Opening Ceremony

Tuesday 19 January, 9:00-10:00

Richard Heusdens, Cedric Richard
General chairs, EUSIPCO2020
Opening address

Patrick Naylor
EURASIP President
State of the Society

Kostas Berberidis
EURASIP Director of Awards
Presentation of the EURASIP Society Awards

On behalf of the European Association for Signal Processing (EURASIP), it is a great pleasure of the organising committee to warmly welcome you to the 28th European Signal Processing Conference, EUSIPCO 2020. Getting together these days has become more difficult because of travel restrictions due to the COVID-19 outbreak worldwide. Still, it is important to get together to meet experts and share experiences. With the safety and well-being of our participants as our top priority, the organising committee and the EURASIP board of directors have decided to reschedule the physical conference from August 24 – 28, 2020, into a virtual event on January 18 – 22, 2021. Meanwhile, the proceedings of the conference have already been published on the EUSIPCO2020.org website as well as on IEEE Xplore.

EUSIPCO is the flagship conference of EURASIP and offers a comprehensive technical program addressing all the latest developments in research and technology for signal processing. The EUSIPCO 2020 program includes four plenary talks given by worldclass speakers, seven tutorial presentations given by prominent experts in the field, oral and poster sessions, and two student-oriented competitions: a best student paper competition and a three-minute thesis contest.

The organization of EUSIPCO 2020 has been possible because of the work of countless people. First of all we would like to thank all the authors who have submitted their papers for presentation at EUSIPCO 2020 and have chosen this conference to disseminate their work to the scientific community. In addition, our sincere appreciation goes to the Technical Program Chairs, the Special Session Chairs, the Area Chairs, as well as to the reviewers for having set-up an exciting program. A special thank goes to Richard Hendriks, the financial chair of the conference, who has been co-organising EUSIPCO 2020. We also thank the EURASIP BoD for asking us to organise the conference. And last but not least, we thank the plenary speakers, the tutorial presenters, the special session organisers, the session chairs, and the satellite workshop organisers for their important contributions.

Lunch Presentations

Wednesday 20 January, 12:30-13:30

Kay Tancock

Elsevier

Author Workshop

This session gives information on how to publish in one of the EURASIP Elsevier journals, i.e.

- Signal Processing
- Signal Processing: Image Communication
- Speech Communication

Thursday 21 January, 12:30-13:30

Angelina Wagner

Springer Nature

Author Workshop

This session gives information on how to publish in one of the EURASIP Springer journals, i.e.

- EURASIP Journal on Advances in Signal Processing
- EURASIP Journal on Wireless Communications and Networking
- EURASIP Journal on Audio, Speech and Music Processing
- EURASIP Journal on Image and Video Processing
- EURASIP Journal on Information Security

3MT Competition

Friday 22 January, 12:30-13:30

Andreas Jakobsson and Jesper Rindom Jensen

EUSIPCO2020 Student Activities Chairs

3 Minutes Thesis Awards Competition

After the successful past editions, the Technical Program Committee of EUSIPCO 2020 is offering for the sixth consecutive year a 3 Minutes Thesis (3MT) contest, where PhD students have three minutes to present a compelling oration on their thesis and its significance. This activity is sponsored by EURASIP. It is an exercise for students to consolidate their ideas so they can present them concisely to an audience specialized in different areas. Together with scientific and technical quality, EURASIP wants to promote transversal skills of PhD researchers such as oral and presentation skills, and it also wants to help PhDs to gain visibility of their work.

A shortlist of five finalists was selected by a jury composed by two members of the EURASIP BoD and the EUSIPCO 2020 Student Activity Chairs.

In this session, the 5 finalists will present their thesis, and the audience can vote for the winner!

- Miao Sun, TU Delft
- Oumaima El Mansouri, University of Toulouse
- Qiongxiu Li, Aalborg University
- Gao Rui, Aalto University
- Pierre Mahé, Université de La Rochelle

Closing ceremony

Friday 22 January, 13:30-14:00

Mads Græsbøll Christensen and Timo Gerkmann

EUSIPCO2020 Awards Co-chairs

Presentation of the Conference Student Paper Award

Richard Heusdens

EUSIPCO2020 General Chair

Closing remarks

Keynote talks

Geert Leus (TU Delft, The Netherlands) and Mário Figueiredo (University of Lisboa, Portugal)

EUSIPCO2020 PLENARY CO-CHAIRS

EUSIPCO is proud to present 4 keynote presentations by world-renowned speakers. The first presentation is traditionally by one of the recently appointed EURASIP Fellows, in this case Stephen McLaughlin.

Tuesday 19 January, 10:00-11:00

Stephen McLaughlin

HERIOT WATT UNIVERSITY

EURASIP Fellow address

Challenges in imaging and sensing in photon-starved regimes

How many photons per pixel do we need to construct an image? This apparently simple question is rather complicated to answer as it is dependent on what you want to use the image for. Computational imaging and sensing combines measurement and computational methods often when the measurement conditions are weak, few in number, or highly indirect (e.g. when the measurements are few in number, the information of interest is indirectly observed, or in challenging observation conditions). The recent surge in the development of sensors, together with a new wave of algorithms allowing on-chip, scalable and robust data processing, has induced an increase of activity with notable results in the domain of low flux imaging and sensing.
In this talk, I will provide an overview of the major challenges encountered in low-illumination (e.g., ultrafast) imaging and how these problems have recently been addressed for a range of applications in extreme conditions. The applications considered ranging from the identification of radionuclide signatures from weak sources in the presence of a high radiation background to single-photon lidar 3D imaging of complex outdoor scenes in broad daylight from distances up to 320 metres.

Short biography:
Stephen McLaughlin the B.Sc. degree in Electronics and Electrical Engineering from the University of Glasgow in 1981 and the Ph.D. degree from the University of Edinburgh in 1990. From 1981 to 1986 he was a Development Engineer in industry. In 1986 he joined the Dept. of Electronics and Electrical Engineering at the University of Edinburgh as a research fellow where he studied the performance of linear adaptive algorithms in high noise and nonstationary environments.

In 1988 he joined the academic staff at Edinburgh, and from 1991 until 2001 he held a Royal Society University Research Fellowship to study nonlinear signal processing techniques. In 2002 he was awarded a personal Chair in Electronic Communication Systems at the University of Edinburgh. In October 2011 he joined Heriot-Watt University as a Professor of Signal Processing and Head of the School of Engineering and Physical Sciences. His research interests is in statistical signal processing theory and its applications to biomedical, energy, imaging and communication systems. Prof McLaughlin is a Fellow of the Royal Academy of Engineering, of the Royal Society of Edinburgh, of the Institute of Engineering and Technology and of the IEEE and is a EURASIP Fellow.

Wednesday 20 January, 11:30-12:30

Michael Unser

EPFL, SWITZERLAND

Deep splines

We present a unifying functional framework for the implementation and training of deep neural networks

(DNN) with free-form activation functions. To make the problem well posed, we constrain the shape of the trainable activations (neurons) by penalizing their second-order total-variations. We prove that the optimal activations are adaptive piecewise-linear splines, which allows us to recast the problem as a parametric optimization.

We then specify some corresponding trainable B-spline-based activation units. These modules can be inserted in deep neural architectures and optimized efficiently using standard tools. We provide experimental results that demonstrate the benefit of our approach.

Short biography:
Michael Unser is professor and director of EPFL's Biomedical Imaging Group, Lausanne, Switzerland. His primary area of investigation is biomedical image processing. He is internationally recognized for his research contributions to sampling theory, wavelets, the use of splines for image processing, stochastic processes, and computational bioimaging. He has published over 350 journal papers on those topics. He is the author with P. Tafti of the book "An introduction to sparse stochastic processes", Cambridge University Press 2014.

From 1985 to 1997, he was with the Biomedical Engineering and Instrumentation Program, National Institutes of Health, Bethesda USA, conducting research on bioimaging.

Dr. Unser has served on the editorial board of most of the primary journals in his field including the IEEE Transactions on Medical Imaging (associate Editor-in-Chief 2003-2005), IEEE Trans. Image Processing, Proc. of IEEE, and SIAM J. of Imaging Sciences. He is the founding chair of the technical committee on Bio Imaging and Signal Processing (BISP) of the IEEE Signal Processing Society.

Prof. Unser is a fellow of the IEEE (1999), an EURASIP fellow (2009), and a member of the Swiss Academy of Engineering Sciences. He is the recipient of several international prizes including five IEEE-SPS Best Paper Awards, two Technical Achievement Awards from the IEEE (2008 SPS and EMBS 2010), the Technical Achievement Award from EURASIP (2018), and a recent Career Achievement Award (IEEE EMBS 2020).

Thursday 21 January, 11:30-12:30

Rebecca Willett
UNIVERSITY OF CHICAGO

Model Adaptation for Inverse Problems in Imaging
Many challenging image processing tasks can be described by an ill-posed linear inverse problem: deblurring, deconvolution, inpainting, compressed sensing, and superresolution all lie in this framework. Traditional inverse problem solvers minimize a cost function consisting of a data-fit term, which measures how well an image matches the observations, and a regularizer, which reflects prior knowledge and promotes images with desirable properties like smoothness. Recent advances in machine learning and image processing have illustrated that it is often possible to learn a regularizer from training data that can outperform more traditional regularizers. In this talk, I describe the central prevailing themes of this emerging area and present a taxonomy that can be used to categorize different problems and reconstruction methods. We will also explore the lack of robustness of such methods to misspecification of the forward model: if at test time the forward model varies (even slightly) from the one the network was trained on, the network performance can degrade substantially. I will describe novel retraining procedures that adapt the network to reconstruct measurements from a perturbed forward model, even without full knowledge of the perturbation.

Short biography:
Rebecca Willett is a Professor of Statistics and Computer Science at the University of Chicago. Her research is focused on machine learning, signal processing, and large-scale data science. Willett received the National Science Foundation CAREER Award in 2007, was a member of the DARPA Computer Science Study Group, and received an Air Force Office of Scientific Research Young Investigator Program award in 2010.

She currently leads the University of Chicago's AI+Science Initiative, is a co-principal investigator and member of the Executive Committee for the Institute for the Foundations of Data Science, helps direct the Air Force Research Lab University Center of Excellence on Machine Learning, and serves on the Scientific Advisory Committee for the National Science Foundation's Institute for Mathematical and Statistical Innovation and the AI for Science committee for the US Department of Energy's Advanced Scientific Computing Research program.
She completed her PhD in Electrical and Computer Engineering at Rice University in 2005 and was an Assistant then tenured Associate Professor of Electrical and Computer Engineering at Duke University from 2005 to 2013. She was an Associate Professor of Electrical and Computer Engineering, Harvey D. Spangler Faculty Scholar, and Fellow of the Wisconsin Institutes for Discovery at the University of Wisconsin-Madison from 2013 to 2018.

Friday 21 January, 11:30-12:30

Robert Heath
NORTH CAROLINA STATE UNIVERSITY

What is next in signal processing for MIMO communication?

In the last 20 years, MIMO wireless communication has gone from concept to commercial deployments in millions of devices. Two flavours of MIMO — massive and mmWave — are key components of 5G. In this talk, I will examine aspects of MIMO communication that may influence the next decade of wireless communications. I will start by highlighting, from a signal processing perspective, what was interesting about taking MIMO to higher carrier frequencies at mmWave. Then I will speculate about forthcoming directions for MIMO communication research. I will discuss the implications of going to mmWave about 100 GHz to terahertz frequencies, including implications on the channel assumptions and array architectures. I will make the case that it may be relevant to go back to signals from a circuits perspective, to make physically consistent MIMO models that work with large bandwidths. Finally, I will talk about how other advancements in circuits, antennas, and materials may change the models and assumptions that are used in MIMO signal processing.

Short Biography:
Robert W. Heath Jr. received the Ph.D. in EE from Stanford University. He is a Distinguished Professor at North Carolina State University.

From 2002-2020 he was with The University of Texas at Austin, most recently as Cockrell Family Regents Chair in Engineering and Director of UT SAVES. He has received several awards including the 2017 EURASIP Technical Achievement Award, the 2019 IEEE Communications Society Stephen O. Rice Prize, and the 2019 IEEE Kiyo Tomiyasu Award.

He authored "Introduction to Wireless Digital Communication" (Prentice Hall in 2017) and "Digital Wireless Communication: Physical Layer Exploration Lab Using the NI USRP" (National Technology and Science Press in 2012). He co-authored "Millimeter Wave Wireless Communications" (Prentice Hall in 2014) and "Foundations of MIMO Communications" (Cambridge 2019). He is currently EIC of IEEE Signal Processing Magazine.

He is a member-at-large on the IEEE Communications Society Board-of-Governors (2020-2022) and is a past member-at-large on the IEEE Signal Processing Society Board-of-Governors (2016-2018). He is a licensed Amateur Radio Operator, a registered Professional Engineer in Texas, a Private Pilot, a Fellow of the National Academy of Inventors, and a Fellow of the IEEE.

Tutorials

Sundeep Chepuri (Indian Institute of Science, India) and Béatrice Pesquet-Popescu (Thales LAS, France)

EUSIPCO2020 Tutorials Chairs

EUSIPCO is proud to present 7 tutorials, selected by their technical quality, relevance, and timeliness of the topic, quality of the proposal, and qualification of the speakers. These half-day tutorials are presented on Monday, before the technical program of the conference starts.

Monday 18 January, 9:00-12:30

T1: Nonconvex Optimization for High-Dimensional Signal Estimation

Yuejie Chi (Carnegie Mellon University), Yuxin Chen (Princeton University), Cong Ma (Princeton University)

Recent years have seen tremendous progress in the development of provable nonconvex information processing, with the aid of proper statistical models of data. Examples include recommendation systems, structured matrix recovery, phase retrieval, community detection, ranking, amongst others. The focal point of this tutorial is two approaches that have received much attention recently. (1) Spectral methods: which refer to a collection of algorithms built upon eigenanalysis of some properly arranged data matrices. While the studies of spectral methods can be traced back to classical matrix perturbation theory, the past decade has witnessed a tremendous theoretical advance with the aid of statistical modeling, particularly in the development of entrywise perturbation bounds that are much less known to the signal processing community. (2) Nonconvex iterative methods, which attempt to solve the nonconvex problems of interest via iterative optimization algorithms like gradient descent. Despite a high degree of nonconvexity, it has been shown that the loss surface of many high-dimensional signal processing problems may possess benign geometric structures either locally or globally, which in turn allow one to find optimal solutions efficiently. As a result, for a broad range of low-rank matrix estimation problems, nonconvex iterative methods are capable of achieving optimal statistical accuracy and computational efficiency simultaneously.

This tutorial will focus on both spectral methods and iterative optimization algorithms for estimating low-complexity models in high dimension, highlighting the following aspects:

- *The role of statistical models:* with the help of statistical models, one is allowed to leverage the population risk / loss functions that might be easier to characterize in terms of optimization geometry. The main challenge lies in how the optimization geometry translates back to the empirical loss. The tutorial will discuss common techniques and tools for developing such an analysis framework in both global (where a random initialization suffices) and local (where a careful initialization close to the desired solution is needed) approaches for optimization.
- *The entrywise performance bounds:* the tutorial will emphasize an entrywise eigenvector (or singular vector) perturbation analysis, a fundamentally important topic that has only recently become tractable thanks to the advances of statistical tools. Such performance bounds, which are previously rarely available, are of great interest in applications such as ranking, community detection, and localization.
- *Case studies:* the tutorial will feature several key applications and analysis techniques, and highlight their broad applicability.

T2: Statistical Relational Artificial Intelligence for Unified Music Understanding and Creation

Carmine-Emanuele Cella (Center for New Music and Audio Technology (CNMAT), University of California, Berkeley, Helene-Camille Crayencour (Centre National de la Recherche Scientifique), George Tzanetakis (Department of Computer Science, University of Victoria, Canada)

Understanding music audio signals requires dealing with uncertainty and complex relational structure at multiple levels of representation and integrating information from multiple tasks. Traditionally these issues have been treated separately. Uncertainty in knowledge has been addressed with probability and learning techniques while knowledge and complex relational information has been modeled using logic representations. Traditional approaches for music processing are not able to cope with its rich, highly structured, relational structure. Logic can handle the complexity of the real world and is capable of reasoning with large numbers of interacting heterogeneous objects, but it cannot deal with its uncertainty. Probabilistic graphical models are a powerful framework for dealing with uncertainty, but they can't handle real- world complexity. Deep learning is able to create complex abstract representations from large-scale raw data but its mechanism for structure learning remains to be understood. In this tutorial we present recent development in the area of Statistical Relational Artificial Intelligence (StarAI) that unifies probability, logic and (deep) learning. We describe how existing approaches to music information retrieval (MIR) can find powerful extensions and unification in StarAI and outline future opportunities and challenges in future research possibilities.

T3: Advances in Massive MIMO Hybrid Beamforming: From Optimization to Learning

Kumar Vijay Mishra (U. S. Army Research Laboratory) and Christos G. Tsinos (University of Luxembourg)

Next-generation millimeter-wave (mm-Wave) communications offer wider bandwidth and higher data rates than conventional cellular systems. Hybrid beamforming techniques are key to successfully realizing the massive multiple-input-multiple-output (MIMO) antenna architectures for mm-Wave communications. The design of the hybrid beamformers requires solving difficult nonconvex optimization problems that involve a common performance metric, i.e. spectral efficiency or energy efficiency as a cost function and a number of constraints related to the employed communication regime and the adopted architecture of the hybrid system. Typical architectures involve a low dimensional baseband counterpart connected to the antenna array via an analog phase shifting network. Thus, the hybrid beamformer admits a factorized form constituted by a beamforming matrix for the BB counterpart and a matrix with unit-modulus entries, i.e. the phase shifts of the analog network. There is no standard methodology for solving such problems and usually, the derivation of an efficient solution is a very challenging task. Various optimization-based approaches have been suggested that are tuned to specific scenarios and requirements. However, these methods suffer from high computational complexity and their performance strongly relies on the perfect channel condition. Some of these challenges are offset by employing deep learning (DL) techniques which offer advantages such as low computational complexity while solving optimization-based or combinatorial search problems in hybrid beamforming. In this tutorial, the audience will learn ways to design hybrid beamforming transceivers by decoupling the transmitter(s)-receiver(s) problem and applying different optimization frameworks for deriving efficient algorithmic solutions. The different approaches will be thoroughly analyzed and compared with respect to their performance and computational complexity. The application of the proposed methodology to the design of hybrid beamformers for single-user MIMO, multi-user MIMO, cognitive radio, cooperative frequency-selective systems will also be discussed. Finally, the audience will learn about applying DL to various aspects of hybrid beamforming including channel estimation, antenna selection, the effect of quantization, wideband beamforming for frequency-selective channels, knowledge transfer across various geometries, and spatial modulation.

T4: A Unified Framework for Underdetermined and Determined Blind Audio Source Separation

Nobutaka Ito (NTT Corporation, Japan) and Hiroshi Sawada (NTT Corporation, Japan)

This tutorial presents a unified framework for underdetermined and determined Blind Source Separation (BSS) for audio signals. The framework encompasses eight BSS methods as particular examples, namely complex-Gaussian/second-order-statistics Independent Component Analysis (ICA), Rank-1 spatial Covariance Analysis (R1CA), Full-rank spatial Covariance Analysis (FCA), FastFCA, Independent Low-Rank Matrix Analysis (ILRMA), rank-1 Multichannel Nonnegative Matrix Factorization (MNMF), full-rank MNMF, and FastMNMF. The framework enables us to garner a unified understanding of the BSS methods. Especially, it elucidates close relation between underdetermined and determined BSS that have been studied somewhat independently of each other, hopefully creating synergy between these research areas and stimulating further advances of them. The tutorial features a live BSS demo, where three volunteers are rounded up from the audience and asked to read a sentence simultaneously. A recording will be made with an IC recorder equipped with two microphones, and separated into individual speakers' speech using some BSS methods explained in the tutorial.

Monday 18 January, 13:30-17:00

T5: Four decades of array signal processing research: an optimization relaxation technique perspective

Marius Pesavento (TU Darmstadt), Minh Trinh-Hoang (TU Darmstadt), Mats Viberg (Blekinge Institute of Technology)

In our community, we currently witness that sensor array processing, more specifically direction-of- arrival (DoA) estimation, receives new momentum due to the emergence of new applications such as automotive radar, drone localization, parametric channel estimation in Massive MIMO. This development is further inspired by the emergence of new powerful and affordable multiantenna hardware platforms. Today, we are looking back at a history of more than four decades of super resolution DoA estimation techniques, starting from the early parametric methods such as the computationally expensive maximum likelihood (ML) techniques to the early subspace based techniques such as Pisarenko, MUSIC, ESPRIT, and MODE.
In this tutorial, we provide a consistent overview of developments in four decades of sensor array processing techniques for DoA estimation, ranging from traditional super resolution techniques to modern sparse optimization based DoA estimation techniques. In our overview, we take a modern optimization based view and retell the story of sensor array processing from the relaxation technique perspective. We will show, from our perspective, that constrained optimization problem formulations and problem relaxation techniques have always played an important role in the development of powerful DoA estimation methods. This optimization relaxation viewpoint will provide novel insight into the design and analysis of existing algorithms. Furthermore, as a consequent step forward along the line of relaxation techniques in DoA estimation, we will introduce the partial relaxation framework. The basic concept of the partial relaxation framework is intuitive and simple, and it can be applied to various multisource DoA estimation criteria. In contrast to classical multisource estimation methods where costly optimization is carried out over the multi-dimensional array manifold, in partial relaxation the manifold structure is maintained only for a single steering vector while the manifold structure is relaxed for the remaining steering vectors. This relaxation, despite still nonconvex, often admits closed form solutions for the nuisance parameters, which in turn results in computationally tractable algorithms. The estimators constructed under the partial relaxation framework show remarkable performance in the practically important threshold domain, i.e., in scenarios where the sources are poorly separated, the SNR is low or the sample number is small.

T6: Machine Learning and Wireless Communications

Nir Shlezinger (Weizmann Institute), Yonina C. Eldar (Weizmann Institute), H. Vincent Poor (Princeton University)

Mobile communications and machine learning are two of the most exciting and rapidly developing technological fields of our time. In the past few years, these two fields have begun to merge in two fundamental ways. First, while mobile communications has developed largely as a model-driven field, the complexities of many emerging communication scenarios raise the need to introduce data-driven methods into the design and analysis of mobile networks. Second, many machine learning problems are by their nature distributed due to either physical limitations or privacy concerns. This distributed nature can be exploited by using mobile networks as part of the learning mechanisms, i.e., as platforms for machine learning.
In this tutorial we will illuminate these two perspectives, presenting a representative set of relevant problems which have been addressed in the recent literature, and discussing the multitude of exciting research directions which arise from the combination of machine learning and wireless communications. We will begin with the application of machine learning methods for optimizing wireless networks: Here, we will first survey some of the challenges in communication networks which can be treated using machine learning tools. Then, we will focus on one of the fundamental problems in digital communications – receiver design. We will review different designs of data-driven receivers, and discuss how they can be related to conventional and emerging approaches for combining machine learning and model-based algorithms. We will conclude this part of the tutorial with a set of communication-related problems which can be tackled in a data-driven manner.
The second part of the tutorial will be dedicated to wireless networks as a platform for machine learning: We will discuss communication issues arising in distributed learning problems such as federated learning and collaborative learning. We will explain how established communications and coding methods can contribute to the development of these emerging distributed learning technologies, illustrating these ideas through examples from recent research in the field. We will conclude with a set of open machine learning related problems, which we believe can be tackled using established communications and signal processing techniques.

T7: Adaptive Optimization Methods for Machine Learning and Signal Processing

Kfir Y. Levy (Technion), Ahmet Alacaoglu (EPFL), Ali Kavis (EPFL) Volkan Cevher (EPFL)

In this tutorial, we are going to focus on several aspects of adaptivity for optimization problems ranging from function minimization to min-max optimization, covering applications such as neural network and generative adversarial network (GAN) training, reinforcement learning, sparse recovery and inverse problems. Our exposition will shed light onto the underlying mechanisms and analyses of the algorithms, such as online learning and regret minimization; and the know-how that is needed to make the most of them in applications. We will also illustrate the benefits of adaptive methods over their non-adaptive variants.

Special Sessions

Sharon Gannot, Tulay Adali, Helmut Bölcskei

EUSIPCO2020 Special Sessions Chairs

EUSIPCO has an excellent track record over the years for organizing Special Sessions in new or emerging areas. This year as well we received innovative, high-quality and potentially interdisciplinary proposals for Special Sessions that complement the regular program of the conference. After review, we were able to select the following list of sessions:

Tuesday 19 January, 11:30-13:30

SS-L1: Signal processing in Network Physiology

Carolina Varon, KU Leuven, Belgium, Luca Faes, Department of Engineering, University of Palermo, Italy and Plamen Ch. Ivanov, Boston University, USA

Network physiology is an emerging interdisciplinary field that aims at understanding the way physiological systems and organs interact to regulate and coordinate their functions in order to maintain a certain physiological state. This is particularly challenging since these interactions are often non-linear and/or time-varying in nature, and occur across multiple time scales. Moreover, it has been observed that physiological systems couple their functions in different coexisting ways, integrating smaller spatial scales (involving, e.g., neural synchrony in the brain) with system-wide couplings (e.g., cardiovascular, cardiorespiratory) and multiple organ couplings (brain-heart and brain-body). The field of network physiology was formalized recently by Prof. Plamen Ivanov, one of the organizers of this session, in order to tackle these challenges by bringing together specialists from different areas like biomedical engineering, signal processing, nonlinear dynamics and statistical physics.

SS-P1: Trends in Graph Signal Processing

Gerald Matz, TU Vienna, Austria

Tuesday 19 January, 13:30-15:30

SS-P2: Bias in Biometrics

Pawel Drozdowski, pawel.drozdowski@h-da.de, Antitza Dantcheva, INRIA, Sophia Antipolis, France and Naser Damer, Fraunhofer Institute for Computer Graphics, Germany

Biometric technologies are ubiquitous in personal, commercial, and governmental applications all around the world, where they represent an integral component of many identity management and access control systems. Biometrics can be used in cooperative systems, where they replace or supplement the knowledge and possession-based methods, as well as in non-cooperative systems such as surveillance and forensics.

Recently, concerns regarding the existence of systematic bias in automated decision systems (including biometrics) have been raised by researchers, media outlets, and non-governmental organisations. In this context, a biased algorithm produces statistically different outcomes (decisions) for different demographic groups of individuals, e.g. based on sex, age, and ethnicity. Most prominently,face recognition algorithms have often been labelled as “racist” or “biased”. Current scientific literature w.r.t. this subject within facial recognition is sparse, whereas for other biometric characteristics it is almost non-existent. The elevated societal interest and the potential of very high impact on the lives of individual citizens make research into this emerging area urgently needed.

Tuesday 19 January, 16:00-18:00

SS-L2: Learning over Graphs

Elvin Isufi, Delft University of Technology, The Netherlands and Geert Leus, Delft University of Technology, The Netherlands

The increasing amount of data over networks, such as data generated by brain, financial, and sensor networks has recently seen an increasing scientific effort to extend signal processing and machine learning tools to these data. While in the last decade we saw efforts to extend Fourier concepts form time and images to graph data, more recently we are experiencing the adaptation of these tools to learn meaningful representations for graph data by exploring concepts like: graph neural networks, graph convolutions, and spectral kernels on graphs. All these sub-areas fall under the concept of Learning over Graphs, which in per se aim to leverage the underlying data structure and the feature signal on top of the nodes —e.g., in a sensor network example, nodes are sensors, communications links are edges, and the signal features are sensor measurements— to find patterns for classification and regression purposes.

Wednesday 20 January, 9:00-11:00

SS-P3: Mathematical Foundations and Algorithms for Ptychography

Felix Krahmer, Technical University of Munich, Germany and Frank Filbir, Helmholtz Zentrum München, Germany

Wednesday 20 January, 16:00-18:00

SS-L3: Signal Processing in Atrial Fibrillation

Bahareh Abdi, TU Delft, The Netherlands and Richard Hendriks, TU Delft, The Netherlands

Atrial fibrillation (AF) is a common age-related cardiac arrhythmia characterized by rapid and irregular electrical activity of the atria. In Europe, 1–3% of the population (more specifically elderly) suffer from AF. These patients have a five times higher risk of strokes, especially ischemic stroke with higher death rate or worse prognosis at higher cost. The development and progression of AF is rooted in impaired electrical conduction and structural damage of atrial tissue. High resolution electrogram (EGM) signals recorded during open chest surgery and electrocardiogram (ECG) signals recorded from body surface electrograms can help to localize and quantify the degree of structural damage of atrial tissue and to stage AF. The interpretation of these signals by a cardiologist is quite complex and time consuming, due to the 3D data set and the interaction of many parameters. Signal processing approaches offer strong tools for automatic assessment of signal properties and to analyse AF.

SS-L4: Deep Machine Listening

Michele Scarpiniti, Universita di Roma, Italy, Jen-Tzung Chien, National Chiao Tung University, Taiwan, and Stefano Squartini, Università Politecnica delle Marche, Ancona, Italy

Machine Listening (ML) refers to the class of smart systems and computational algorithms targeted at the automatic analysis and understanding of sound by a machine. Machine Listening is a multidisciplinary research field that requires a combination of signal processing, machine learning, and artificial intelligence techniques. Given also the recent interest and great success of Deep Learning techniques, ML has recently attracted increasing interest within several application domains, such as safety, security, entertainment, health, psychology, and several others. The focus is on suitably processing the audio streams, often acquired in presence of harsh acoustic conditions, to extract the information contained therein to create and control knowledgeable services. More recently, the exploitation of end-to-end computational models, to directly handle the acoustic raw data, and the employment of cross-domain approaches, to jointly identify the information contained in heterogeneous audio signals, have been widely used on purpose. The aim of this session is therefore to provide the most recent advances in the applications of Machine Listening exploiting Deep Learning techniques to a wide range of audio processing tasks in real acoustic environments.

Thursday 21 January, 9:00-11:00

SS-L5: Acoustic Scene Analysis and Signal Enhancement Based on Advanced Signal Processing, ML

Shoji Makino, University of Tsukuba, Japan and Nobutaka Ono, Tokyo Metropolitan University, Japan

We are surrounded by sounds in our daily lives. To know the acoustic environment, Acoustic Scene Analysis and Signal Enhancement technologies are essential. The Acoustic Scene Analysis and Signal Enhancement include (but are not limited to) event detection, audio content searching, acoustic scene classification, sound profiling, source localization, source separation, noise reduction, dereverberation, sound effect generation, virtual acoustic reproduction, and many others. These techniques form the core of the state-of-the-art audio and acoustic signal processing and are indispensable to the realization of future communication via for both man-machine and human-human interfaces.

SS-L6: Computational Imaging in the Era of Learning: Imagers, Priors and Algorithms

Laurent Jacques, UC Louvain, Belgium and Emrah Bostan, University of Amsterdam, The Netherlands

How can we co-design data capture and image reconstruction to optimally recover visual information in challenging imaging conditions such as low-light, multiple scattering, and non-line-of-sight? How can machine learning help us solve these complex problems that are fundamental to computational cameras, diffractive imaging, and autonomous navigation. Can we learn effective prior models from data to represent images while characterizing the imager simultaneously? How can we leverage multiple data streams that differ in spatial and/or temporal resolution, field-of-view, and dynamic range to boost the accuracy of the image recovery algorithms?

This special session will cover the latest breakthrough research that answer these questions. Selected works are at the interplay of signal processing and machine learning. The session will hence provide the EUSIPCO audience and signal processing community with a very timely update on how imaging benefits from recent advances in deep neural networks and generative models.

SS-P4: New Challenges in Tensor/Structured Matrix Based Methods and Algorithms

Remy Boyer, Université de Lille 1, France and Xiao Fu, Oregon State University, USA

Matrix and tensor methods for various models have sparked a large amount of research across multiple disciplines, e.g., signal processing and communications, machine learning, data mining, environmental sciences, and analytical chemistry. Key techniques such as nonnegative matrix factorization (NMF), low-rank matrix completion, Tucker decomposition, and canonical polyadic decomposition (CPD) have been advancing many classical and timely problems such as speech and audio separation, array processing, topic modelling, community detection, hidden Markov model learning, image classification, word embedding, and hyperspectral imaging – to name just a few.

This special session aims to bring together researchers and experts from the broader signal processing and machine learning communities to address existing and arising challenges in structured matrix and tensor analytics.

Friday 22 January, 9:00-11:00

SS-L7: Latent Variable Methods: Theoretical Advances and Applications in the Age of Machine Learning

Zois Boukouvalas, American University, Washington, USA and Vagelis Papalexakis, UC Riverside, USA

SS-P5: Recent Advances in Differential Geometry for Signal and Image Processing

Arnaud Breloy, Univ. Paris Nanterre, France, Guillaume Ginolhac, LISTIC, Univ. Savoie Mont Blanc, France and Nicolas Le Bihan, GIPSAlab, France

The theory of differential geometry - and associated field such as Riemannian and Information geometry – have recently attracted more and more attention in the signal and image processing community. Indeed, treating data points as being in manifolds offers an elegant way to account for their inherent structure. This point of view drove many recent advances for efficiently analyzing/solving fundamental problems, as well as recent applicative challenges (computer vision, medical imaging, radar, etc.). To cite a few: statistical distributions and natural distances for objects living in manifolds have been successfully leveraged in clustering applications, Riemannian optimization permitted to derive estimation algorithms for structured parameters, and natural gradients can now provide practical tools to train neural networks.
This special session proposes to present both a tutorial and recent advances in the field. As a result, this session would not only be a comprehensive/pedagogical introduction to area, but would also constitute a forum for gathering scientist interested by the topic, and potentially initiate new collaborations between them.