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Journal articles

▶ [Sparse Stable Outlier-Robust Signal Recovery Under Gaussian Noise]
(https://ieeexplore.ieee.org/document/10041941)

Kyohei Suzuki and Masahiro Yukawa

IEEE Trans. Signal Processing, vol.71, pp.372--387, 2023

Abstract: This paper presents a novel framework for sparse robust signal recovery integrating the sparse recovery using the minimax concave (MC) penalty and robust regression called sparse outlier-robust regression (SORR) using the MC loss. While the proposed approach is highly robust against huge outliers, the sparseness of estimates can be controlled by taking into consideration a tradeoff between sparseness and robustness. To accommodate the prior information about additive Gaussian noise and outliers, an auxiliary vector to model the noise is introduced. The remarkable robustness and stability come from the use of the MC loss and the squared $\ell 2$ penalty of the noise vector, respectively. In addition, the simultaneous use of the MC and squared $\ell 2$ penalties of the coefficient vector leads to a certain remarkable grouping effect. The necessary and sufficient conditions for convexity of the smooth part of the cost are derived under a certain nonempty-interior assumption via the product space formulation using the linearly-involved Moreau-enhanced-over-subspace (LiMES) framework. The efficacy of the proposed method is demonstrated by simulations in its application to speech denoising under highly noisy environments as well as to toy problems.

▶ [Robust recovery of jointly-sparse signals using minimax concave loss function]
(https://ieeexplore.ieee.org/document/9296314)

Kyohei Suzuki and Masahiro Yukawa

IEEE Trans. Signal Processing, vol.69, pp.669--681, 2021 (Publication: December 2020)

Abstract: We propose a robust approach to recovering jointly sparse signals in the presence of outliers. The robust recovery task is cast as a convex optimization problem involving a minimax concave loss function (which is weakly convex) and a strongly convex regularizer (which ensures the overall convexity). The use of the nonconvex loss makes the problem difficult to solve directly by the convex optimization methods even with the well-established firm shrinkage. We circumvent this difficulty by reformulating the problem via the Moreau decomposition so that the objective function becomes a sum of convex functions that can be minimized by the primal-dual splitting method. The parameter designs/ranges for the present specific case are derived to ensure the convergence. We demonstrate the remarkable robustness of the proposed approach against outliers by extensive simulations to the application of multi-lead electrocardiogram as well as synthetic data.

Peer-Reviewed Conference Proceedings

▶ [Robust jointly-sparse signal recovery based on minimax concave loss function] (https://ieeexplore.ieee.org/document/9287635)

Kyohei Suzuki and Masahiro Yukawa

Proc. EUSIPCO (European Signal Processing Conference), pp.2070--2074, January 2021

Abstract: We propose a robust approach to recovering the jointly-sparse signals in the presence of outliers. We formulate the recovering task as a minimization problem involving three terms: (i) the minimax concave (MC) loss function, (ii) the MC penalty function, and (iii) the squared Frobenius norm. The MC-based loss and penalty functions enhance robustness and group sparsity, respectively, while the squared Frobenius norm induces the convexity. The problem is solved, via reformulation, by the primal-dual splitting method, for which the convergence condition is derived. Numerical examples show that the proposed approach enjoys remarkable outlier robustness.

Non-Peer-Reviewed Articles

- Multiscale Manifold Clustering and Embedding with Multiple Kernels

  Kyohei Suzuki and Masahiro Yukawa

  Proc. Technical Report of IEICE, pp.276--281, Okinawa, Mar. 2023
- Sparse Stable Outlier-Robust Regression Using Minimax Concave Function

  Kyohei Suzuki and Masahiro Yukawa

  Proc. IEICE SIP Symposium, pp.96--101, Zoom (fully virtual), Nov. 2021
- A Robust Approach to Jointly-Sparse Signal Recovery Based on Minimax Concave Loss Function

  Kyohei Suzuki and Masahiro Yukawa

  Proc. Technical Report of IEICE, vol. 119, no. 440, IEICE-SIP2019-124, pp. 123--128, Okinawa, Mar. 2020