University of Athens, Greece, <sup>8</sup>State Scientific Institution "Institute for Single Crystals" of National Academy of Science of Ukraine, Ukraine

**Keywords:** Crystal Scintillators, LuAG:Pr, PET detector.

**Abstract**

*The aim of this study the construction and evaluation of a small field of view PET detector, based on a R8900U-00-C12 position sensitive photomultiplier tube coupled to a 2x2mm<sup>2</sup> LuAG:Pr scintillator crystals with 5mm thick crystal size elements. Additionally, a resistor network readout circuit was used, reducing the photomultiplier anode signals to 4 position signals (Xa, Xb, Yc and Yd). An FPGA (Spartan 6 LX16) was used for triggering and signal processing of the signal pulses acquired using a free running sampling technique. Raw images and energy histograms of the 2x2mm<sup>2</sup> LuAG:Pr scintillator crystals were obtained under Na-22 excitation, emitting mainly at 511keV, with high voltage equal to -800V. Sensitivity*

and energy resolution were measured and compared with a similar BGO discrete scintillator array with 2x2x5mm<sup>3</sup> scintillator elements.

#### **Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme..

#### **Rare Side Effects of Spinal Cord Neurostimulator**

E. Kounadi<sup>1</sup>, M. Adamopoulou<sup>1</sup>, E. Ventouras<sup>2</sup>, P. Sakelariou<sup>1</sup>, M. Rekas<sup>1</sup> and M. Sabatakakis<sup>1</sup>

<sup>1</sup>Ministry of Health in Greece, SEYYP, Athens, Greece,

<sup>2</sup>Department of Medical Instruments Technology, Technological Education Institute of Athens, Greece

**Keywords:** Side Effects, neurostimulators, implants.

#### **Abstract**

*The purpose of this study is to indicate side effects after surgical implantation of neurostimulator in spinal cord in a patient with possible neuropsychiatric disorder. Neurostimulator was surgically implanted in spinal cord eight years ago in a patient with chronic pain in the lumbar spine and after multiple failed spinal cord fusion surgeries. This type of analgesia, through surgical implantation of neurostimulator, was proposed by neurosurgeons to the patient from his first visit. After some of years, the patient complained that he was feeling electrical discharges within the myocardial and musculoskeletal tissue when the neurostimulator was active and even when it was inactive. The patient claimed that the neurostimulator was interacting with the spinal cord fusion materials creating electromagnetic fields, which were affecting his health by causing ischemic heart attacks, mobility problems and autoimmune disease (myasthenia gravis). The patient argued that in order to continue with his everyday activities he had to use magnets and metallic materials that, supposedly, canceled the nefarious effects of the neurostimulator.*

*To our best of knowledge concerning bibliographic references, as well as statements of neurologists and neurosurgeons, similar effects following neurostimulator implantation were not demonstrated in the past. Additionally, the patient underwent placebo-controlled examination by two neurologists. The examination was positive in showing that the patient's complaints were based on obsessive behavior.*

*This case indicates that the collaboration of specialists from various medical disciplines and the application of specific clinical and laboratory assessments of the patient must take place before surgical implantation of biotechnology devices, including neurostimulators. The application of proper protocols before surgical implantation might help in excluding from surgery patients whose psychiatric morbidity profile, such as the possible existence of Obsessive-Compulsive Disorder (OCD) might interfere with the prolonged use of the device..*

#### **Reendothelialization Assessment by Analysing Endovascular Optical Coherence Tomography (OCT) Sequences**

K. Mandelias<sup>2</sup>, S. Tsantis<sup>1</sup>, G. C. Kagadis<sup>2</sup>, K. Katsanos<sup>3</sup>, D. Karnabatidis<sup>3</sup> and G.C. Nikiforidis<sup>2</sup>.

<sup>1</sup>Laboratory of Ionizing and Non Ionizing Radiation Imaging Systems, Department of Medical Instruments Technology, TEI of Athens,

<sup>2</sup> Department of Medical Physics, School of Medicine, University of Patras, Greece,

<sup>3</sup> Department of Radiology, School of Medicine, University of Patras, Greece

**Keywords:** Fuzzy C-Means Clustering, Optical Coherence Imaging, Strut Detection.

#### **Abstract**

*Purpose: The aim of this study is to assess reendothelialization by analyzing endovascular optical coherence tomography (OCT) sequences. We developed and proposed a segmentation technique for automatic lumen area extraction and a stent strut detection algorithm in intravascular OCT images for the purpose of quantitative analysis of neointimal hyperplasia (NIH). Materials and methods: A clinical dataset of frequency-domain OCT scans of the human arteries was analyzed. First, a combined scheme was*

designed, comprising of a Fuzzy C Means (FCM) clustering and a Continuous Wavelet Transform (CWT) algorithm, towards lumen border identification and extraction of the inner luminal contour. Second by using CWT and extrema algorithm in the grayscale image various features (such as wavelet coefficient, fwhm and the profile of maxima points resulting of the CWT) were employed as input to the FCM membership function providing high membership values for strut wavelet responses cluster and low memberships values for the rest of the wavelet responses. Results: The inner lumen contour and the position of stent strut were extracted with very high accuracy. Regarding vessel lumen detection, the proposed methodology demonstrated high accuracy with overlap values of  $0.917 \pm 0.065$  for lumen contour (compared to the gold standard – medical expert). The strut detection procedure successfully identified  $6.7 \pm 0.5$  struts

### Wavelet Based Analysis of the Cardiotocograms in Labour

G. Sykas<sup>1</sup>, S. Tsantis<sup>1</sup> and G.C. Nikiforidis<sup>2</sup>.

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<sup>2</sup> Department of Medical Physics, School of Medicine, University of Patras, Greece

**Keywords:** CTG, Wavelet, Labor, Baseline.

#### Abstract

*Purpose:* To develop and validate a computerised algorithm for the interpretation of the characteristics of the fetal heart rate (FHR) in labour. *Materials and methods:* A computerised algorithm based on wavelet transform was developed to assess baseline, variability, the presence of accelerations and types of decelerations. Twenty four segments of intrapartum cardiotocographs (CTG) were interpreted using the algorithm and evaluated by seven expert observers. The results compared to assess inter observer variation and agreement between the computer and experts. *Results:* Inter observer agreement for FHR baseline and the presence and type of decelerations was good (Interclass correlation coefficient (ICC), 0.93, 0.93 and 0.79 respectively). *Conclusions:* The validation of a computerised algorithm is limited by inter observer variation. The prediction of baseline and decelerations is as good as clinical observers but is more reproducible.

### Wavelet Based Marcov-Random-Fields towards Speckle Suppression in Ultrasound Images

S. Tsantis<sup>1</sup> and A. Skouroliahou<sup>2</sup>

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<sup>2</sup>Department of Physics-Chemistry and Material Technology, Technological Educational Institute of Athens

**Keywords:** Marcov Random Fields, Speckle, Ultrasound, Denoising.

#### Abstract

*Purpose:* In this study, a denoising technique is presented that utilized Wavelet Transform and Marcov-Random Fields (MRF) in order to suppress speckle in ultrasound images. *Materials and methods:* 40 ultrasound examinations were performed on a Logiq 9, General Electric ultrasound system. Each of these images has been subjected to the proposed algorithm so as to employ the edge detection properties of wavelet transform along with MRF modeling, that combines conditional (local intensity distribution) with contextual (intensity similarity within small neighborhoods) information under the Bayesian framework in order to estimate the true intensities of the image rather than those based only on the conditional information. *Results:* The quantification of the speckle suppression performance was carried out by means of the speckle index (SI) and the signal-to-mean-square-error ratio (S/mse). The evaluation of the edge preservation capacity was made by means of the parameter- $\beta$ . The proposed algorithm exhibited high performance in all indexes. *Conclusions:* An efficient speckle suppression algorithm can improve the overall image quality, which in turns could improve the decision-making procedure in Ultrasound Imaging

**Acknowledgement**

This research has been co-funded by the European Union (European Social Fund) and Greek national resources under the framework of the "Archimedes III: Funding of Research Groups in TEI of Athens" project of the "Education & Lifelong Learning" Operational Programme.

**Radiation Dose Reduction in Cardiac CT – A Comparison of Two Protocols**

Th. Syrigou, G. Marpinis, Th. Bagiatis, St. Papageorgiou, N. Kollaros, S. Katsilouli, and I. Mastorakou

Department of Radiology, Onassis Cardiac Surgery Center

**Keywords:** Radiation Dose Risk, Angiography, CTDIvol.

**Abstract**

**PURPOSE:** The aim of this study was to estimate the radiation dose related risk during cardiac multislice Computed Tomography, as well as to standardize our protocols, in the context of optimisation. **METHOD:** 143 male and 96 female patients undergoing coronary angiography were categorised according to their body size. Three different protocols were used for normal, overweight and obese patients. CTDIvol and DLP values were recorded and the effective dose as well as the scan length calculated for each category. **RESULTS:** For normal male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 49.51, 864, 17.5, 14.7±3.12. For overweight male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were : 68, 1207, 17.8, 20.5±4.58. For obese male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were : 74.89, 1392, 18.6, 23.7±7.37. For normal female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 49.1, 792, 16.1, 13.5±3.18. For overweight female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 70.8, 1159, 16.3, 19.7±5.95. For obese female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 69.2, 1142, 16.5, 19.4. **CONCLUSION:** This study reveals that the dose received from coronary CT scanning is significant, particularly for obese patients. Therefore referral for this procedure must be well justified. In the present study, dosimetric values are higher than those reported in literature. This increase is mainly attributed to the larger scan length. However, a further investigation of our protocol's rest scan parameters is needed, in order to optimise the patient dose.

**Radiation Dose in Calcium Score Measurement. Sequential Versus Spiral Mode using 64-Slice Dual Source MDCT**

Th. Syrigou, Ch. Plemmenos, Th. Skaltsas, N. Kollaros, St. Kampanarou, O. Karapanagiotou and I. Mastorakou

Department of Radiology, Onassis Cardiac Surgery Center

**Keywords:** Radiation Dose, Calcium score, Cardiac CT.

**Abstract**

**PURPOSE :** The aim of this study was to compare two different techniques for calcium score measurements using MDCT. **METHOD:** A total of 33 patients underwent two calcium score measurements using a dual source multislice scanner. The first was performed in sequential and the second one in spiral mode. The value of DLP was recorded, and the effective dose was calculated for each patient. Calcium score values were automatically calculated by manufacturer's software. **RESULTS:** The effective dose was 1.1 +/- 0.3 mSv in sequential vs 3.9 +/- 1.4 in spiral mode ( $p < 0.01$ ). The calcium score was 280.65 +/- 93.7 in sequential and 211.7 +/- 77.1 in spiral mode. **CONCLUSION:** Calcium score measurement in sequential mode gives significantly lower dose to the patient when compared to spiral mode. Reliability is not compromised.



## Radiation Dose Considerations in Dual Source Cardiac 64-Slice Computed Tomography. A First Experience

Th. Syrigou, A. Diamantis, V, Argoudeli, E. Kirikos, N. Kollaros, St. Kampanarou and I. Mastorakou

Department of Radiology, Onassis Cardiac Surgery Center

**Keywords:** Radiation Dose, Dual Source Cardiac 64-slice CT.

### Abstract

**PURPOSE:** The aim of this study was to estimate the radiation dose related risk during cardiac multislice Computed Tomography, as well as to standardize our protocols, in the context of optimisation. **METHOD:** 143 male and 96 female patients undergoing coronary angiography were categorised according to their body size. Three different protocols were used for normal, overweight and obese patients. CTDIvol and DLP values were recorded and the effective dose as well as the scan length calculated for each category. **RESULTS:** For normal male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 49.51, 864, 17.5, 14.7±3.12. For overweight male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were : 68, 1207, 17.8, 20.5±4.58. For obese male patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were : 74.89, 1392, 18.6, 23.7±7.37. For normal female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 49.1, 792, 16.1, 13.5±3.18. For overweight female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 70.8, 1159, 16.3, 19.7±5.95. For obese female patients the mean values of CTDIvol (mGy), DLP (mGyxcM), Length (cm), Effective Dose (mSv) respectively were: 69.2, 1142, 16.5, 19.4. **CONCLUSION:** This study reveals that the dose received from coronary CT scanning is significant, particularly for obese patients. Therefore referral for this procedure must be well justified. In the present study, dosimetric values are higher than those reported in literature. This increase is mainly attributed to the larger scan length. However, a further investigation of our protocol's rest scan parameters is needed, in order to optimise the patient dose.

## Mapping Expected Advances in Anaesthesia Vaporizer and Gas-Monitoring Technology as Reflected on Industrial Property Documents

E. Maridaki, L. Papageorgiou and B. Spyropoulos

Biomedical Technology Laboratory, Medical Instrumentation Technology Department, Technological Education Institute (TEI) of Athens, Athens, Greece

**Keywords:** Anaesthesia Vaporizer, Gas Monitoring, IP-documents.

### Abstract

**Objective:** The purpose of this paper is to attempt to predict the physical advantages and the consequent industrial applicability expectations, of emerging Anaesthesia Vaporizer and Gas-monitoring Technology, as they appear in the number and the quality of relevant Patent Applications filed. **Method:** All major relevant International Patent Classification (IPC) classes have been searched, by employing the on-line esp@cenet search-engine of the European Patent Office and numerous Industrial Property (IP) documents have been retrieved and evaluated, focused mainly on Anaesthesia Vaporizers and Gas-monitoring. **Results:** The "innovation path" has pinpointed a set of promising IP-documents (Table 1), disclosing useful technologies and they corroborate, both, the technical significance and the market-predictive potential of Patent-Literature.

Table 1: Promising IP-documents identified.

US2011297149 (A1)	US2011253137(A1)	EP0904793 (A2)	US6415792 (B1)	WO2010045408 (A2)
US2011094508 (A1)	WO2011102674 (A2)	US6236041 (B1)	US5603332 (A)	US2010078018 (A1)
US2007107736 (A1)	WO2011090243 (A1)	US6138674 (A)	US2011253137 (A1)	EP2236103 (A1)
DE102005012340 (B3)	US2011094511 (A1)	WO9810818 (A1)	WO2011102674 (A2)	EP1974764 (A1)

US2004163648 (A1)	WO2010045408 (A2)	US5975078 (A)	WO2011090243 (A1)	DE102007051166 (A1)
US2004243017 (A1)	US2010078018 (A1)	WO9738746 (A1)	US2011094511 (A1)	FR2917626 (A1)

*Conclusions: Regardless of the accuracy of our prediction, appraising and assessing medical-technical aspects, as reflected on Patents, constitutes an important decision-support for Health-Care Technology Management.*

### **Noise Monitoring and Alarm System for Infant Incubators**

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<sup>2</sup>Biomedical Engineering Department, Aretaieio University Hospital

**Keywords:** automated control, noise monitoring, neonatal intensive care unit, neurological disorders, incubator noise, newborns.

#### **Abstract**

*PURPOSE: Several studies have demonstrated the correlation between high noise levels in the neonatal intensive care units (NICU) and neurological disorders in the newborns. The purpose of this work was two-fold: (a) perform a qualitative and quantitative analysis of the stressful acoustic stimuli in the NICU and (b) design, develop, and test a system to monitor the noise levels in the interior of the incubators generating a visual alarm to the NICU personnel when a threshold is exceeded. MATERIALS & METHODS: Noise sources and levels inside and outside four incubators of an NICU unit were evaluated and measured every 8 hours in a period of 72 hours under three conditions: (a) incubator OFF, (b) incubator ON, and (c) incubator and oxygen controller ON at a flow of 5 l/min. Based on the NICU requirements and noise statistics, a prototype system was developed to monitor noise levels automatically and trigger a visual alarm when acceptable thresholds are exceeded. The system included a 9 V power supply, amplifier, divider, and comparator circuits with a red LED. RESULTS: It was observed that noise levels were above clinical thresholds in all cases due to environmental factors, primarily NICU personnel activities, and the oxygen generators. The developed noise monitoring and alarm system operated as designed, reliably and accurately under various NICU conditions. CONCLUSIONS: The visual alarm, triggered when noise exceeded specified thresholds, could initiate immediate interventions from the NICU personnel in order to lower noise and improve neonatal care. The developed system may be used in other biomedical noise monitoring applications as well as for educational purposes.*

### **Advanced Image Post Processing and Visualization Tools in Computed Tomography**

D. Koumarios, E. Lavdas, D. Kehagias and G. Oikonomou

Department of Medical Radiological Technology, Faculty of Health and Caring Professions, TEI of Athens

**Keywords:** image post processing, multi detector CT, three-dimensional image processing.

#### **Abstract**

*Introduction: Image post processing and advanced visualization tools form nowadays an integral part of the diagnostic process in almost all modern applications of CT imaging. A good understanding of their basis including their pros and cons is necessary in order to make the best use of them. Aim: The aim of this poster is to these tools from the medical radiological technologist's and the radiologist's point of view using pictorial means in order to enhance understanding of their contribution in diagnosis. Methods and Results: Examples have been drawn from 64-MDCT relevant examinations and displayed so as to point out clearly the advantages and disadvantages of these techniques as well as the most appropriate indications for their use. Conclusions: Advanced image post processing and visualization tools are indispensable in modern CT imaging but they should be used by operators well aware of their function and drawbacks.*

