10th Cyprus Workshop on Signal Processing and Informatics (CWSPI) 2017

University of Cyprus (New Campus)

THEE001, ROOM 148 (Building of the Department of Computer Science)

July 19, 2017, 14:00-19:15 hrs

https://cwspi.cs.ucy.ac.cy/

**FINAL PROGRAM AND BOOK
OF ABSTRACTS**

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Preface:

Following the successful one-day workshop we had in the last 9 years, we would like to cordially invite you to participate in the upcoming 10th Cyprus Workshop on Signal Processing and Informatics (CWSPI 2017).

The overall objective of CWSPI 2017 is to disseminate new research results in several areas and help establish industry, university, and multi - university collaborations.
The workshop is mainly targeted to our graduate students to present their most recent findings.

This one-day workshop hosts presentations by faculty, students, and industry researchers in the areas of signal processing image processing and analysis and informatics.

We would like to express our sincere thanks to IEEE Cyprus Section, the IEEE EMBC/Signal Processing Cyprus Chapter, the IEEE CIS Cyprus Chapter and the IET Cyprus Network for their support and sponsorship.

Wishing you a fruitful and joyful event.

M. Neofytou, A. Panayides
July 2017

Topics:
- Digital signal and image processing
- Sensor networks and signal analysis
- Biomedical signal, image, and video analysis
- Wireless communications and signal processing
- Multimedia systems
- Speech, and audio, processing
- Cognitive systems
- FPGAS in signal, image and video processing.

Workshop Organizing Committee:

Chair:	M. Neofytou, University of Cyprus, Cyprus
Co-Chair:	A. Panayides, University of Cyprus, Cyprus
Program Chair:	C. P. Loizou, Cyprus University of Technology, Cyprus
Program Committee:	M.S. Pattichis, University of New Mexico, USA
	E. Kyriacou, Frederick University, Cyprus
	A. Spanias, Arizona State University
Local Arrangements:	C. S. Pattichis, University of Cyprus, Cyprus
Publications:	C. P. Loizou, Cyprus University of Technology, Cyprus
Liaison/Publicity:	T. Kasparis, Cyprus University of Technology, Cyprus
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        &
      http://www.ehealthlab.cs.ucy.ac.cy/

       or

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Technical Program

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	Department of Health Sciences, European University Cyprus, Nicosia, Cyprus and with School of Mathematical Sciences, Computer Science and Engineering, City, University of London, London, United Kingdom
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Abstracts

14:00-15:00

Keynote: Cognitive Sequential Estimation Using Configurable Heterogeneous Sensor Networks

Ass. Prof. Ioannis Kyriakides

Department of Engineering of the University of Nicosia, Cyprus

Abstract:

Configurable heterogeneous sensor nodes in a sensor network are able to improve estimation performance in sequential estimation applications such as target tracking or environmental monitoring. Configurable sensor nodes can be adaptively reconfigured in terms of transmission, sensing, processing, communication, and actuation to improve sequential estimation performance based on information from sequentially arriving measurements and prior information while operating under resource constraints. Heterogeneous sensors have the potential to enrich information on the unknown state to be estimated and provide further gains in sequential estimation performance. However, the use of possibly large numbers of configurable heterogeneous sensors and the non-linear relationship between the measurements and state to be estimated present challenges in performing optimal data fusion and sensor configuration. In addition, the increasing surface of sensor networks, in terms of both hardware and software, makes networks more and more vulnerable to interference and faults that compromise information integrity. This talk will examine challenges faced in the design of cognitive sensor networks for sequential estimation. Specifically, the talk will suggest a framework for use in cognitive sensor node configuration and heterogeneous sensor data fusion for the purpose of sequential state estimation that also takes into account interference and faults in the sensor network. Additionally, the talk will propose the use of sequential Monte Carlo methods in synergy with neural networks for the solution of the complex problem of improving estimation performance via heterogeneous data fusion, adaptive node configuration, measurement model learning, and information integrity risk mitigation. Finally, the talk will include relevant applications of sequential estimation using cognitive sensors.

Short bio: Dr. Ioannis Kyriakides is an Associate Professor at the Department of Engineering of the University of Nicosia. He received his Diploma in Electrical Engineering from the Higher Technical Institute in 1999 and his B.S. degree in Electrical Engineering in 2003 from Texas A&M University. He received his M.S. and Ph.D. degrees in 2005 and 2008 respectively from Arizona State University. His research interests include Bayesian target tracking, sequential Monte Carlo methods, heterogeneous sensor data fusion, and adaptive sensor network configuration. He is a member of the Institute of Electrical and Electronic Engineers and the Technical Chamber of Cyprus. He regularly serves as a reviewer for a number of journals and conferences.

15:15-16:45

SESSION 1: Biomedical Signal, Image, and Video Analysis

Chair: *Marios Neofytou*, **University of Cyprus**

15:15-15:30   **A novel Bidirectional Echo State Network for Protein Secondary Structure Prediction**

Maria Igarievna Maslioukova, Michalis Agathocleous, Chris Christodoulou and Vasilis Promponas

Abstract — Proteins are responsible for many functions of the human body and their function is determined by their three-dimensional (3D) structure. Until now, many protein sequences have been recorded but the 3D structure is known only for a small part of them. This created the need for a computational approach to the problem of predicting the secondary structure of the proteins and through it their 3D structure, with the Deep Convolutional Neural Fields having the best results. In this paper, we present the design and implementation of a novel Bidirectional Echo State Network (BESN) trained with backpropagation and tested with a small dataset of 513 proteins. The preliminary results of this model are close to 73% per residue accuracy, which we expect to improve with the use of postprocessing, like ensembles, filtering and external rules, and of course experiment on larger datasets. The advantage of this method, as opposed to the architecturally similar Bidirectional Recurrent Neural Network (BRRN), is the execution time which is a lot less thanks to the ESN's training process.

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15:30-15:45 Brain Image and Lesions Registration and 3D Reconstruction in DICOM MRI Images

C. Loizou, C. Papacharalambous, G. Samaras, E. Kyriacou, M. Pantziaris, C. Pattichis

Abstract — During a human brain MRI acquisition the resulting image is formed out of 2D slices. The slices must then be aligned and reconstructed to provide a 3-dimensional (3D) visualization of the brain volume. We propose and evaluate a brain MRI registration and 3D reconstruction system for the accurate 3D reconstruction of DICOM brain images and lesions from multiple sclerosis (MS) subjects. The method is validated on calibrated 3D MRI models as well as on real DICOM MRI brain images and MS lesions.

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15:45-16:00   Quantitative MRI in the Assessment of Alzheimer's disease: A volume analysis of the hippocampus and entorhinal cortex

S. Leandrou

Abstract — Quantitative Magnetic Resonance Imaging (MRI) methods, based on high tissue contrast 3D T1-weighted MR images, are used for the assessment of Alzheimer's disease (AD). These methods are based on Computer-aided diagnosis (CAD) systems and include: i. voxel-based morphometry (VBM), ii volumetric measurements in specific Regions of Interest (ROIs), iii. cortical thickness measurements and iv. shape analysis. Texture analysis can be used to identify the microstructural changes before the larger-scale morphological characteristics which are detected by the other aforementioned techniques. The majority of these methods are mainly used for the classification of 3 groups of subjects: AD patients, Mild Cognitive Impairment (MCI) subjects and Normal Controls (NC). In the early stages of the disease, the entorhinal cortex is more affected, whereas with disease progression both entorhinal cortex and hippocampus offer similar discriminative power. For disease prognosis, entorhinal cortex provides better predictive accuracies rather than other structures, such as the hippocampus.

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16:00-16:15   **Carotid Bifurcation plaque stability estimation based on motion analysis**

E. Kyriacou, A. Nicolaides, M. Griffin, A. Constantinou, C. Loizou, M. Pattichis, C. Pattichis

Abstract — Atherosclerosis of the internal carotid artery (ICA) is an important risk factor for stroke. We are presenting the initial steps towards a real-time motion analysis system to predict the stability of carotid bifurcation plaques. The analysis is performed on B-mode video loops by trying to quantify discordant plaque motion, which is the phenomenon of different parts of the plaque moving in different directions with different velocities during the cardiac cycle. In contrast, concordant plaque motion is the phenomenon of all parts of the plaque moving in the same direction and the same velocity during the cardiac cycle.

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16:15-16:30   Comparison of heart rate variability indices in athletes and non-athletes during intense physical exercise

Rafaella Elia, Theocharis Theocharides and Christina Orphanidou

Abstract— The effect of athletic conditioning on the mechanics of the heart is a subject of wide interest not only for gaining scientific knowledge on the functioning of the heart itself but also for guiding the development of early warning systems targeted for the athletes's population. In this study, we designed an experimental protocol, intended to study the heart in different stages of intense exercise and collected continuous ECG, PPG and RSP signals using wearable sensors from 6 semi-professional basketball athletes and 9 non-athletes while running on a treadmill. We extracted time-domain and frequency-domain indices of Heart Rate Variability (HRV), a significant descriptor of the Autonomic Nervous System (ANS) and compared them at the different stages of exercise using statistical significance testing. We found significant differences between the two populations at all stages of the protocol with the most pronounced differences occurring the acceleration phase.

Corresponding Author: Rafaella Elia, Department of Electrical and Computer Engineering and with the KIOS Research and Innovation Center of Excellence, University of Cyprus, email: relia001@ucy.ac.cy

16:30-16:45   **Deployment of Generic Cross Border eHealth Services in Cyprus**

Z. Antoniou, I. Constantinou, M. Neofytou, K. Neokleous, E. Schiza, A. Panayides, C. Loizou, C. Pattichis, C. Schizas, E. Giorgitsi, M. Kalakouti-Kassapi, E. Yiapatou, M. Kyriakides

Abstract — The aim of this paper is to provide a snapshot of the national architecture and functionality for the deployment of generic cross border eHealth services in Cyprus allowing the exchange of Patient Summaries and/or ePrescriptions.

Corresponding Author: Marios Neofytou, eHealth Laboratory, Department of Computer Science, University of Cyprus, Nicosia, 1678, Cyprus, e-mail: mneoph@ucy.ac.cy

16:45-17:00 Coffee Break

17:00-17:30

SESSION 2: Intelligent Systems and IoT

Chair: Christos Loizou, Cyprus University of Technology, Cyprus

17:00-17:15   **The SenSIP REU Program on Sensors and Machine Learning for Health and IoT Applications**

Andreas Spanias, Jennifer Blain Christen

Abstract— A unique Research Experiences for Undergraduates (REU) site was established at Arizona State University to address education and research problems in integrated sensor device and DSP algorithm design. The site will recruit and train nine undergraduate students each summer and engage them in research endeavors on the design of sensors including student training in mathematical methods for extracting information from sensor systems. This three year NSF REU site was established in January 2017 and admitted the first cohort of undergraduate students that started their research in late May 2017. The investigators along with a team of faculty advisors are supervising a series of multidisciplinary research projects in the design of integrated sensor systems. In addition to planned projects, the faculty leaders of this program developed and deployed a series of video-streamed modules on sensor device design and machine learning algorithms. The program engaged colleges across the country to broaden participation. The REU research emphasizes STEM related problems associated with sensor applications in signal processing, internet of things, and health monitoring. The nine projects in 2017 were selected to embed REU students in tasks whose focus is to design sensors and interpret data from sensors by studying and programming appropriate machine learning algorithms and sensor fusion methods. The paper will describe all the technical details of the research activities. The paper will also include an independent assessment of the projects, training and overall program.

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17:15-17:30   **Research Programs at the Robots & Sensors for the Human Well Being (RoSeHuB) NSF Center**

Nikolaos Papanikolopoulos

Abstract — We provide an overview of the Robots & Sensors for the Human Well Being (RoSeHuB) NSF Industry-University Cooperative Research center (I/UCRC) lead by the University of Minnesota. Partner sites include U. Penn, Purdue, University of North Carolina, and University of Denver. The mission of the center is to: a) Advance research and target technology innovation and development and achieve technology penetration in all areas that promote human well-being and improve life quality, and b) Produce highly trained graduate students with advanced coursework and hands-on exposure to multi-disciplinary integrative systems. The center has several industry members and funded projects across disciplines.

Corresponding Author: Nikolaos Papanikolopoulos, Professor and Center Director, University of Minnesota

17:30-17:45 **LBS Augmented Reality Assistive System for Utilities Infrastructure Management through Galileo and EGNOS**

Konstantinos Michael, Tasos Kounoudes

Abstract —The LARA is a Horizon 2020 project funded by Galileo Space Agency aimed to take advantage of the newly developed European satellite system called Galileo. The project has successfully passed the final review that was held in the European GNSS agency. The outcome of the project is a hand-held device for utility field workers. The device integrates different technologies: global navigation satellite system, augmented reality and geographic information system. In practise, this device will guide the field workers in underground utilities to visualise the underground infrastructure. The system is using AR interfaces to render the complex 3D models of the underground utilities infrastructure such as water, gas, electricity, etc. in an approach that is easily understandable and useful during field work. The 3D information is acquired from 3D GIS geodatabases. SignalGeneriX is leading the hardware development of the prototype.

Corresponding Author: Konstantinos Michael, Signal GeneriX, Cyprus

17:45-18:00   Identifying Floating Debris at Sea

Kyriaki Kylili, Ioannis Kyriakides, Constantinos Hadjistassou and Alessandro Artusi

Abstract — Here we introduce a new way for detecting and identifying marine debris using machine-learning techniques instead of visual observation. The investigation involves testing several detectors, as implemented in Matlab, with the intention of constructing a method for detecting and classifying floating debris at sea. Preliminary results indicate that the SURF algorithm and the bag-of-features identifier yield the most promising findings. Future directions, we envision, will center on the utilization of deep-learning approaches, i.e., convolutional neural networks (CNNs).

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18:00-18:15   The Fast Discrete Periodic Radon Transform and Its Application to Computing 2D Convolutions and Cross-correlations

Prof. Marios Pattichis

Abstract— The Discrete Periodic Radon Transform (DPRT) computes projections of an input image along a set of integer directions. For prime-sized PxP images, the DPRT is invertible. In 2016, we developed a family of scalable hardware architectures for computing the DPRT in O(P) to O(P^2) clock cycles based on available resources. In 2017, we extended the approach to a family of scalable hardware architectures for computing 2D convolutions and cross-correlations in just O(P) to O(P^2) clock cycles, based on available resources. As a result, the fast DPRT based architectures have outperformed all other methods for computing 2D convolutions and cross-correlations. The research was conducted in collaboration with Prof. Cesar Carranza and Prof. Daniel Llamocca.

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18:15-18:30 Coffee Break

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SESSION 3: Networks

Chair: Andreas Panayides, University of Cyprus

18:30-18:45   Utilizing Mobile Nodes for Congestion Control in Wireless Sensor Networks

Natalie Temene, Chryssis Georgiou, Antonia Nicolaou, Charalambos Sergiou and Vasos Vassiliou

Abstract — Congestion control and especially mobility are subjects that in the recent years attracted many researches in Wireless Sensor Networks (WSNs). In this work, we present an algorithm with two variations to assist existing congestion control algorithms facing congestion in WSNs. The first variation employs mobile nodes in order to create locally significant alternative paths leading to the sink. The second variation employs mobile nodes to create completely individual paths to the sink. Simulation results show that both algorithms assist the alleviation of congestion in WSNs.

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18:45-19:00   **Adaptive Video Encoding Framework based on Multi-objective Optimization for Real-time mHealth Applications**

Zinonas Antoniou

Abstract — We propose an adaptive video encoding framework based on multi-objective optimization that jointly maximizes the encoded video's quality and encoding rate (in frames per second) while minimizing bitrate demands. The goal is to provide methods for real-time end-to-end systems that dynamically adapt to time-varying channel state while maximizing clinical video quality or guaranteeing a minimum, acceptable level of clinical video quality. The latter is expected to expedite the adoption of mHealth medical video communications in standard clinical practice by preserving the quality thresholds for remote diagnosis and decision making.

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19:00-19:15 Closing Remarks