2010 IEEE Sensor Array and Multichannel Signal Processing Workshop

(SAM 2010)

Jerusalem, Israel
4 – 7 October 2010

Technical Program

Time   Session

Monday, October 4

12:00 REG: *Registration*
14:00 OP: *Opening remarks*
14:15 Plenary 1: *Plenary 1: An Information Theoretic View of Robust Cooperation/Relaying in Wireless Networks*
15:15 Coffee: *Coffee break (Mon PM)*
15:30 PS1: *Poster session I*
18:00 Plenary 2: *Plenary 2: Parallel Magnetic Resonance Imaging: a Multi-Channel Signal Processing Perspective*
19:30 REC: *Welcome Reception*

Tuesday, October 5

08:30 Plenary 3: *Plenary 3: A Data Processing Pipeline for the Cosmic Microwave Background*
09:30 SS1: *MIMO Radar*,
SS2a: *Underwater acoustic communications I*
10:30 Coffee: *Coffee break (Tue AM)*
11:00 SS2b: *Underwater acoustic communications II*,
SS3a: *Performance bounds I*
12:00 Lunch: *Lunch (Tue)*
13:30 Plenary 4: *Plenary 4: Calibration Challenges for Large Radio Telescope Arrays*
14:30 SS3b: *Performance bounds II*
15:50 Coffee: *Coffee break (Tue PM)*
16:00 PS2: *Poster session II*
19:30 JT: *Jerusalem tour*

Wednesday, October 6

08:30 Plenary 5: *Plenary 5: Performance-Driven Information Fusion*
09:30 SS4: *High dimensional covariance estimation*,
SS5: *Low rank matrix approximation*
10:45 Coffee: *Coffee break (Wed AM)*
11:00 SS6: *Multichannel DSL communication systems*
12:00 Lunch: *Lunch (Wed)*
13:30 PS3: *Poster session III*
15:30 Plenary 6: *Plenary 6: Direct Position Determination and Sparsity in Localization Problems*
19:30 BANQ: *Banquet*

Thursday, October 7

08:00 VISIT: *Hi-Tech Industry Visit*

Monday, October 4

12:00 - 14:00

REG: Registration

14:00 - 14:15

OP: Opening remarks

14:15 - 15:15

Plenary 1: Plenary 1: An Information Theoretic View of Robust Cooperation/Relaying in Wireless Networks

Shlomo Shamai, Technion-Israel Institute of Technology, Israel
In many wireless networks, cooperation, in the form of relaying, takes place over out-of- band spectral resources. Examples are ad hoc networks in which multiple radio interfaces are available for communications or cellular systems with (wireless or wired) backhaul links. In an overview from an information-theoretic standpoint, we put emphasis on robust processing and cooperation via out-of-band links for both ad hoc and cellular networks. Specifically, we focus on robust approaches and practical aspects such as imperfect information regarding the channel state and the codebooks (modulation, coding) shared by transmitters and receivers. First, we address cooperation scenarios with perfect channel state information and investigate the impact of lack of information regarding the codebooks (oblivious processing) on basic relay channels and cellular systems with cooperation among base stations. Then, similar models are examined in the absence of perfect channel state information. Robust coding strategies are designed based on 'variable-to-fixed' channel coding concepts (the broadcast coding approach, or unequal error protection codes). The effectiveness of such strategies are discussed for multirelay channels and cellular systems overlaid with femtocell hotspots.

15:15 - 15:30

Coffee: Coffee break (Mon PM)

15:30 - 18:00

PS1: Poster session I

Student competition papers

Robust Focusing for Wideband MVDR Beamforming
> Yaakov Bucris (Technion, Israel institute of technology, Israel); Israel Cohen (Technion - Israel Institue of Technology, Israel); Miriam Doron (RAFAEL, Advanced Defense Systems LTD, Israel)
> pp. 1-4

Estimating the Performance of a Superdirective Microphone Array with a Frequency-Invariant Response
> Federico Traverso (University of Genoa, Italy); Marco Crocco (University of Genoa, Italy); Andrea Trucco (University of Genoa, Italy)
> pp. 5-8

Multiantenna Spectrum Sensing: The Case of Wideband Rank-One Primary Signals

18:00 - 19:00

Plenary 2: Plenary 2: Parallel Magnetic Resonance Imaging: a Multi-Channel Signal Processing Perspective

Yoram Bresler, University of Illinois, Urbana-Champaign, USA
Magnetic resonance imaging (MRI) is one of the leading diagnostic imaging modalities. While

providing excellent spatial resolution and exquisite soft tissue contrast, MRI suffers from slow acquisition. One of the highly effective approaches developed to address this limitation, is parallel imaging with phased-array coils. However,the freedom in acquisition, modeling, coil calibration, and reconstruction is often dealt with in a heuristic way. In this talk we provide a signal processing perspective on these problems, emphasizing the multichannel structure. We show that this perspective provides some interesting variations with improved performance

19:30 - 21:00

REC: Welcome Reception

Tuesday, October 5

08:30 - 09:30

Plenary 3: Plenary 3: A Data Processing Pipeline for the Cosmic Microwave Background

Jean-Francois Cardoso, LTCI, TELECOM Paris, France
At the Sun-Earth Lagrange point L2, 1.5e6 km away from Earth, an array of 63 sensors aboard the Planck satellite is scanning the sky, patiently measuring to unprecedented resolution and sensitivity the micro-Kelvin fluctuations of the Cosmic Microwave Background temperature and polarization. Getting from there to building multi-million-pixel spherical maps of the microwave sky in 9 frequency channels, to reconstructing the history of our Universe is a story in technology, cosmology and... challenging signal processing. This talk will highlight some of the key steps of the data processing pipeline being developed for the Planck space mission of ESA.

09:30 - 10:30

SS1: MIMO Radar

Estimating the Parameters of a Moving Target in MIMO Radar with Widely Separated Antennas
    Abdulnasr Hassanein (University of Alberta, Canada); Sergiy A. Vorobyov (University of Alberta, Canada); Alex Gershman (Darmstadt University of Technology, Germany); Michael Rübsamen (Darmstadt University of Technology, Germany)
    pp. 57-60
Waveform Design for Sequential MIMO Detection
    Emanuele Grossi (University of Cassino, Italy); Marco Lops (University of Cassino, Italy)
    pp. 61-64
MIMO GMTI Radar with Multipath Clutter Suppression
    Jeffrey Krolik (Duke University, USA); Granger Hickman (Duke University, USA)
    pp. 65-68
Fundamental Limitations of Pixel Based Image Deconvolution in Radio Astronomy
    Sarod Yatawatta (Kapteyn Institute/ASTRON, The Netherlands)
    pp. 69-72

SS2a: Underwater acoustic communications I

Efficient Channel Equalization for MIMO Underwater Acoustic Communications
    Ling Jun (University of Florida, USA); Xing Tan (University of Florida, USA); Jian Li (University of Florida, USA); Magnus Lundberg Nordenvaad (Luleå University of Technology, Sweden)
    pp. 73-76
Adaptive Linear Turbo Equalization of Large Delay Spread Time-Varying Channel Responses
    Jun Won Choi (University of Illinois at Urbana-Champaign, USA); Thomas Riedl (University of Illinois at Urbana Champaign, USA); Erica L Daly (University of Illinois at Urbana Champaign,

USA); Kyeongyeon Kim (University of Illinois at Urbana-Champaign, USA); Andrew C. Singer (University of Illinois at Urbana Champaign, USA); James Preisig (Woods Hole Oceanographic Institution, USA)
pp. 77-80

Joint Channel Estimation and Markov Chain Monte Carlo Detection for Frequency-Selective Channels
Hong Wan (Unviersity of Utah, USA); Rong-Rong Chen (University of Utah, USA); Jun Won Choi (University of Illinois at Urbana-Champaign, USA); Andrew C. Singer (University of Illinois at Urbana Champaign, USA); James Preisig (Woods Hole Oceanographic Institution, USA); Behrouz Farhang-Boroujeny (Univ of Utah, USA)
pp. 81-84

10:30 - 11:00

Coffee: Coffee break (Tue AM)

11:00 - 12:00

SS2b: Underwater acoustic communications II

A Method for Differentially Coherent Detection of OFDM Signals on Doppler-Distorted Channels
Milica Stojanovic (Northeastern University, USA)
pp. 85-88

Isotropic Filter Design for MIMO Filter Bank Multicarrier Communications
Pooyan Amini (University of Utah, USA); Chung Him (George) Yuen (University of Utah, USA); Rong-Rong Chen (University of Utah, USA); Behrouz Farhang-Boroujeny (Univ of Utah, USA)
pp. 89-92

Reduced Bandwidth Frequency Domain Equalization for Underwater Acoustic Communications
James Preisig (Woods Hole Oceanographic Institution, USA); Andrew C. Singer (University of Illinois at Urbana Champaign, USA); Gregory Wornell (Massachusetts Institute of Technology, USA)
pp. 93-96

SS3a: Performance bounds I

Performance Bounds for the Estimation of Finite Rate of Innovation Signals From Noisy Measurements
Zvika Ben-Haim (Technion - Israel Institute of Technology, Israel); Tomer Michaeli (Technion - Israel Institute of Technology, Israel); Yonina C. Eldar (Technion—Israel Institute of Technology, Israel)
pp. 97-100

Numerically Efficient Mean Squared Error Threshold SNR Prediction for Adaptive Arrays
Christ D. Richmond (MIT Lincoln Laboratory, USA)
pp. 101-104

Outage Error Probability Lower Bounds in Vector Parameter Estimation
Tirza Routtenberg (Ben Gurion university of the Negev, Israel); Joseph Tabrikian (Ben-Gurion University of the Negev, Israel)
pp. 105-108

Information Theoretic Bounds on Mobile Source Localization in a Dense Urban Environment
Igal Bilik (University of Massachusetts, USA); Kaushallya Adhikari (University of Massachusetts Dartmouth, USA); John Buck (University of Massachusetts Dartmouth, USA)
pp. 109-112

12:00 - 13:30

Lunch: Lunch (Tue)

13:30 - 14:30

Plenary 4: Plenary 4: Calibration Challenges for Large Radio Telescope Arrays

Alle-Jan van der Veen, TU Delft, The Netherlands
Radio astronomy is known for its very large telescope dishes, but currently there is a transition towards the use of large numbers of small elements. E.g., the recently commissioned LOFAR low frequency array uses 50 stations each with some 200 antennas, and the numbers will be even larger for the Square Kilometer Array, planned for 2020. Meanwhile some of the existing telescope dishes are being retrofitted with focal plane arrays. These instruments pose interesting challenges for array signal processing. One aspect, which we cover in this talk, is the calibration of such large numbers of antennas, especially if they are distributed over a wide area. Apart from the unknown element gains and phases (which may be directionally dependent), there is the unknown propagation through the ionosphere, which at low frequencies may be diffractive and different over the extent of the array. The talk will discuss several of the challenges, present the underlying data models, and propose some of the answers. We will also touch upon a recent initiative to develop a low-frequency telescope array in space, on a distributed platform formed by a swarm of nanosatellites.

14:30 - 15:30

SS3b: Performance bounds II

Constrained Hypothesis Testing and the Cramér-Rao Bound
    Brian Sadler (Army Research Laboratory, USA); Terrence Moore (Army Research Laboratory, USA)
    pp. 113-116
Achievable MSE Lower Bounds in Non-Bayesian Biased Estimation
    Koby Todros (Ben Gurion University of the Negev, Israel); Joseph Tabrikian (Ben-Gurion University of the Negev, Israel)
    pp. 117-120
New Trends in Deterministic Lower Bounds and SNR Threshold Estimation
    Eric Chaumette (ONERA, France)
    pp. 121-124
Closed-form Expression of the Weiss-Weinstein Bound for 3D Source Localization: The Conditional Case
    Dinh Thang VU (University Paris Sud XI, France); Alexandre Renaux (Universite Paris 11, France); Rémy Boyer (CNRS, Université Paris-Sud (UPS), Supelec, France); Sylvie Marcos (Laboratoire des Signaux et Systems, Supélec, CNRS UMR8506, France)
    pp. 125-128

15:50 - 16:00

Coffee: Coffee break (Tue PM)

16:00 - 18:00

PS2: Poster session II

Multichannel Blind Compressed Sensing
    Sivan Gleichman (Technion, Israel Institute of Technology, Israel); Yonina C. Eldar (Technion—Israel Institute of Technology, Israel)
    pp. 129-132

Sampling of Pulse Streams: Achieving the Rate of Innovation
    Kfir Gedalyahu (Technion - Israel Institute of Technology, Israel); Ronen Tur (Technion- Israel Institute of Technology, Israel); Yonina C. Eldar (Technion—Israel Institute of Technology, Israel)
    pp. 133-136
Sparse Component Analysis for Linear Mixed Models
    Martin Hurtado (National University of La Plata, Argentina); Nicolas von Ellenreider (National University of La Plata, Argentina); Carlos Muravchik (Universidad Nacional de La Plata, Argentina); Arye Nehorai (Washington University in St. Louis, USA)
    pp. 137-140
Band-Diagonal Regularization of Gaussian Interference Covariance Matrices ML Estimates
    David Lekhovytskiy (Kharkov National University of Radio Electronics, Ukraine); Yuri Abramovich (Defence Science and Technology Organisation (DSTO), Australia); Oleksandr Dokhov (Kharkov National University of Radio Electronics, Ukraine); Valerii Zarytskyi (Kharkov National University of Radio Electronics, Ukraine); Gennadiy Zhuga (Kharkov National University of Radio Electronics, Ukraine); Dmytro Rachkov (Kharkov National University of Radio Electronics, Ukraine)
    pp. 141-144
Independent Component Analysis of Quaternion Gaussian Vectors
    Javier Via (University of Cantabria, Spain); Luis Vielva (University of Cantabria, Spain); Ignacio Santamaria (University of Cantabria, Spain); Daniel P Palomar (Hong Kong University of Science and Technology, Hong Kong)
    pp. 145-148
Combining Multiband Joint Position-Pitch Algorithm and Particle Filters for Speaker Localization
    TANIA Habib (Graz University of Technology, Austria); Harald Romsdorfer (Graz University of Technology, Austria)
    pp. 149-152
Target Tracking in Mixed LOS/NLOS Environments Based on Individual TOA Measurement Detection
    Lili Yi (NTU, Singapore); Sirajudeen Gulam Razul (Nanyang Technological University, Singapore); Zhiping Lin (NTU, Singapore); Chong Meng Samson See (DSO National Laboratories, Singapore)
    pp. 153-156
A Reference-Free Time Difference of Arrival Source Localization Using a Passive Sensor Array
    Alon Amar (Delft University of Technology, The Netherlands); Geert Leus (Delft University of Technology, The Netherlands)
    pp. 157-160
A Hierarchical Approach to Noise-Adaptive Estimation
    Magnus Lundberg Nordenvaad (Luleå University of Technology, Sweden)
    pp. 161-164
Fuzzy Triangle Contour Characterization by Subspace Based Methods of Array Processing
    Haiping Jiang (Ecole Centrale Marseille, France); Julien Marot (Institut Fresnel, France); Caroline Fossati (Ecole Centrale Marseille, France); Salah Bourennane (Ecole Centrale Marseille, France)
    pp. 165-168
Adaptive Identification of Nonlinear MIMO Systems Based on Volterra Models with Additive Coupling
    Angel Fernández-Herrero (Universidad Politécnica de Madrid, Spain); Carlos Carreras (Universidad Politécnica de Madrid, Spain); Javier Casajús (Universidad Politécnica de Madrid, Spain)
    pp. 169-172
Prequential Bayes Mixture Approach for Gaussian Mixture Order Selection
    Keith Gilbert (University of Massachusetts Dartmouth, USA); Igal Bilik (University of Massachusetts, USA); John Buck (University of Massachusetts Dartmouth, USA); Karen Payton (University of Massachusetts Dartmouth, USA)
    pp. 173-176

19:30 - 23:00

Wednesday, October 6

08:30 - 09:30

Plenary 5: Plenary 5: Performance-Driven Information Fusion

Alfred Hero, University of Michigan, Ann Arbor, USA
Information fusion involves combining different information sources using models for the joint source distributions. It is a key component of multichannel sensor processing when there are multiple sensing modalities. Practical information fusion algorithms must approximate information theoretic quantities such as entropy and mutual information from finite number of samples from the sensors. Recently we have developed a framework, called performance-driven information fusion, that specifically accounts for the effect of finite sample estimation errors and bias on the information fusion task. The cornerstone for this framework is a large sample analysis of bias, variance, and probability distribution that applies to a general class of information divergence measures including /Csisz\'ar's / f-divergence, Shannon's mutual information, and R\'enyi's entropy. Under this framework information fusion algorithms can be implemented that incorporate error control, and for which one can optimize feature selection and specify optimal tuning parameters such as kernel bandwidth. This talk will introduce this framework and apply it to several applications in multichannel sensor processing.

09:30 - 10:45

SS4: High dimensional covariance estimation

The Breakdown Point of Signal Subspace Estimation
    Raj Rao Nadakuditi (University of Michigan, USA); Florent Benaych-Georges (University of Paris, France)
    pp. 177-180
Hypothesis Testing in High-Dimensional Space with the Sparse Matrix Transform
    Leonardo Bachega (Purdue University, USA); Charles Bouman (Purdue University, USA); James Theiler (Los Alamos National Laboratory Space and Remote Sensing Group, USA)
    pp. 181-184
On Toeplitz and Kronecker Structured Covariance Matrix Estimation
    Petter Wirfalt (Royal Institute of Technology (KTH), Sweden); Magnus Jansson (KTH, Sweden)
    pp. 185-188
Robust Shrinkage Estimation of High-dimensional Covariance Matrices
    Yilun Chen (University of Michigan, USA); Ami Wiesel (Hebrew University in Jerusalem, Israel); Alfred Hero iii (University of Michigan, USA)
    pp. 189-192
Distributed Covariance Estimation in Gaussian Graphical Models
    Ami Wiesel (Hebrew University in Jerusalem, Israel); Alfred Hero (University of Michigan, USA)
    pp. 193-196

SS5: Low rank matrix approximation

On Positioning Via Distributed Matrix Completion
    Andrea Montanari (Stanford University, USA); Sewoong Oh (Stanford University, USA)
    pp. 197-200
Robust Principal Component Analysis?
    Emmanuel Candés (Caltech, USA); Xiaodong Li (Stanford University, USA); Yi Ma (University of Illinois at Urbana-Champaign, USA); John Wright (Microsoft Research Asia, P.R. China)

pp. 201-204

Subspace-Augmented MUSIC for Joint Sparse Recovery with Any Rank
Kiryung Lee (University of Illinois at Urbana-Champaign, USA); Yoram Bresler (University of Illinois, Urbana-Champaign. USA, USA)
pp. 205-208

Order-preserving Factor Discovery From Misaligned Data
Arnau Tibau Puig (University of Michigan, France); Ami Wiesel (Hebrew University in Jerusalem, Israel); Alfred Hero iii (University of Michigan, USA)
pp. 209-212

Nonparametric Bayesian Matrix Completion
Lawrence Carin (Duke University, USA)
pp. 213-216

10:45 - 11:00

Coffee: Coffee break (Wed AM)

11:00 - 12:00

SS6: Multichannel DSL communication systems

Convergence Analysis of Adaptive Partial FEXT Cancellation Precoder for Multichannel Downstream VDSL
Ido Binyamini (Bar-Ilan University, Israel); Itsik Bergel (Bar Ilan University, Israel); Amir Leshem (Bar-Ilan University, Israel)
pp. 217-220

Frequency Domain Crosstalk Canceling Between VDSL2 Systems with Different Symbol Rates
Sigurd Schelstraete (Ikanos Communications, USA)
pp. 221-224

Vectored VDSL From a Practical Perspective
Ronen Yizhaq Gilad (Bar Ilan - Israel, Israel); Amit Priebatch (Bar Ilan, Israel); Elad Domanovitz (Bar Ilan, Israel); Ilan Sharfer (Bar Ilan, Israel); Avi. Matza (Bar Ilan, Israel); Eitan Tsur (Bar Ilan, Israel)
pp. 225-228

12:00 - 13:30

Lunch: Lunch (Wed)

13:30 - 15:30

PS3: Poster session III

A Recursive Model for Partially Correlated Chi^2 Targets
Abner Ephrath (Rafael Inc., Israel)
pp. 229-232

The Polynomial Predictive Gaussian Mixture MeMBer Filter
Yin (Fudan University, P.R. China); Jian-qiu Zhang (Fudan University, P.R. China); Bo Hu (EE Dept., Fudan University, Shanghai, P.R.China, P.R. China); Qiyong Lu (Fudan University, Shanghai, PRC, P.R. China)
pp. 233-236

Expected Likelihood Support for Deterministic Maximum Likelihood DOA Estimation
Yuri Abramovich (Defence Science and Technology Organisation (DSTO), Australia); Ben A. Johnson (JORN Technical Director, Australia)

pp. 237-240

Covariance-informed Detection in compound-Gaussian Clutter Without Secondary Data
Francesco Bandiera (University of Salento, Italy); Olivier Besson (ISAE, France); Giuseppe Ricci (University of Salento, Lecce, Italy)
pp. 241-244

A Low Complexity STAP for Reverberation Cancellation in Active Sonar Detection
Neethu M Sasi (NIT Calicut, India); Pradeepa R (NPOL, India); Sarath Gopi (NPOL, India); Sathidevi P.s (National Institute of Technology Calicut, India)
pp. 245-248

A Migrating Target Indicator for Wideband Radar
François Deudon (University of Toulouse, France); François Le Chevalier (Thales Aerospace Division, France); Stéphanie Bidon (ISAE, France); Olivier Besson (ISAE, France); Laurent Savy (ONERA, France)
pp. 249-252

A Computationally Efficient Blind Estimator of Polynomial Phase Signals Observed by a Sensor Array
Alon Amar (Delft University of Technology, The Netherlands); Amir Leshem (Bar-Ilan University, Israel); Alle Jan van der Veen (Delft University, The Netherlands)
pp. 253-256

Passive Radar Imaging of Moving Targets with Sparsely Distributed Receivers
Ling Wang (Nanjing University of Aeronautics and Astronautics, P.R. China); Birsen Yazici (Rensselaer Polytechnic Institute, USA)
pp. 257-260

Two-Dimentional Direction-of-Arrival Estimation of Coherent Signals with L-Sharped Array
Wang Guangmin (Xi'an Jiaotong University, P.R. China); Jingmin Xin (Xi'an Jiaotong University, P.R. China); Nanning Zheng (Xi'an Jiaotong University, P.R. China)
pp. 261-264

Steering Vector Modeling for Polarimetric Arrays of Arbitrary Geometry
Mario Costa (Helsinki University of Technology, Finland); Andreas Richter (Aalto University, Finland); Visa Koivunen (Helsinki University of Technology, Finland)
pp. 265-268

Parametric Joint Detection-Estimation of the Number of Sources in Array Processing
Noam Arkind (Weizmann Institute of Science, Israel); Boaz Nadler (Weizmann Institute of Science, Israel)
pp. 269-272

15:30 - 16:30

Plenary 6: Plenary 6: Direct Position Determination and Sparsity in Localization Problems

Anthony. J. Weiss, Tel Aviv University, Israel
The most common methods for location of communications/radar transmitters are based on measuring a specified parameter such as signal Angle of Arrival (AOA), Time of Arrival (TOA), Received Signal Strength (RSS) or Differential Doppler (DD). The measured parameters are then used to estimate the transmitter location. Since the AOA/TOA/RSS/DD measurements are done independently, without using the constraint that all measurements must correspond to the same transmitter, the location estimate is suboptimal. Optimal localization is obtained by a single step which uses all the observations together in order to estimate the emitter position. We refer to single-step localization as Direct Position Determination (DPD). Although this principle is known for long time the signal processing community overlooked its potential benefits for long time. In this talk we will compare the DPD with two-step algorithms. We will show and explain why under ideal conditions such as high SNR the DPD is equivalent to two-step algorithms. However, under low SNR, jamming and other interferences the DPD provide better results. Further, we will show that DPD can overcome well known limitations on the number of sources associated with AOA. In the second part of the talk we will show how we can harness recent developments in sparsity theory to handle outliers in localization measurements. Surprisingly, under known limitations on the number of outliers, we can obtain the exact emitter location. Further, sparsity can also be used to find the location of sources by

efficient linear programming or Second Order Cone programming.

19:30 - 23:00

BANQ: Banquet

Thursday, October 7

08:00 - 16:00

VISIT: Hi-Tech Industry Visit