

Distinguished Lecturer Series “Leon the Mathematician” at the Department of Informatics, Aristotle University of Thessaloniki Greece (<http://dls.csd.auth.gr>)



CELEBRATING  
**1992 - 2012**  
YEARS

The European Association for Signal Processing, the IEEE Signal Processing Society, and the Department of Informatics cordially invite you to the

### Second Greek Signal Processing Jam

at the **Auditorium III** of **Aristotle University Research Dissemination Center** – ΚΕΔΕΑ ΑΠΘ (September 3rd Ave., University Campus) on **Thursday May 17<sup>th</sup>**, 2012.

There will be a morning session comprising four lectures, a long Greek get-together lunch break, followed by an afternoon session with another three lectures. The seminar is organized in memorial of our colleague *Nicolas Galatsanos*; will honor Professor *Michael Strintzis*, who has paved the careers of local Signal Processing community members; and it is an integral part of *the celebrations for the 20 years of the Department of Informatics*. Our goal is to reach out and bring together aspiring, young, and seasoned researchers with an interest in signal processing and its applications from image and music to communications and networking – including social networking!

**Admission is free to all** (notably the EURASIP and the IEEE members)



### Program

0800-0820 Registration

0820-0840 Opening

**Yannis Manolopoulos**, *Professor, Department Head*

**Kostas Berberidis**, *Professor, IEEE SPS Chapter Chair*

**Costas Kotropoulos**, *Associate Professor, EURASIP Local Liaison Officer*

- 0840-0900** **Tribute to Nicolas Galatsanos** (*Dr. Ioannis Chantas and Prof. Aristidis Likas*)
- 0900-1000** **Aggelos Katsaggelos**, *Professor and AT&T Chair*, Northwestern University, Department of Electrical Engineering & Computer Science (*IEEE/ SPIE Fellow, IEEE SPS DL*), **Sparse and Redundant Representations: Theory and Applications**
- 1000-1100** **Aristidis Likas**, *Associate Professor* and **Christoforos Nikou**, *Assistant Professor*, University of Ioannina, Department of Computer Science, **Mixture Models for Image Analysis**
- 1000-1100** **Ioannis Pitas**, *Professor*, Aristotle University of Thessaloniki, Department of Informatics (*IEEE Fellow*), **Semantic 3DTV Content Analysis and Description**
- 1200-1300** **Yonina Eldar**, *Professor*, Technion, Electrical Engineering Department (*IEEE SPS DL*), **Defying Nyquist in Analog to Digital Conversion**
- 1300-1420** Lunch break
- 1420-1440** **Awarding Gerasimos Strintzis**, *Professor*, Aristotle University of Thessaloniki, Department of Electrical and Computer Engineering (*IEEE Fellow*) **for his contributions to Signal Processing**
- 1440-1540** **Georgios Giannakis**, *Professor and ADC Chair in Wireless Telecommunications*, University of Minnesota, Department of Electrical & Computer Engineering (*IEEE/EURASIP Fellow, IEEE SPS DL*), **Sparsity Control for Robustness and Social Data Analysis**
- 1540-1600** Coffee break
- 1600-1700** **Nicholas Kalouptsidis**, *Professor*, National and Kapodistrian University of Athens, Department of Informatics and Telecommunications, **Nonlinear Communications: Achievable Rates, Estimation and Decoding**
- 1700-1800** **Constantine Kotropoulos**, *Associate Professor*, Aristotle University of Thessaloniki, Department of Informatics, **Sparse and Low Rank Representations in Music Signal Analysis**

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## Plenary Talks

### **Sparse and Redundant Representations: Theory and Applications**

Aggelos Katsaggelos

Northwestern University

Department of Electrical & Computer Engineering, Evanston, IL 60208, USA

#### ABSTRACT

Some of the recent advances in sparse and redundant representations of signals are discussed. Specific applications are described ranging from the matrix completion problem, to video retrieval and compressive sensing. A Bayesian framework is utilized in the formulation and solution of such problems. Specific examples are shown from image and video processing and comparisons are made with the state-of-the-art algorithms. Open problems and future research directions are discussed.

#### SPEAKER BIOGRAPHY

**Aggelos K. Katsaggelos** received the Diploma degree in electrical and mechanical engineering from the Aristotelian University of Thessaloniki, Greece, in 1979, and the M.S. and Ph.D. degrees in Electrical Engineering from the Georgia Institute of Technology, in 1981 and 1985, respectively.

In 1985, he joined the Department of Electrical Engineering and Computer Science at Northwestern University, where he is currently a Professor, holder of the AT&T Chair. He was the holder of the Ameritech Chair of Information Technology (1997–2003). He is also the Director of the Motorola Center for



Seamless Communications, a member of the Academic Staff, NorthShore University Health System, an affiliated faculty at the Department of Linguistics and he has an appointment with the Argonne National Laboratory. He is also a Professor at the University of Athens, Department of Physics.

He has published extensively in the areas of multimedia signal processing and communications and he is the holder of 18 international patents. He is the co-author of Rate-Distortion Based Video Compression (Kluwer, 1997), Super-Resolution for Images and Video (Claypool, 2007) and Joint Source-Channel Video Transmission (Claypool, 2007).

Among his many professional activities Prof. Katsaggelos was Editor-in-Chief of the IEEE Signal Processing Magazine (1997–2002), a BOG Member of the IEEE Signal Processing Society (1999–2001), and a member of the Publication Board of the IEEE Proceedings (2003–2007). He is a Fellow of the IEEE (1998) and SPIE (2009) and the recipient of the IEEE Third Millennium Medal (2000), the IEEE Signal Processing Society Meritorious Service Award (2001), the IEEE Signal Processing Society Technical Achievement Award (2010), an IEEE Signal Processing Society Best Paper Award (2001), an IEEE ICME Paper Award (2006), an IEEE ICIP Paper Award (2007) and an ISPA Paper Award (2009). He was a Distinguished Lecturer of the IEEE Signal Processing Society (2007–2008).

### **Mixture Models for Image Analysis**

Aristidis Likas and Christoforos Nikou

Department of Computer Science

University of Ioannina, Greece

#### ABSTRACT

Mixture models have been widely used as an effective statistical tool for image modeling and analysis. We will present mixture models successfully employed in image analysis, such as Bayesian Gaussian and Student-t mixtures with several types of priors, along with the corresponding training methods

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based on the Expectation-Maximization (EM) algorithm. Application examples will also be demonstrated for image segmentation and registration problems.

#### SPEAKERS’ BIOGRAPHY

**Aristidis Likas** received the Diploma Degree in Electrical Engineering and the Ph.D Degree in Electrical and Computer Engineering, both from the National Technical University of Athens, Greece. Since 1996, he has been with the Department of Computer Science, University of Ioannina, Greece, where he is currently an Associate Professor.



He has published more than 150 journal and conference papers in the areas of machine learning/neural networks and data mining as well as on machine learning applications in image analysis, multimedia, bioinformatics and text mining. He is an IEEE Senior member and an associate editor of the IEEE Transactions on Neural Networks and Learning Systems. He also served as General Co-chair of the ECML PKDD 2011 conference.

**Christophoros Nikou** received the Diploma degree in Electrical Engineering from the Aristotle University of Thessaloniki, Greece, in 1994 and the DEA and PhD degrees in image processing and computer vision from Louis Pasteur University, Strasbourg, France, in 1995 and 1999, respectively. During 2001, he was a Senior Researcher with the Department of Informatics, Aristotle University of Thessaloniki. From 2002 to 2004, he was with Compucon S.A., Thessaloniki. Since 2004, he is with the Department of Computer Science, University of Ioannina, Greece where he was a Lecturer (2004-2009) and he is now an Assistant Professor. His research interests mainly include image processing and computer vision and their application to medical imaging. C. Nikou is an Associate Editor for EURASIP Journal on Advances in Signal Processing. He is a member of EURASIP and an IEEE Senior Member.



#### Semantic 3DTV Content Analysis and Description

Ioannis Pitas

Department of Informatics

Aristotle University of Thessaloniki

Thessaloniki 54124, Greece

#### ABSTRACT

Human centered video analysis tasks will be reviewed, notably face detection, person tracking, facial pose estimation, eye/mouth detection, visual speech detection, dialog detection, human activity recognition, facial biometrics, and facial expression recognition. 3DTV content analysis tasks will be reviewed as well, notably multiview face/person detection and tracking, multiview video analysis, 3D face reconstruction. XML description schemes (MPEG7 profiles) of the analysis results will be discussed.

#### SPEAKER BIOGRAPHY

**Ioannis Pitas** (IEEE Fellow) received the Diploma and PhD degree in Electrical Engineering, both from the Aristotle University of Thessaloniki, Greece. Since 1994, he has been a Professor at the Department of Informatics of the same University. He served as a Visiting Research Associate or Visiting Assistant Professor at several Universities.

His current interests are in the areas of intelligent digital media, image/video processing (2D/3D) and human-centered interfaces. He has published over 690 papers, contributed in



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39 books in his areas of interest and edited or (co-)authored another 8 books. He has also been an invited speaker and/or member of the program committee of many scientific conferences and workshops. In the past he served as Associate Editor or co-Editor of eight international journals and General or Technical Chair of four international conferences (including ICIP2001). He participated in 64 R&D projects, primarily funded by the European Union and is/was principal investigator/researcher in 40 such projects. He has 13650+ citations to his work and H-index 56+.

## **Defying Nyquist in Analog to Digital Conversion**

Yonina Eldar

Department of Electrical Engineering  
Technion - Israel Institute of Technology  
Technion City, Haifa 32000, Israel

### **ABSTRACT**

The famous Shannon-Nyquist theorem has become a landmark in the development of digital signal processing. However, in many modern applications, the signal bandwidths have increased tremendously, while the acquisition capabilities have not scaled sufficiently fast. Consequently, conversion to digital has become a serious bottleneck. Furthermore, the resulting high rate digital data requires storage, communication and processing at very high rates which is computationally expensive and requires large amounts of power. In this talk a new framework for sampling and processing wideband analog signals at rates far below that dictated by the Nyquist rate will be presented. Applications to a variety of different problems in imaging, communications, signal and image processing will be described.

### **SPEAKER BIOGRAPHY**

**Yonina C. Eldar** (SM) received the B.Sc. degree in Physics (1995) and the B.Sc. degree in Electrical Engineering (1996) both from Tel-Aviv University (TAU), Tel-Aviv, Israel, and the Ph.D. degree in Electrical Engineering and Computer Science (2002) from the Massachusetts Institute of Technology (MIT), Cambridge, MA (USA).



Dr. Eldar was a Postdoctoral Fellow, Digital Signal Processing Group at MIT (January 2002 to July 2002). She is currently Professor, Department of Electrical Engineering at the Technion - Israel Institute of Technology, Haifa, Israel; Research Affiliate, Research Laboratory of Electronics at MIT; and Visiting Professor, Stanford University, Stanford, CA.

Dr. Eldar was in the program for outstanding students at TAU (1992 to 1996); held the Rosenblith Fellowship for study in Electrical Engineering at MIT (1998); held an IBM Research Fellowship (2000); and was a Horev Fellow, Leaders in Science and Technology program at the Technion and an Alon Fellow (2002-2005). Dr. Eldar was awarded the Wolf Foundation Krill Prize for Excellence in Scientific Research (2004); the Andre and Bella Meyer Lectureship (2005); the Henry Taub Prize for Excellence in Research (2007); the Hershel Rich Innovation Award, the Award for Women with Distinguished Contributions, the Muriel & David Jacknow Award for Excellence in Teaching, and the Technion Outstanding Lecture Award (2008); the Technion's Award for Excellence in Teaching (2009); the Michael Bruno Memorial Award from the Rothschild Foundation (2010); and the Weizmann Prize for Exact Sciences (2011).

Dr. Eldar is a Signal Processing Society Distinguished Lecturer; member, IEEE Bio Imaging and Signal Processing Technical Committee (2009-Present); Associate Editor, SIAM Journal on Imaging Sciences, and on the Editorial Board, Foundations and Trends in Signal Processing. In the past, she was a member, IEEE Signal Processing Theory and Methods Technical Committee (2005-2010); Associate Editor, IEEE Transactions on Signal Processing (2006-2008), the EURASIP Journal of Signal Processing, and the SIAM Journal on Matrix Analysis and Applications.

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## **Sparsity Control for Robustness and Social Data Analysis**

Georgios Giannakis

Department of Electrical and Computer Engineering

University of Minnesota

200 Union Street SE, Minneapolis, MN 55455, USA

### **ABSTRACT**

The information explosion propelled by the advent of personal computers, the Internet, and the global-scale communications has rendered statistical learning from data increasingly important for analysis and processing. The ability to mine valuable information from unprecedented volumes of data will facilitate preventing or limiting the spread of epidemics and diseases, identifying trends in global financial markets, protecting critical infrastructure including the smart grid, and understanding the social and behavioral dynamics of emergent social-computational systems. Along with data that adhere to postulated models, present in large volumes of data are also those that do not -- the so-called outliers.

In this talk I will touch upon several issues that pertain to resilience against outliers, a fundamental aspect of statistical inference tasks such as estimation, model selection, prediction, classification, tracking, and dimensionality reduction, to name a few. The recent upsurge of research toward compressive sampling and parsimonious signal representations hinges on signals being sparse, either naturally, or, after projecting them on a proper basis. I will start by introducing a neat link between the seemingly unrelated notions of sparsity and robustness against outliers, even when the signals involved are not sparse. It will be argued that controlling sparsity of model residuals leads to statistical learning algorithms that are computationally affordable and universally robust to outlier models. I will highlight a few relevant application domains that include preference measurement for consumer utility function estimation in marketing, and load curve cleansing - a critical task in power systems engineering and management.

In the second part of the talk, I will switch focus towards robust principal component analysis (PCA) algorithms, which are capable of extracting the most informative low-dimensional structure from (grossly corrupted) high-dimensional data. Beyond its ties to robust statistics, the developed outlier-aware PCA framework is versatile to accommodate scalable algorithms to: i) track the low-rank signal subspace as new data are acquired in real time; and ii) determine principal components robustly in (possibly) infinite-dimensional feature spaces. Synthetic and real data tests corroborate the effectiveness of the proposed robust PCA schemes, when used to identify aberrant responses in personality assessment surveys, as well as unveil communities in social networks, and intruders from video surveillance data.

### **SPEAKER BIOGRAPHY**

**G. B. Giannakis** (IEEE Fellow'97) received his Diploma in Electrical Engineering from the National Technical University of Athens, Greece, 1981. From 1982 to 1986 he was with the Univ. of Southern California (USC), where he received his MSc. in Electrical Engineering, 1983, MSc. in Mathematics, 1986, and Ph.D. in Electrical Engr., 1986. Since 1999 he has been a professor with the Univ. of Minnesota, where he now holds an ADC Chair in Wireless Telecommunications in the ECE Department, and serves as director of the Digital Technology Center.



His general interests span the areas of communications, networking and statistical signal processing - subjects on which he has published two edited books, two research monographs, 20 book chapters, 325 journal and 525 conference papers (H-index=95; top in SP Society). Current research focuses on compressive sampling, cognitive radios, cross-layer designs, wireless sensors, social and power grid

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networks. He is the (co-) inventor of 21 patents issued, and the (co-) recipient of 8 best paper awards from the IEEE Signal Processing (SP) and Communications Societies, including the G. Marconi Prize Paper Award in Wireless Communications. He also received Technical Achievement Awards from the SP Society (2000), from EURASIP (2005), a Young Faculty Teaching Award, and the G. W. Taylor Award for Distinguished Research from the University of Minnesota. He is a Fellow of EURASIP, and has served the IEEE in a number of posts, including that of a Distinguished Lecturer for the IEEE-SP Society.

### **Nonlinear Communications: Achievable Rates, Estimation and Decoding**

Nicholas Kalouptsidis

University of Athens

Department of Informatics & Telecommunications

Division of Communications and Signal Processing,

TYPA Building, Panepistimiopolis, 157 84 Ilissia, Athens

Greece

#### **ABSTRACT**

Transmission over nonlinear communication channels is approached by sparse Volterra models. Input output and blind techniques for adaptive channel identification are presented. Error probability bounds and achievable rates are developed. Channel coding based on LDPD codes and compressive sensing decoding is described.

#### **SPEAKER BIOGRAPHY**

**N. Kalouptsidis** was born in Athens, Greece, on September 13, 1951. He received the B.Sc. degree in mathematics (with highest honors) from the University of Athens, Athens, Greece, in 1973 and the M.S. and Ph.D. degrees in systems science and mathematics from Washington University, St. Louis, MO, in 1975 and 1976 respectively. He has held visiting positions at Washington University, St. Louis, MO; Politecnico di Torino, Turin, Italy; Northeastern University, Boston, MA; and CNET Lannion, France. He has been an Associate Professor and Professor with the Department of Physics, University of Athens. In Fall 1998, he was a Clyde Chair Professor with the School of Engineering, University of Utah, Salt Lake City. In Spring 2008, he was a visiting scholar at Harvard university. He is currently a Professor with the Department of Informatics and Telecommunications, University of Athens. He is the author of the textbook *Signal Processing Systems: Theory and Design* (New York: Wiley, 1997) and co-editor, with S. Theodoridis, of the book *Adaptive System Identification and Signal Processing Algorithms* (Englewood Cliffs, NJ: Prentice-Hall, 1993).



### **Sparse and Low Rank Representations in Music Signal Analysis**

Constantine Kotropoulos

Department of Informatics

Aristotle University of Thessaloniki

Thessaloniki 54124, Greece

#### **ABSTRACT**

Music genre is probably the most popular description of music despite the lack of a commonly agreed definition of music genre. Joint sparse and low rank representations (JSLRR) will be applied to music genre classification. Each music recording is parameterized in terms of its slow auditory spectro-temporal modulations, yielding the so-called auditory cortical representation. By assuming that each genre class is spanned by a linear subspace, an ensemble of auditory cortical representations, which

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belongs to diverse music genres, is drawn from a union of independent linear subspaces. If this assumption holds exactly, each test cortical representation can be represented as a linear combination of the training cortical representations stemming from the class it belongs to. Consequently, it can be classified by identifying the subspace where it lies onto. However in practice, the cortical representations do not follow exactly subspace structures due to modeling noise. The JSLRR is able to: 1) correct the modeling noise in the test samples, 2) identify the subspaces that the test samples lie onto, and 3) provide a simple means of rejecting invalid test samples not drawn from any particular genre subspace. In the ideal case, when the data contain neither outliers nor noise, the JSLRR is proved to be dense for within-class affinities, while exhibiting zero between-class affinities. In the presence of noise, a robust version of the JSLRR is obtained by solving a convex problem, which involves the minimization of the nuclear norm, the  $\ell_1$  norm, and the  $\ell_2/\ell_1$  norm. To this end, an efficient algorithm is proposed. Based on the JSLRR, a novel classifier is developed. Special cases of this classifier are the joint sparse subspace classifier and the low-rank subspace classifier. The performance of the aforementioned classifiers is compared against that of the sparse representation based classifier, the nearest subspace classifier, the support vector machines, and the nearest neighbour classifier for music genre classification on the GTZAN dataset and the ISMIR 2004 Genre benchmark datasets. Sparse and low rank representations are not limited to music genre recognition. Applications to music annotation and music structure analysis will be presented as well.

#### SPEAKER BIOGRAPHY

**Constantine Kotropoulos** was born in Kavala, Greece in 1965. He received the Diploma degree with honors in Electrical Engineering in 1988 and the PhD degree in Electrical & Computer Engineering in 1993, both from the Aristotle University of Thessaloniki.

He is currently an Associate Professor in the Department of Informatics at the Aristotle University of Thessaloniki. From 1989 to 1993 he was a research and teaching assistant in the Department of Electrical & Computer Engineering at the same university. In 1995, he joined the Department of Informatics at the Aristotle University of Thessaloniki as a senior researcher and served then as a Lecturer from 1997 to 2001 and as an Assistant Professor from 2002 to 2007. He was a visiting research scholar in the Department of Electrical and Computer Engineering at the University of Delaware, USA during the academic year 2008-2009 and he conducted research in the Signal Processing Laboratory at Tampere University of Technology, Finland during the summer of 1993. He has co-authored 44 journal papers, 157 conference papers, and contributed 6 chapters to edited books in his areas of expertise. He is co-editor of the book “Nonlinear Model-Based Image/Video Processing and Analysis” (J. Wiley and Sons, 2001). His current research interests include audio, speech, and language processing; signal processing; pattern recognition; multimedia information retrieval; biometric authentication techniques, and human-centered multimodal computer interaction.

Prof. Kotropoulos was a scholar of the State Scholarship Foundation of Greece and the Bodossaki Foundation. He is a senior member of the IEEE and a member of EURASIP, IAPR, and the Technical Chamber of Greece. He is an Associate Editor of IEEE Signal Processing Letters, a member of the Editorial Board of Advances in Multimedia and ISRN Artificial Intelligence journals, and serves as a EURASIP local liaison officer for Greece.

