

# 9th Cyprus Workshop on Signal Processing and Informatics (CWSPI) 2016

University of Cyprus (New Campus)

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

June 29, 2016, 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 8 years, we would like to cordially invite you to participate in the upcoming 9th Cyprus Workshop on Signal Processing and Informatics (CWSPI 2016).

The overall objective of CWSPI 2016 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 Dr Tasos Kounoudes, for willing to give the keynote talks entitled SignalGeneriX DSP for commercial applications.

A total of 12 abstracts are presented into 3 different sessions. These sessions are the following: Image and Video Processing, Intelligent Systems, and Networks.

Last but not least, we would like to express our sincere thanks to IEEE Cyprus Section, the IEEE EMBS/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, A. Spanias, C.S. Pattichis*  
June 2016

## **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:**

<b>Chair:</b>	<i>M. Neofytou</i> , University of Cyprus, Cyprus
<b>Co-Chair:</b>	<i>A. Panayides</i> , University of Cyprus, Cyprus
<b>Program Chair:</b>	<i>A. Spanias</i> , Arizona State University, USA
<b>Program Committee:</b>	<i>M.S. Pattichis</i> , University of New Mexico, USA <i>C. P. Loizou</i> , Intercollege, Cyprus <i>E. Kyriacou</i> , Frederick University, Cyprus
<b>Local Arrangements:</b>	<i>C. S. Pattichis</i> , University of Cyprus, Cyprus
<b>Publications:</b>	<i>C. P. Loizou</i> , Cyprus University of Technology, Cyprus
<b>Liaison/Publicity:</b>	<i>T. Kasparis</i> , Cyprus University of Technology, Cyprus
<b>Webmaster:</b>	<i>M. Neofytou</i> , University of Cyprus, Cyprus

## **Venue:**

Department of Computer Science, University of Cyprus (New Campus),  
THEE001 ROOM 148,  
P.O.Box. 20537, CY-1678 Nicosia,  
CYPRUS

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Tel.: + 357-22-892700, Fax: + 357-22-892701, e-mail: [cs@ucy.ac.cy](mailto:cs@ucy.ac.cy)

## **Webpage:**

<http://cwspi.cs.ucy.ac.cy>

&

<http://www.ehealthlab.cs.ucy.ac.cy/>

or

**Visit us on Facebook: [cwspi cyprus](#)**

(see Facebook site for news and pictures <https://www.facebook.com/cwspi.cyprus>)

## Technical Program

TIME	SESSIONS
13:45	<b>Introductions and Refreshments</b>
13:55	<b>Welcome</b> <i>Andreas Spanias, Arizona State University, USA</i>
14:00-15:00	<b>Keynote: SignalGeneriX DSP for commercial applications</b> <i>Dr Tasos Kounoudes, SignalGeneriX, Cyprus</i>
15:00-15:15	<b>Coffee break</b>
15:15-16:45	<b>SESSION 1: Biomedical Signal, Image, and Video Analysis</b> <b>Chair: Marios Neofytou, University of Cyprus</b>
15:15-15:30	<b>Biomarker and Imaging Marker Discovery and Exploitation for Human Diseases</b> <i>George M. Spyrou, Member, IEEE, Bioinformatics ERA Chair, Head of the Bioinformatics Group, The Cyprus Institute of Neurology and Genetics</i>
15:30-15:45	<b>Group Velocity Dispersion (GVD) measurement using Optical Coherence Tomography (OCT)</b> <i>Christos Photiou, Costas Pitris, KIOS Research Center, Department of Electrical and Computer Engineering, University of Cyprus, Nicosia, Cyprus</i>
15:45-16:00	<b>Multiscale AM-FM Image Reconstructions Based on Elastic Net Regression and Gabor Filterbanks</b> <i>Ioannis Constantinou, eHealth Lab, Computer Science Department, University of Cyprus, Cyprus</i>
16:00-16:15	<b>Evaluation of Ultrasound Diaphragmatic Motion</b> <i>C. Chrysostomou, C. P. Loizou, G. Minas, and C. S. Pattichis Department of Computer Science, University of Cyprus, Nicosia, Cyprus</i>
16:15-16:30	<b>Cardiac Ultrasonography over 4G Wireless Networks using a Tele-operated Robot</b> <i>Sotiris Avgousti, Nursing Department, Cyprus University of technology, Cyprus</i>
16:30-16:45	<b>Digital ECG &amp; Biosensors Analysis (Shimmer Wireless Sensors &amp; Arduino Microcontroller) with Patient Real Time Location Tracking</b> <i>Stelios Maimaris, Andreas Panayidis, Zinonas Antoniou and Ioannis Constantinou, eHealth Lab, Computer Science Department, University of Cyprus, Cyprus</i>
16:45-17:00	<b>Coffee Break</b>
17:00-18:15	<b>SESSION 2: Intelligent Systems</b> <b>Chair: <i>Chris Christodoulou, University of Cyprus, Cyprus</i></b>
17:00-17:15	<b>Designing and evaluating virtual environments for the treatment of claustrophobia</b> <i>M. Christofi and D. Michael, GET Lab of Cyprus University of Technology</i>
17:15-17:30	<b>A Methodological Approach for Supporting Automatic Detection of Images Containing Child Pornographic Material</b>

	Rafaella Demetriou, Gabriel Panis, Andreas Lanitis, Visual Media Computing Lab, Dept. of Multimedia and Graphic Arts, Cyprus University of Technology
<b>17:30-17:45</b>	<b>Real-time Vehicle Detection using Unmanned Aircraft Systems (UAS)</b> Petros Petrides, Christos Kyrkou, Theocharis Theocharides, Panayiotis Kolios and Christos Panayiotou, KIOS Research Center, Department of Electrical and Computer Engineering, University of Cyprus, Cyprus
<b>17:45-18:00</b>	<b>Using Second-order learning algorithms to train Bidirectional Recurrent Neural Networks</b> Michalis Agathocleous, Chris Christodoulou, Vasilis Promponas, Petros Kountouris and Vassilis Vassiliades, Department of Computer Science, University of Cyprus
<b>18:00-18:15</b>	<b>The SenSIP Solar Monitoring Facility at the ASU Research Park</b> Sunil Rao, David Ramirez, Henry Braun, Jongmin Lee, Cihan Tepedelenlioglu, Elias Kyriakides and Andreas Spanias, Arizona State University, USA
<b>18:15-18:30</b>	<b>Coffee Break</b>
<b>18:30-19:15</b>	<b>SESSION 3: Networks</b> <b>Chair: <i>Andreas Panayides</i>, University of Cyprus, Cyprus</b>
<b>18:30-18:45</b>	<b>Caching in Large-Scale Cellular Networks with D2D Assistance</b> Eleni Demarchou, Constantinos Psomas, and Ioannis Krikidis, KIOS Research, Center for Intelligent Systems and Networks, Electrical and Computer, Engineering, University of Cyprus, Cyprus
<b>18:45-19:00</b>	<b>Low-Complexity Base Station Cooperation for mmWave Heterogeneous Cellular Networks</b> Christodoulos Skouroumounis, Constantinos Psomas, and Ioannis Krikidis, KIOS Research Center for Intelligent Systems and Networks, Department of Electrical and Computer Engineering, University of Cyprus, Cyprus
<b>19:00-19:15</b>	<b>CLOSING REMARKS</b>

## Abstracts

14:00-15:00

### SignalGeneriX DSP for commercial applications

**Dr Tasos Kounoudes**

**CEO of SignalGeneriX, Cyprus**

**Abstract:**

The presentation gives an overview of SignalGeneriX and its activities, and focuses on the latest projects, technologies and products.

**Short bio:** Tasos Kounoudes is the founder and CEO of SignalGeneriX with more than fifteen years of industrial experience in the development of innovative products in the area of Telecommunications and Digital Signal Processing. He received his Ptychio in Computer Engineering and Informatics from University of Patras, Greece, in 1997 and his PhD in Signal Processing and Telecommunications from Imperial College, University of London, in 2000. He worked as a postdoctoral research fellow at the same group of Imperial College for two years before joining the high-tech industry in the UK. In 2004, he co-founded SignalGeneriX Ltd in Limassol, and since then he is fully engaged in the company's activities initially as Chief Technical Officer and now as the Chief Executive Officer. Dr Kounoudes is the co-author of European patents and has published more than 50 papers in international journals, book chapters and proceedings of international conferences.



**15:15-16:45**

**SESSION 1: Biomedical Signal, Image, and Video Analysis**

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

**15:15-15:30 Biomarker and Imaging Marker Discovery and Exploitation for Human Diseases**

George M. Spyrou, Member IEEE

**Abstract— To be announced**

**Corresponding Author:** George M. Spyrou, Member, IEEE, Bioinformatics ERA Chair, Head of the Bioinformatics Group, Cyprus Institute of Neurology and Genetics.

**15:30-15.45 Group Velocity Dispersion (GVD) measurement using Optical Coherence Tomography (OCT)**

Christos Photiou, Costas Pitris

**Abstract—** Many materials exhibit Group Velocity Dispersion (GVD) as a result of index of refraction variations which are a function of wavelength. Measurement of the GVD can be useful for differentiating materials, concentrations, and also tissue changes that can be, for example, indicative of cancer. GVD can be estimated, in various ways, using Optical Coherence Tomography (OCT) images. In this paper, a comparison of three GVD measurement methods is presented, comparing their accuracy and applicability to highly scattering tissues.

**Corresponding Author:** Costas Pitris, KIOS Research Center, Department of Electrical and Computer Engineering, University of Cyprus, Nicosia, Cyprus. (e-mail: [cpitris@ucy.ac.cy](mailto:cpitris@ucy.ac.cy)).

**15:45-16:00 Multiscale AM-FM Image Reconstructions Based on Elastic Net Regression and Gabor Filterbanks**  
Ioannis Constantinou

**Abstract**—Current multi-scale AM-FM image analysis methods are based on the use of Dominant Component Analysis (DCA), multiscale DCA, and Channel Component Analysis (CCA). In this presentation, we present a new AM-FM component selection method based on elastic net regression. The new approach is implemented using a family of Gabor filterbanks, each of them based on different filter parameters such as progressive bandwidth and overlap characteristics. The results show that the elastic net regression component selection algorithm performs better than all other methods.

**Corresponding Author:** Ioannis Constantinou, eHealth Lab, Computer Science Department, University of Cyprus, Cyprus, (email: [ioannis@istagnosis.com.cy](mailto:ioannis@istagnosis.com.cy))

**16:00-16:15 Evaluation of Ultrasound Diaphragmatic Motion**

C. Chrysostomou, C. P. Loizou, G. Minas, and C. S. Pattichis

**Abstract**—Motion characteristics of the diaphragmatic muscle provide useful information about normal and abnormal diaphragmatic function and indicate diaphragmatic weakness. We further evaluate and validate a simple system for the quantitative analysis of ultrasonic diaphragmatic motion by extracting measurements from the original (O), normalized (N) and normalized despeckled (NDS) simulated videos. Best measurements were obtained for the NDS simulated video (MAE=2.7, p=0.5,  $\rho=0.9$ ). Manual and automated measurements were very close. Further work in a larger number of real ultrasound videos is needed for validating the proposed method.

**Corresponding Author:** C. Chrysostomou, Department of Computer Science, University of Cyprus, Nicosia, Cyprus; (e-mail: [con.chrysos@gmail.com](mailto:con.chrysos@gmail.com))

**16:15-16:30 Cardiac Ultrasonography over 4G Wireless Networks using a Tele-operated Robot**

Sotiris Avgousti

**Abstract**—An end-to-end mobile tele-echography platform using a portable robot for remote cardiac ultrasonography has been developed. Performance evaluation investigates the capacity of LTE wireless networks to facilitate responsive robot tele-manipulation and real-time ultrasound video streaming that qualifies for clinical practice. Within this context, a thorough video coding comparison for cardiac ultrasound applications is performed, using a data set of 9 ultrasound videos.

**Corresponding Author:** Sotiris Avgousti is with the Nursing Department, Cyprus University of technology, Cyprus, (e-mail: sotiris.avgousti@cut.ac.cy).

**16:30-16:45 Digital ECG & Biosensors Analysis (Shimmer Wireless Sensors & Arduino Microcontroller) with Patient Real Time Location Tracking**

Stelios Maimaris, Andreas Panayidis, Zinonas Antoniou and Ioannis Constantinou

**Abstract**—An Android app has been developed during my bachelor thesis for Digital Electrocardiograph & Biosensors Analysis using a microcontroller (Arduino) and Shimmer Wearable Sensors with the ability of patient real-time location tracking using data from Google Maps. The Android app indicated for use by the patient only and provides data that are taken from Arduino controller, using eHealth platform V2.0 and starter kit from Libelium, and Shimmer sensors. In total 9 different biosensors, including ECG signal sensor, are provided for health measurements. The patient can monitor his/her health progress summary by visualize measurements in graphs with additional visualize real-time movements in house's rooms (blueprints).

**Corresponding Author:** Stelios Maimaris, eHealth Lab, Computer Science Department, University of Cyprus, Cyprus, (email: smaima01@cs.ucy.ac.cy)

**17:00-17:30**

**SESSION 2: Intelligent Systems**

**Chair: *Chris Christodoulou*, University of Cyprus, Cyprus**



**17:00-17:15    Designing and evaluating virtual environments for the treatment of claustrophobia**

M. Christofi and D. Michael, GET Lab of Cyprus University of Technology

**Abstract**—It is an unquestionable fact that the future is headed towards virtual reality (VR). It is widely used in many different fields like in education, in training, in video games, in heritage and in psychology. Many researchers claim that the best VR applications are focused in therapy rather than entertainment. The effective use of virtual reality applications for the treatment of psychological disorders like phobias and specifically claustrophobia, has been proven by a lot of studies through the years.

Virtual reality exposure therapy (VRET) can help people change the way they think, act and interpret information. It brings them face-to-face with their fears in a safe environment, where knowing that the situation is harmless, they can deal with them safely. It has many advantages over vivo exposure; it's more convenient and cost effective. For the fear of flight for example, it's impossible to make a patient fly over and over again with a real airplane until his/her fear reduces, whilst with VRET, you can repeat the process, as many times as it is needed. Another advantage is that the developed VR application can be completely controlled by the therapist and by the patient.

Claustrophobia is the phobia that we have studied. Creating the right virtual environments (VEs) for a patient to get immersed in, is crucial if we want to eventually treat them only with the use of VRET. We designed and developed a virtual reality application, and conducted an experiment to identify the characteristics that the VEs should have in order to make them most suitable for the treatment of claustrophobia. It is important though, if we want this method of treatment to be as reliable and successful as possible, to fully understand the human behavior in claustrophobic environments. We need to identify what characteristics make the environments claustrophobic and what makes people anxious there. The reasons and ways the environment made the participants anxious were examined from their own reports combined with the observation of their behavior during the experiment. Moreover, with the use of questionnaires, their anxiety and claustrophobia were measured, and the relationship between the amount of claustrophobia a person has and specific behaviors in the VEs was checked.

Lastly, it was investigated whether the gender of the person affects their anxiety. This way, we will be able to create the ideal claustrophobic environments in future VR applications for patients to be immersed in and to effectively treat their fear.

Our results have shown that a factor that contributes to the anxiety of a person in a VE is the messiness of the space. Moreover, the VE should definitely be a closed space, and its dominant color isn't a factor for anxiety alongside how present the patient feels in the VE.

**Corresponding Author:** M. Christofi is with the GET Lab of Cyprus University of Technology (e-mail: [mu.christofi@edu.cut.ac.cy](mailto:mu.christofi@edu.cut.ac.cy))

**17:15-17:30 A Methodological Approach for Supporting Automatic Detection of Images Containing Child Pornographic Material**

Rafaella Demetriou, Gabriel Panis, Andreas Lanitis

**Abstract**—In order to deal with the problem of on-line child pornographic material it is desirable to use automated Child Pornography image Detectors (CPD's). However, the complexity of the problem coupled with the nonexistence of suitable datasets, inhibit the development CPD's. In order to deal with the problem we propose a methodological approach that can be used for supporting CPD development through the generation of synthetic datasets. During the process we also define specific image indicators associated with offensive images so that the problem of detecting suspicious images can be decomposed into a set of easier tasks.

**Corresponding Author:** Rafaella Demetriou, Department Visual Media Computing Lab, Dept. of Multimedia and Graphic Arts, Cyprus University of Technology, Cyprus, (email: [rp.dimitriou@edu.cut.ac.cy](mailto:rp.dimitriou@edu.cut.ac.cy))

**17:30-17:45 Real-time Vehicle Detection using Unmanned Aircraft Systems (UAS)**

Petros Petrides, Christos Kyrkou, Theocharis Theocharides, Panayiotis Kolios and Christos Panayiotou

**Abstract**—Unmanned Aircraft Systems (UAS) are becoming an important tool for reconnaissance in both military and civilian applications. A wide range of applications could take a huge advantage by introducing UAS capable of autonomously detecting objects and tracking. More specifically vehicle object detection and tracking are typical requirements for applications such as Search & Rescue, traffic monitoring, intelligence surveillance, border patrol, and parking monitoring.

In this research, the visual information captured by Unmanned Aircraft Systems (UAS) are eminently utilized in detecting and tracking vehicles. The aim of this research is to capture the images or video from a top down view camera sensor carried by the UAS and then process the information in an on-board processing unit for real-time detection of vehicles. After the vehicles have been successfully detected, the UAS could be advised to track and follow a specific vehicle.

Currently the research is in the preliminary stage, where different detection algorithms are evaluated. At this stage the cascade classifier proposed by Viola-Jones is used by training the classifier with data that we have collected using local binary patterns (LBP) and histogram of oriented gradients (HoG) features. The results for the detection stage have been promising thus far however we still need to fine tune some parameters and also evaluate other algorithms such as deep Convolutional Neural Networks.

**Corresponding Author:** Petros Petrides, KIOS Research Center, Department of Electrical and Computer Engineering, University of Cyprus, Cyprus, (email: petrides.s.petros@ucy.ac.cy)

**17:45-18:00 Using Second-order learning algorithms to train Bidirectional Recurrent Neural Networks**

Michalis Agathocleous, Chris Christodoulou, Vasilis Promponas, Petros Kountouris and Vassilis Vassiliades

**Abstract—** Predictions on sequential data, when both the upstream and downstream information is important, is a difficult and challenging task. The Bidirectional Recurrent Neural Network (BRNN) architecture has been designed to deal with this class of problems. In this project, we present the development and implementation of the Scaled Conjugate Gradient (SCG) learning algorithm for BRNN architectures. The model has been tested on the Protein Secondary Structure Prediction (PSSP) and Transmembrane Protein Topology Prediction problems (TMPTP). Our method currently achieves preliminary results close to 73% correct predictions for the PSSP problem and close to 79% for the TMPTP problem, which are expected to increase with larger datasets, external rules, ensemble methods and filtering techniques. Importantly, the SCG algorithm is training the BRNN architecture approximately 3 times faster than the Backpropagation Through Time (BPTT) algorithm.

**Corresponding Author:** C. Christodoulou, Department of Computer Science, University of Cyprus, (email: cchrist@cs.ucy.ac.cy).

**18:00-18:15 The SenSIP Solar Monitoring Facility at the ASU Research Park**

Sunil Rao, David Ramirez, Henry Braun, Jongmin Lee, Cihan Tepedelenlioglu, Elias Kyriakides and Andreas Spanias, Arizona State University, USA

**Abstract**—The Sensor Signal and Information Processing (SenSIP) center solar monitoring facility was developed in the beginning of 2016 for experimental research on fault detection and power optimization. The facility consists of 104 panels fitted with sensors and actuators and is rated at 18kW. This Photovoltaic (PV) array system enables remote monitoring and analytics through a network of smart monitoring devices (SMDs) that have wireless communication capabilities. These devices are also equipped with relays allowing dynamic changes in the connections of the panels including modes such as bypass, series and parallel. All data is transmitted to a central control center which allows obtaining the status of each panel and also enables operators to program the SMDs and control the PV array. Research on this PV array is supported in part by the NSF GOALI award 1308052, Poundra LLC, and Energy Wireless.

**Corresponding Author:** Andreas Spanias, School of ECEE, SenSIP Center and Industry Consortium, Arizona State University (ASU)

**18:30-19:15**

**SESSION 3: Networks**

**Chair: *Andreas Panayides*, University of Cyprus, Cyprus**

**18:30-18:45 Caching in Large-Scale Cellular Networks with D2D Assistance**

Eleni Demarchou, Constantinos Psomas, and Ioannis Krikidis

**Abstract**—This paper exploits the device’s storage units to employ distributed caching using device-to-device (D2D) communications. The coexistence of cache-enabled cellular networks with cache-enabled D2D networks allows users to connect with either a device or a BS in order to receive their requested file. Using a known file popularity we apply the conventional “most popular” caching policy on the BSs and seeking to satisfy most of the users’ requests we propose a caching-policy for the devices. Considering the D2D network spatially distributed in clusters among the cellular network, we use stochastic geometry to study the performance of this architecture. For this purpose, the probability of successful reception is derived and the backhaul link is modelled to extract the delivery delay.

**Corresponding Author:** E. Demarchou, C. Psomas and I. Krikidis are with the KIOS Research Center for Intelligent Systems and Networks, Electrical and Computer Engineering, University of Cyprus, Cyprus, (email: [fedemar01@ucy.ac.cy](mailto:fedemar01@ucy.ac.cy))

**18:45-19:00 Low-Complexity Base Station Cooperation for mmWave Heterogeneous Cellular Networks**

Christodoulos Skouroumounis, Constantinos Psomas, and Ioannis Krikidis, KIOS Research Center for Intelligent Systems and Networks, Department of Electrical and Computer Engineering, University of Cyprus, Cyprus

**Abstract—** In this paper, we study the problem of base station (BS) cooperation in millimeter wave multi-tier heterogeneous cellular networks. We investigate a low-complexity technique that enables the selection of a single BS that provides the highest instantaneous signal-to-interference-plus-noise ratio, among the strongest BSs from each tier. By using stochastic geometry tools, we derive closed-form expressions for the coverage probability and the diversity gain of the system by taking into account spatial randomness and blockage effects. Our results show that the proposed scheme achieves full diversity and is appropriate for networks with strict computation constraints. In addition, we study the case where users employ successive interference cancellation (SIC) to further boost the achieved performance; SIC allows the mitigation of strong interference terms from the received signal. The impact of SIC on the coverage probability of the system is studied and closed-form expressions are provided.

**Corresponding Author:** Christodoulos Skouroumounis, KIOS Research Center for Intelligent Systems and Networks, Department of Electrical and Computer Engineering, University of Cyprus, Cyprus.



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University of Cyprus (New Campus)

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

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