IEEE international School of Imaging – Chania, Greece, October 2016

Lecturers Abstract & Bio

Technical coordinator: Selina Kolokytha, Ph.D.

Lecture 1: Towards Standardization of X-ray Beam Filters for use in Digital

Mammography and Digital Breast Tomosynthesis

Tuesday, October 4, 09:00 - 10:00

Ballroom A

Suman Shrestha (University of Massachusetts, USA)

Abstract

The x-ray beam filter is an essential component of a mammographic imaging system for the spectral shaping of the beam, which affects image contrast and radiation dose. Commonly used filters are molybdenum, rhodium, and silver for mammography and tomosynthesis. Aluminum filtration is predominantly used only for digital breast tomosynthesis (DBT). In general, during digital mammography (DM), the filter with the higher characteristic K-edge is used for the more attenuating breast and this approach is effective in maintaining image contrast at an acceptable dose. It is believed that the standardization of filters is possible by using aluminum filters of different thickness in mammography and tomosynthesis. The thickness of the aluminum filter used would depend on the thickness of the breast to be imaged. The investigation on the use of aluminum filtration of a single thickness or variable thickness depending on the imaging mode (mammography or tomosynthesis) and on breast thickness and glandularity in digital breast tomosynthesis systems capable of digital mammography will be discussed. The potential advantages in converting from K-edge filtration to aluminum filtration would be:

1. Higher x-ray photon fluence per mA, resulting in shorter exposure duration for typical fixed mA systems.

2. Simplification of system design.

3. Consistency in spectra between DM and DBT acquisition modes.

4. Standardization across different DM and DBT platforms.

5. Simplification of instruments, and calibration requirements for instruments, used to measure xray tube potential. 6. Low-cost wide availability of high purity aluminum. The half value layer (HVL) and mean energy of the spectra are important in selecting the type of the filter and its thickness in different imaging systems. The use of optimal beam filtration that could lead to great throughout is always desirable in mammography as the exposure times in mammography is long, typically ranging from about 0.5 seconds to more than 2 seconds

depending on breast thickness and composition. The application of optimal beam filtration can lead to shorter exposure times and this can contribute to reduced motion effects and patient discomfort from breast compression. Compelling results obtained on the potential of replacing the currently used K-edge filters to aluminum filters will be presented. The results suggest the reduction in the exposure duration in DM and DBT systems using the aluminum beam filtration for different breast thickness at the standard imaging settings with comparable or reduced radiation dose to the breast as compared to the K-edge filters, while still maintaining the image quality metrics.

Bio:

Suman Shrestha received his B.E. in Electronics and Communication Engineering from Tribhuvan University, Kathmandu, Nepal in 2009 and his M.S. degree in Electrical Engineering from the University of Akron, Akron, OH in 2013. After his Master's degree, he started working as a Research Engineer in the Radiological Physics Laboratory at the Department of Radiology in the University of Massachusetts Medical School. His research interests are in the field of imaging physics, medical imaging, medical instrumentation and optics. He had authored and co-authored 9 peer-reviewed journal publications. He was the recipient of the Best Reviewer Award for IEEE International Conference on Imaging Systems and Techniques in 2014.

Suman Shrestha

Research Engineer

Radiological Physics Laboratory

Department of Radiology

University of Massachusetts Medical School

Room S2-851

Phone: (508)-856-1233

Lecture 2: Airport baggage screening: challenges and ideas

Tuesday, October 4, 09:00 - 10:00

Ballroom B

Selina Kolokytha (Swiss Federal Laboratories for Materials Science and Technology,

Switzerland)

Abstract:

Within the grand scheme of security, aviation security, and specifically the protection of airports and aircrafts from terrorism and smuggling, has undergone significant development in recent years. During 2014, a record total of 37.4 million commercial flights worldwide, carrying over 3 billion passengers was reported. In addition, aviation activity, in terms of annual commercial flights, is reportedly growing at a rate of 3-5% per year. Clearly, the demand for security in movement of passengers' accompanying baggage is enormous and growing. This lecture specifically focuses on baggage inspection: the methods used for the detection of explosives and illicit materials, with the purpose of prohibiting the illegal movement of goods and dangerous items. The systems and methods currently being used for these purposes internationally will be discussed, along with the related challenges that this discipline faces such as evolving threats, the human factor of inspector officers. Future ideas will be triggered for progresses in this sector, such as combined intelligence of security methods, and advanced technological developments.

Bio:

Selina Kolokytha (Ph.D., MPhil, MSc) successfully completed her doctorate at University College London in conjunction with the three departments of: Medical Physics & Biomedical Engineering; Civil, Environmental & Geomatic Engineering; Security & Crime Science. She is currently a Postdoc at EMPA, Swiss Federal Laboratories for Materials Testing and Research in the department of X-Ray Analytics. Her expertise in Radiation Physics and Imaging has been internationally recognised, published, and presented. She also hold deep interest and experience within science teaching, particularly in Higher Education, and became Associate Fellow of the Higher Education Academic in 2014. Aside her expanding knowledge and experience based skills; the attributes of an enthusiastic and ambitious young scientist are what drive her. Within IEEE, she has obtained the positions of: Technical Coordinator of IEEE International School of Imaging, Technical Program Co-chair of IEEE Imaging Systems and Techniques Conference, and TC-19 Technical Committee member of Imaging Measurements and Systems.

Selina Kolokytha, Ph.D.
Research Scientist
Centre for X-Ray Analytics
Empa
Swiss Federal Laboratories for Materials Science and Technology
Überlandstrasse 129
8600 Dübendorf
Switzerland
+41 (0) 58 765 41 84
selina.kolokytha@empa.ch
www.empa.ch/x-ray

Lecture 3: New developments in hyperspectral technology add new dimensions in biomedical imaging and in Non-Destructive Testing Tuesday, October 4, 10:00 - 11:00 Ballroom A

Costas Balas (Technical University of Crete, Greece)

Abstract:

HSI has the unique feature of combining the advantages of both imaging and spectroscopy (high spatial and spectral resolution) in a single instrument. The HSI systems acquire a 3-dimensional data set of spectral and spatial information, known as spectral cube. The spectral cube can be considered as a stack of images, each of them acquired at a different wavelength. The vastly improved computational power, together with the recent technological developments in tunable optical filter and imaging sensor technologies have become the catalysts for merging together imaging and spectroscopy. Both areas–imaging and spectroscopy-continue to be impacted by technological innovations that enable faster acquisition of superior-quality data. In HSI, light intensity is recorded as a function of both wavelength and location. In the image domain, the data set includes a full image at each individual wavelength. In the spectroscopy domain, a fully resolved spectrum at each individual pixel can be recorded. Several mathematical approaches are used for spectral classification and image segmentation on the basis of the acquired spectral characteristics. The spectra are classified using spectral similarity measures and the resulting different spectral classes are recognized as color-coded image clusters. A major disadvantage of systems based on spatial or spectral scanning is that they are fundamentally unsuitable for analyzing moving of dynamically changing targets. This motivated the recent evolution of HIS as "single exposure" spectral imagers capable of recording a plurality of spectral cubes at ms time regime.

HSI is intensively investigated as a tool for identifying various pathologic conditions on the basis of their spectral signatures, the profile of which change during the development of the disease. HSI is a wide, rapidly evolving interdisciplinary field and it has been recently reach a high development level capable of comprising the basis for the development of the new generation of diagnostic imaging technology.

Bio:

Costas BALAS is full Professor, Director of the Electronics Lab and founder/leader of the Optoelectronics group of the ECE School of Technical University of Crete, Chania, Greece.

http://cbalas.electronics.tuc.gr/ He has been elected and serves as the president of the Greek Photonics Platform-the National pole of the EU photonics21 organization. In 2002, and on the basis of his innovations, he founded DySIS-Medical Ltd http://dysismedical.com/aboutus/ -a biophotonic medical device spin-off currently with well expanded international activities. He recently attracted investments and founded two new companies in hyperspectral Imaging: QCell (mobile consumer platforms) and Holoptica (scientific instruments). Apart from being the founder and the inventor, he held for more than 10 years key positions, including member of the Board of Directors and Chief Scientific Officer-head of the R&D dept. He is the author or co-author of numerous peer-reviewed scientific publications and has delivered numerous invited presentations in international conferences. He is the sole inventor or the co-inventor of several issued patents (USA, EU, Japan, China etc) or pending patents, a number of which has become products launched worldwide, though technology-transfer contracts. He has attracted multimillion level EU and US grants for supporting his research and has contributed in financing the startup he founded with several millions from international venture capital entities. Prof. Costas Balas, is the Winner of the Applied Research & Innovation Competition "Greece Innovates", 2013. He has received fellowships, and institutional, conference and patent awards. He has been a member of several international conference committees and a regular paper reviewer in top-level scientific journals and conferences. His research experience/interests include photonic devices, hyperspectral imaging systems, spectroscopy, medical diagnostic devices, biophotonics, optical biopsy, molecular imaging, in-silico modelling of dynamic bio-optical processes and scientific instrumentation for non-destructive analysis. He is a member of IEEE-photonics society, Optical Society of America, SPIE-the International Society for Optical Engineering.

Costas BALAS Ph.D | Professor&Director Electronics Lab| Group Leader Optoelectronics & Diagnostic Imaging Group| School of Electronic, and Computer Engineering,| Technical University of Crete | University Campus, Acroterion |73100, Chania | Crete | Greece |?: +30 28210 37212 |+30 28210 37223 |Fax ?: +30 28210 37572|?: balas@electronics.tuc.gr | |

Lecture 4: TDLAS tomography and application in combustion flame monitoring

Ballroom B

Lijun Xu (Beihang University, China)

Abstract:

Distributions of temperature and gas concentration within the combustor are critical to evaluating the performance of a gas turbine combustor. An on-line tomography system based on tunable diode laser absorption spectroscopy (TDLAS) is developed to monitor the rotational flame generated by a swirling burner. The system consists of two distributed feedback (DFB) laser diodes, a tomographic sensor, electronic circuits, and a computer. The central frequencies of the two DFB laser diodes are 7444.36cm-1 and 7185.6cm-1, respectively. The tomographic sensor is used to generate fan-beam illumination from five views and to produce 60 ray measurements. The electronic circuits not only control signals for the laser diodes but also can accurately sample the transmitted laser intensities and extract integrated absorbance in real time. Then the two-dimensional (2D) distributions of temperature and H_2O mole fraction are reconstructed by modified Landweber algorithm. Stable and lean-blow-off status of Swirl flame are monitored at different planes using the system. When the burning is stable, anticlockwise rotated crescent areas of high temperature and dense H_2O are observed. The anticlockwise rotated crescent areas are induced by the helical processing vortex core which occurs in high Reynolds number and swirl number flows. The anticlockwise rotated crescent areas decrease when the equivalent ratio ($0.0575 \times m_{ch4}/m_{air}$) drops. When the burning is close to lean blowout, anticlockwise rotated crescent areas disappear. The temperature and H_2O concentration fluctuate obviously, indicating the vertically shake of the flame.

Lecture 5: Bioinspired Unmanned Robotic Vision Systems: Technical Challenges, and Market Forecast

Ballroom A

George Giakos, Panagiotis Pachis, Lina Bengtson, Joseph B. Majeski & Michael Surovich (Manhattan College, USA)

Abstract:

The goal of this presentation is to introduce the technical challenges associated with the design and operational capabilities of drone vision systems, then introduce sensing principles and techniques, borrowed from biological sensory response systems, overcoming these challenges. Although unmanned aerial vehicles (UAV)s have established an impressive performance track during the course of the modern conflicts, operation of UAVs in urban settings for combat or commercial applications is not practical, and limited by their competing design requirements. Specifically, existing small UAVs (SUAV)s and micro air vehicles (MAV)s, although exhibiting high intrinsic value in terms of information-surveillance- reconnaissance (ISR) assets, they are not agile enough to operate in the confined, obstacle cluttered environments of city streets. A number of coexisting issues such as limited ability to operate in close proximity to terrain, structures, and other vehicles; limited ability to land on stationary or moving objects; communication latency and drop-out; and sufficient autonomy for reasonable operator workload, introduce severe limitations in current drone technologies. Given the dynamic nature of urban settings, operation in those scenarios introduces significant uncertainties and risks. While the human eye can practically cope only with two aspects of light, brightness and color, many insects use polarization as a further source of visual information. In fact, the polarization pattern of the blue sky serves as an important reference for spatial orientation in insects. Polarization sensitivity differs according to insect species: for instance, crickets use blue receptors in polarization vision while honeybees, desert ants and flies use UV-receptors. Insects possess compound eyes. The enhanced polarization vision capabilities of insects, combined with a wide field-of- view, multi-functional eye structure, and good tracking offers enhanced structural, geometrical, chemical, and metabolic information, as wells as unique tracking, guidance, and object discrimination capabilities.

Bio:

George C. Giakos is Professor and Chair of the Department of Electrical and Computer Engineering at Manhattan College, NY. In addition, he is the Director of the Graduate Program. Prior joining Manhattan College, he has been a Professor of Electrical and Computer Engineering and Biomedical Engineering, for the last 20 years, at the University of Akron, OH, USA.

He has been the Director of the US AFRL Multifunctional Imaging Surveillance platform, designed under an US AFRL research contract. He has been recognized for "his leadership efforts in advancing the professional goals of IEEE" by receiving the 2014 IEEE-USA Professional Achievement Award, "in recognition of his efforts in strengthening links between industry, government and academia". He has been elected an IEEE Fellow based on his "Contributions to Efficient Imaging Devices, Systems and Techniques". He is a Distinguished Faculty fellow for the Office of Naval Research.

In addition, he served for several years as faculty Fellow at NASA and Air Force Research Laboratories (AFRL). Professor Giakos received his Laurea in Physics from the University of Turin (Italy), a Post Graduate Diploma in Nuclear Instrumentation from the University of Edinburgh (Scotland), an MS Degree in Physics from Ohio University. He received his Ph.D in Electrical and Computer Engineering, from Marquette University, following Post-Doctoral Training in Medical Imaging, in the Department of Biomedical Engineering, University of Tennessee.

His research group was the first in the US to pioneer the characterization of the detection and imaging characteristics of Cadmium Zinc Telluride semiconductor substrates for flat-panel digital radiography applications.

Lecture 6: Cardiovascular Imaging Informatics

Ballroom B

Kostas Marias (University of Ioannina/FORTH, Greece)

Abstract:

Visualizing tumor environment is a critical task for assessing treatment response as well as tailoring therapy to the individual by better understanding the viable, necrotic and hypoxic areas. While a number of imaging modalities can provide complementary information about the tumor composition, there are several constraints regarding radiation, cost and patient tolerance that dictate the need of non-invasive and cost-effective methods to be used for tumor imaging in the context of personalized medicine. This talk presents some of the major challenges in imaging tumor environment using perfusion and diffusion Magnetic Resonance Imaging (MRI) based on the actual computational workflows and discuss important computational issues that affect the robustness, reproducibility as well as the clinical significance of the extracted clinical biomarkers.

Bio:

Kostas Marias holds a Principal Researcher position in the Institute of Computer Science (ICS-FORTH) since 2006, and since 2010 he is the Head and Founder of the Computational Biomedicine Laboratory at FORTH-ICS. During 2000-2002, he worked as a Researcher at the University of Oxford and from 2003-2006 as Associated Researcher at FORTH-ICS. He was the coordinator two EC projects on image-based cancer modelling (http://www.contracancrum.eu/ and http://www.tumor-project.eu/), while during 2010-2015 he actively participated in several other EC funded projects developing ICT technology focusing on IT applications for personalized medicine. He coordinated the development of a wide range of image analysis and modelling tools designed for the clinical setting within the wider Virtual Physiological Human (VPH) EC initiative and has published more than 120 papers in international journals, books and conference proceedings focusing on medical image processing, analysis and image-based modelling.

Lecture 7: Potentialities of Microwave Imaging Techniques for Brain Stroke Detection Tuesday, October 4, 12:20 - 13:20 Ballroom A

Matteo Pastorino (University of Genoa, Italy)

Abstract

The aim of this lecture is to provide an insight on the potentialities of microwave imaging techniques for brain stroke detection. Brain stroke is a disorder with a high prevalence, which is clinically characterized by an abrupt onset of a focal neurological deficit, due to a vascular occlusion secondary to atherosclerotic thrombosis or embolism, or to a cerebral hemorrhage, due to the rupture of a cerebral blood vessel. The most effective therapy in stroke due to vascular occlusion is intravenous or intra-arterial thrombolytic agents. Such a therapy is contraindicated in hemorrhagic stroke. The possibility to have a correct differential diagnosis between an ischemic and a hemorrhagic stroke in a short period of time is therefore of main relevance for the administration of an adequate therapy and a positive clinical outcome. In this context, the possible use of microwave imaging techniques has been recently considered by several research groups around the world. In some cases, prototypes of imaging systems, in the form of "helmets", have been developed to point out in a very short time the possible presence of hemorrhagic spots, which clearly characterize one of the two kinds of strokes. The lecture will first introduce the basic concepts of microwave imaging, which is a technique aimed at retrieving the distributions of the dielectric parameters of a target under test starting by the measured values of the field it scatters when illuminated by an incident radiation at microwave frequencies. Then, the recently proposed applications to brain stroke imaging will be reviewed. In addition, the lecture will include some discussions about the development of experimental apparatuses, concerning both the illumination/measurement systems and the numerical procedures that can be applied to "invert" the collected samples of the scattered electric field.

Bio:

Matteo Pastorino received the "laurea" degree in electronic engineering from the University of Genoa, Italy, in 1987 and the Ph.D. degree in electronics and computer science in 1992. Since 2008, he has been a Full Professor of Electromagnetic Fields at the same university. He has been the past Director of the Department of Biophysical and Electronic Engineering (DIBE, 2008-2011) and the past Director of the Department of Telecommunication, Electronic, Electrical Engineering and Naval Architecture (DITEN, 2012-2014). Presently, he is the responsible of the local section of the National Society of Electromagnetics (SIEM) and the officer of the National URSI Commission B (Fields and Wave). Prof. Pastorino teaches the courses of "Electromagnetic Fields", "Remote Sensing and Electromagnetic Propagation", "Acoustic and Electromagnetic Emission of Ships," and "Yacht Navigation Support Systems". His main research interests are in the field of imaging and diagnostic systems, antennas and propagation, direct and inverse electromagnetic scattering, and biolectromagnetics. He is the author of the book Microwave Imaging (Wiley, 2010) and the coauthor of about 450 papers in international journals and congress proceedings. Prof. Pastorino is an Associate Editor of the IEEE Transactions on Instrumentation and Measurement and of the IEEE Antennas and Propagation Magazine. He served several times as a Co-chair of the IEEE International Conference on Imaging Systems and Techniques (IST). He is also a member of the editorial boards and technical program committees of several other international journals and conferences in the field of microwaves and antennas.