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Journal articles

- Linearly-Involved Moreau-Enhanced-Over-Subspace Model: Debiased Sparse Modeling and Stable Outlier-Robust Regression

  Masahiro Yukawa, Hiroyuki Kaneko, **Kyohei Suzuki** and Isao Yamada

  IEEE Trans. Signal Processing, vol.71, pp. 1232--1247, 2023

  ▶ Abstract

  We present an efficient mathematical framework to derive promising methods that enjoy “enhanced” desirable properties. The popular minimax concave penalty for sparse modeling subtracts, from the ℓ1 norm, its Moreau envelope, inducing nearly unbiased estimates and thus yielding considerable performance enhancements. To extend it to underdetermined linear systems, we propose the projective minimax concave penalty , which leads to “enhanced” sparseness over the input subspace. We also present a promising regression method which has an “enhanced” robustness and substantial stability by distinguishing outlier and noise explicitly. The proposed framework, named the linearly-involved Moreau-enhanced-over-subspace (LiMES) model , encompasses those two specific examples as well as two others: stable principal component pursuit and robust classification. The LiMES function involved in the model is an “additively nonseparable” weakly convex function, while the ‘inner’ objective function to define the Moreau envelope is “separable”. This mixed nature of separability and nonseparability allows an application of the LiMES model to the underdetermined case with an efficient algorithmic implementation. Two linear/affine operators play key roles in the model: one corresponds to the projection mentioned above and the other takes care of robust regression/classification. A necessary and sufficient condition for convexity of the smooth part of the objective function is studied. Numerical examples show the efficacy of LiMES in applications to sparse modeling and robust regression.

- Sparse Stable Outlier-Robust Signal Recovery Under Gaussian Noise

  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 ℓ2 penalty of the noise vector, respectively. In addition, the simultaneous use of the MC and squared ℓ2 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

  Kyohei Suzuki and Masahiro Yukawa

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

  ▶ Abstract

Peer-Reviewed Conference Proceedings

- Sparse Stable Outlier-Robust Regression with Minimax Concave Function

  Kyohei Suzuki and Masahiro Yukawa

  Proc. International Workshop on Machine Learning for Signal Processing (MLSP), pp. 1--6, August 2022

  ▶ Abstract

- On Grouping Effect of Sparse Stable Outlier-Robust Regression

  Kyohei Suzuki and Masahiro Yukawa

  Proc. International Workshop on Machine Learning for Signal Processing (MLSP), pp. 1--6, August 2022

  ▶ Abstract

- Robust jointly-sparse signal recovery based on minimax concave loss function

  Kyohei Suzuki and Masahiro Yukawa

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

  ▶ Abstract

Non-Peer-Reviewed Articles

- Debiased Estimation of Signals with Structured Sparsity Based on External Division of Two Proximity Operators

  Kyohei Suzuki and Masahiro Yukawa

  Proc. IEICE SIP Symposium, pp.1--6, Nov. 2023
- 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