Journal Watch

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- Papers from Sep 2011

Structured Compressed Sensing: From Theory to Applications

Marco F. Duarte and Yonina C. Eldar
University of Massachusetts, and Technion - Israel Institute of Technology

- Two classes of CS research
  - Theory and applications in CS with structured (non-random) matrices
  - Beyond sparsity priors - extension to continuous (infinite dimensional) signals?
- Summary paper. Summarizes research in CS, sub-Nyquist rate sampling, RIP (and other properties), reconstruction techniques, reconstruction error bounds etc.
- Emphasizes more on the practical/application level of CS.

Optimal Design of Source and Relay Pilots for MIMO Relay Channel Estimation

Ting Kong and Yingbo Hua
VIA Telecom,San Diego, and University of California, Riverside

- Channel estimation and pilot design for MIMO, two hop, AF relay system. No direct link between source and dest.
- Two phases of communication
  - R $\rightarrow$ D, an algorithm is proposed to design the pilot, LMMSE of H_2 is obtained.
  - S $\rightarrow$ R, R $\xrightarrow{(AF)}$ D, an algorithm is proposed to design SR and RD pilots, LMMSE of H_1 is obtained.
- Prior knowledge of channel statistics is required.
- Pilot design problem $\rightarrow$ minimization of the LMMSE cost function subject to total power constraint (in both phases).

Decision Fusion Over Noncoherent Fading Multiaccess Channels

Feng Li, Jamie S. Evans and Subhrakanti Dey
University of Melbourne

- N sensors transmit their binary decisions to a FC over a fading multiaccess (MA) channel.
- Sensor transmits $a > 0$ (or $-b, |a| > |b|$) when $\mathcal{H}_1$ (or $\mathcal{H}_0$) is decided. FC receives superposition of all the signals from sensors.
- As $N \uparrow$, an error floor on p_e is observed under Rayleigh fading and a positive error exponent is derived (using LDP) under Rician fading. NP framework.
- Under Rayleigh, MA outperforms PA for low N and low SNR.
- Under Rayleigh, on-off keying is most energy efficient modulation scheme for sensors to tx their info. Under Rician, optimizing sensors' modulation scheme improves error exponent (not true under no fading).

Bayes Risk Error is a Bregman Divergence

Kush R. Varshney
IBM T. J. Watson Research Center, Yorktown Heights, NY

- Practically, quantized/approximate prior probability π_0 values are used in Bayesian signal detection.
- Quantizers for π_0 were designed in author's previous work such that Bayes' risk error was minimized.
- It is shown that the Bayes risk error is the Bregman divergence generated by the negative Bayes' risk function.
- All the earlier known proofs about the Bayes risk error follows directly from this discovery.
- In addition, new implications are discussed.

- Papers from Oct 2011

Lower Bounds on the Mean-Squared Error of Low-Rank Matrix Reconstruction

Gongguo Tang and Arye Nehorai
Washington University, St. Louis, USA

- Problem : Low rank matrix reconstruction and matrix completion from noisy measurements. $y = \mathcal{A}(X) + w$.
- In particular, when operator $\mathcal{A}$ observes a subset from entries of X, it is a completion problem.
- Matrix LASSO problem : $\min_{X \in \mathbb{R}^{n \times p}} \frac{1}{2}||y - \mathcal{A}(X)||^2 + \mu||X||_*$
- The behavior of MSE is studied and they derive Constrained CRB (CCRB) when (a) a locally unbiased estimator is used and (b) when a subset of entries of the underlying matrix is randomly observed.
- Lower bounds on the worst case scalar MSE is calculated through Chapman-Robbins type Barankin bound and performance is compared with existing bounds in the literature.

Partial Interference Alignment for K-User MIMO Interference Channels

Huang Huang and Vincent K. N. Lau
The Hong Kong University of Science and Technology, Hong Kong

- Partial Interference Alignment and Interference Detection (PIAID) for K-user, quasi-static MIMO interference channels with discrete constellation inputs.
- Focus on the case where all $K-1$ interfering transmitters cannot be aligned at every receiver (residual interference).
- IA helps in "creating" a desirable interference profile (favorable interference profile) by an appropriate user selection for IA.
- Average SER under non-gaussian interferences is derived using graph theory and SDR techniques.
- A low complexity ID algorithm for the proposed PIAID scheme is proposed.

Xampling: Signal Acquisition and Processing in Union of Subspaces

Moshe Mishali, Yonina C. Eldar and Asaf J. Elron
Technion - Israel Institute of Technology and Stanford (visiting)

- Xampling - Unified framework for signal acquisition and processing in a union of subspaces.
- X-ADC : Analog compression prior to sampling - three performance metrics viz. (a) robustness to model mismatch, (b) required h/w accuracy and (c) software complexities.
- X-DSP : Input subspace is detected before signal processing.
- Spectrally sparse signals are studied in detail as a case study. Algorithms in X-ADC stage are compared with existing (CS based) methods viz. the random demodulator (RD) and modulated wideband converter (MWC).
- In X-DSP stage, an algorithm for MWC is proposed that makes it "backward compatible" to the conventional DSP methods.

More... (1/2)

- Adaptive Radar Detection and Localization of a Point-Like Target, Danilo Orlando and Giuseppe Ricci, Dipartimento di Ingegneria dellInnovazione, Universit del Salento, 73100 Lecce (LE), Italy
- C-HiLasso: A Collaborative Hierarchical Sparse Modeling Framework, Pablo Sprechmann, Ignacio Ramrez, Guillermo Sapiro, and Yonina C. Eldar, University of Minnesota and Technion - Israel Institute of Technology
- Distributed Detection via Gaussian Running Consensus: Large Deviations Asymptotic Analysis, Dragana Bajovic, Du an Jakovetic, Joo Xavier, Bruno Sinopoli and Jos M. F. Moura, Technical University of Lisbon, Carnegie Mellon University

More... (2/2)

- On the Restricted NeymanPearson Approach for Composite Hypothesis-Testing in Presence of Prior Distribution Uncertainty, Suat Bayram and Sinan Gezici, Bilkent University, Bilkent, Ankara, Turkey
- Sensor Selection for Event Detection in Wireless Sensor Networks, Dragana Bajovic, Bruno Sinopoli, and Joo Xavier, Technical University of Lisbon and CMU
- Sensor Scheduling for Energy-Efficient Target Tracking in Sensor Networks, George K. Atia, Venugopal V. Veeravalli, and Jason A. Fuemmeler, University of Illinois at Urbana Champaign