Journal Watch: IEEE Trans. Signal Processing, Jan, 2014

Prashant Khanduri

SPC Lab, IISC Bangalore

Jan 25, 2014

Robust Training Sequence Design for Correlated MIMO Channel Estimation

Nafiseh Shariati, *KTH*; Jiaheng Wang, *National Mobile Communications Research Laboratory, China* and Mats Bengtsson, *KTH*

- **Problem**
  - Robust training sequence design for MIMO channel estimation
  - Algorithms to address robust training design problem
  - Arbitrarily correlated MIMO channels, MISO channels and Kronecker structured MIMO channels
- **System Model**

$$\mathbf{Y} = \mathbf{H}\mathbf{P}^{\mathbf{T}} + \mathbf{N}$$

where $\mathbf{P} \in \mathbf{C}^{B \times n_T}$, matrix with rows comprising training symbols at each channel use, $\mathbf{H} \in \mathbf{C}^{n_R \times n_T}$ and $\mathbf{N} \in \mathbf{C}^{n_R \times B}$

- **Design Problem**

$$\min_{\mathbf{P}} \quad \max_{\mathbf{E}} \mathrm{Tr}\left\{\left[\left(\hat{\mathbf{R}}+\mathbf{E}\right)^{-1}+\frac{1}{\sigma_n^2}(\mathbf{P}\otimes\mathbf{I}_{n_R})^H(\mathbf{P}\otimes\mathbf{I}_{n_R})\right]^{-1}\right\}$$

$$\text{s.t. } \mathrm{Tr}\left\{\mathbf{P}\mathbf{P}^H \leq P_T, \mathbf{E}\in\varepsilon\right\}$$

- **Contributions**
  1. Algorithms for arbitrary correlated MIMO when **E** belongs to compact convex uncertainty set
  2. Convex-Concave structure: Globally optimal solution
  3. MISO and Kronecker Model for unitarily-invariant uncertainty sets
  4. For MISO: Closed form solutions for robust training sequences with uncertainty sets defined by spectral and nuclear norm

A Dual-Phase Power Allocation Scheme for Multicarrier Relay System With Direct Link

Yiming Ma, *UC, Riverside*; An Liu, *HKUST* and Yingbo Hua, *UC, Riverside*

- **Problem**
  - Power allocation algorithms for two phase relay n/w
- **System Model**
  1. Source, Relay (AF) and Destination Nodes
  2. Source transmits in both phases
  3. OFDM (N sub channels)
- **Contributions**
  1. Joint optimization of source and relay power: non-convex problem
  2. Alternating optimization (AO) method
  3. Non-convex relay power allocation problem and Convex source power allocation problem

- **Results and Conclusion**
  - Algorithms that yield the optimal solution
  - AO algorithm converges to a stationary point of the joint problem
  - Proposed AO algorithm is asymptotically optimal for large relay transmit power or large source-relay channel gain
  - Significant gain over baselines

Non-Negative Matrix Factorization Revisited: Uniqueness and Algorithm for Symmetric Decomposition

Kejun Huang, Nicholas D. Sidiropoulos, *University of Minnesota, Minneapolis*; and Ananthram Swami, *Army Research Laboratory, Adelphi*

- **Problem**
  - Uniqueness aspects of NMF: Geometrical point of view
  - Algorithm for Symmetric NMF
- **Model**

$$\mathbf{S} = \mathbf{W}\mathbf{H}$$

where $\mathbf{S}$ is $I \times J$, $\mathbf{W}$ is $I \times K$, $\mathbf{H}$ is $K \times J$, $\mathbf{W} \geq 0$ and $\mathbf{H} \geq 0$

- Symmetric and asymmetric factorization
- Symmetric factorization: Equivalent to element-wise non-negative square-root factorization of positive semi definite matrices

- **Contributions**
  1. Established a new sufficient condition for uniqueness: Conic hulls of latent factors must be supersets of a particular second order cone
  2. Checking sufficiency is NP-complete
  3. Novel algorithm using the alternating approach and Procrustes projections
  4. Complexity: $O(IK^2)$ in contrast to previous $O(I^2K)$
  5. Computationally cheap

Convergence and Stability of Iteratively Re-weighted Least Squares Algorithms

Demba Ba, Behtash Babadi, Patrick L. Purdon, and Emery N. Brown, *MIT*

- **Problem**
  - Study theoretical properties of Iteratively re-weighted least squares (IRLS) algorithms
    1. Correspondence with EM algorithms
    2. Stability and Convergence
- **Contributions**
  - One to one correspondence with EM for constrained maximum likelihood estimation under Gaussian scale mixture (GSM)
  - Both minimize smooth versions of l_μ norm for $0 < \mu \leq 1$
  - Stable if the limit points of the iterates coincides with global minimizer
  - Linear convergence for $\mu = 1$, super-linear convergence for $0 < \mu < 1$

Some Useful Publications

- MIMO Systems With Quantized Covariance Feedback
  T. Krishnamachari, Mahesh K. Varanasi and Kaniska Mohanty, *University of Colorado, Boulder*
- Beamforming With Decentralized Coordination in Cognitive and Cellular Networks
  Harri Pennanen, Antti Tlli and Matti Latva-aho, *University of Oulu, Finland*
- Adaptive Identification and Recovery of Jointly Sparse Vectors
  Roy Amel and Arie Feuer, *Technion*
- Spatial Compressive Sensing for MIMO Radar
  Marco Rossi, Alexander M. Haimovich, *NJIT* and Yonina C. Eldar, *Technion*