Journal Watch
IEEE Trans. Signal Processing (Nov 2019)

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16/11/2019

Hypothesis Test for Bounds on the Size of Random Defective Set (A. Dyachkov, N. Polyanskii, V. Shchukin, and I. Vorobyev)

Problem Considered

How to distinguish reliably the null hypothesis H_0: the number of defective elements is at most s_1, and the alternative one H_1: the number of defective elements is at least s_2.

Results

- For the case $s_1 = s$ and $s_2 = \alpha s$, $\alpha \geq 1$ fixed, the optimal number of non-adaptive tests required to accept or reject H_0 with error probability ϵ is $\Theta(\log \frac{1}{\epsilon})$.
- When $s_1 = s$ and $s_2 = s + c$ for $c = o(s)$, the necessity of $O(\frac{s}{c \log \frac{1}{\epsilon}})$ tests and provide a simple weight algorithm with $O(\frac{s^2}{c^2 \log \frac{1}{\epsilon}})$ tests.
- Simulation results confirm the advantage of this algorithm over the COMP algorithm adapted for this problem.

Basis Pursuit Denoise With Nonsmooth Constraints (R. Baraldi, R. Kumar, and Aleksandr Aravkin)

Problem Considered

$$\min_x \phi(\mathcal{C}(x)) \quad \text{s.t.} \quad \psi(\mathcal{A}(x) - b) \leq \sigma, \tag{2}$$

where ϕ and ψ may be nonsmooth, nonconvex, but have well-defined proximity and projection operators:

$$\begin{aligned} \mathrm{prox}_{\eta\phi}(y) &= \arg\min_x \frac{1}{2\eta}\|x-y\|^2 + \phi(x) \\ \mathrm{proj}_{\psi(\cdot)\leq\sigma} &= \arg\min_{\psi(x)\leq\sigma} \frac{1}{2\eta}\|x-y\|^2. \end{aligned} \tag{3}$$

$\mathcal{C} : \mathbb{C}^{m\times n} \to \mathbb{R}^c$ and $\mathcal{A} : \mathbb{C}^{m\times n} \to \mathbb{R}^d$

Results

Relaxed Version

$$\min_{x,w_1,w_2} \phi(w_1) + \frac{1}{2\eta_1}\|\mathcal{C}(x) - w_1\|^2 + \frac{1}{2\eta_2}\|w_2 - \mathcal{A}(x) + b\|_2^2$$
$$\text{s.t.} \quad \psi(w_2) \le \sigma.$$

- Proposed a new approach for basis pursuit denoise and residual-constrained low-rank formulations.
- Adapted to a variety of nonsmooth and nonconvex data constraints.
- Solved using prox-gradient and Value-function Optimization.
- The algorithms are simple, scalable, and efficient.
- Sparse curvelet denoising and low-rank interpolation of a monochromatic slice from the $4D$ seismic data volumes demonstrate the potential of the approach.

Clustering of Data With Missing Entries Using Non-Convex Fusion Penalties (S. Poddar and M. Jacob)

Problem Considered

Clustering the points $\mathbf{X} = \{\mathbf{x}_i\}$ in the presence of entries missing uniformly at random. The rows of $\mathbf{X}$ are referred to as features. Assume that each entry of $\mathbf{X}$ is observed with probability p_0. The entries measured in the i^{th} column are denoted by:

$$\mathbf{y}_i = \mathbf{S}_i\,\mathbf{x}_i, \quad i = 1, .., KM \tag{7}$$

where S_i is the sampling matrix, formed by selecting rows of the identity matrix. Consider the following optimization problem to cluster data with missing entries:

$$\{\mathbf{u}_i^*\} = \min_{\{\mathbf{u}_i\}} \sum_{i=1}^{KM} \sum_{j=1}^{KM} \|\mathbf{u}_i - \mathbf{u}_j\|_{2,0}$$
$$\text{s.t } \|\mathbf{S}_i\,(\mathbf{x}_i - \mathbf{u}_i)\|_\infty \leq \frac{\epsilon}{2}, \quad i \in \{1 \dots KM\} \tag{8}$$

Continue ..

$$\|\mathbf{x}\|_{2,0} = \begin{cases} 0, & \text{if } \|\mathbf{x}\|_2 = 0 \\ 1, & \text{otherwise} \end{cases}$$

Parameters

- $\min_{\{m,n\}} \|\mathbf{z}_k(m) - \mathbf{z}_l(n)\|_2 \geq \delta; \quad \forall\, k \neq l$
- $$\max_{\{m,n\}} \|\mathbf{z}_k(m) - \mathbf{z}_k(n)\|_\infty = \epsilon; \quad \forall k = 1, \ldots, K$$
- $$\mu(\mathbf{y}) = \frac{P\|\mathbf{y}\|_\infty^2}{\|\mathbf{y}\|_2^2},\ y \in \mathbb{R}^P$$
  $$\max_{\{m,n\}} \mu(\mathbf{z}_k(m) - \mathbf{z}_l(n)) \leq \mu_0; \quad \forall\, k \neq l$$

Results

Proposed algorithm can successfully recover the clusters with high probability when:

- The clusters are well separated (i.e., low $\kappa = \frac{\epsilon\sqrt{P}}{\delta}$).
- The sampling probability p_0 is sufficiently high.
- The coherence μ_0 is small.

Other papers:

- Rate-Flexible Fast Polar Decoders (S. A. Hashemi, C. Condo, M. Mondelli, and W. J. Gross)
- TARM: A Turbo-Type Algorithm for Affine Rank Minimization (Z. Xue, X. Yuan, J. Ma, and Y. Ma)
- Spectral Norm Based Mean Matrix Estimation and Its Application to Radar Target CFAR Detection (W. Zhao, W. Liu, and M. Jin)
- Manifold Optimization Over the Set of Doubly Stochastic Matrices: A Second-Order Geometry (A. Douik, and B. Hassibi)
- Sparse Bayesian Learning for Robust PCA: Algorithms and Analyses (J. Liu, and B. D. Rao)
- Hybrid-Spline Dictionaries for Continuous-Domain Inverse Problems (T. Debarre, S. Aziznejad, and M. Unser)