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Robust sparse signal reconstructions against basis mismatch and their applications. (English) Zbl 1391.94305

Summary: Creating a proper dictionary is an essential step in sparse signal recovery to explore sparsity in a variety of applications. To utilize the sparse property of the signal of interest, a large and fine dictionary is usually desired to achieve high estimation accuracy. Unfortunately, a big dictionary requires high computational complexity. Furthermore, one can imagine that no matter how fine we grid the domain to create the dictionary, there will always be an off-grid problem, namely the parameters to be estimated do not lie on the grids. This off-grid problem is the so-called a basis mismatch, which will degrade the estimation performance and it can be formulated as the multiplicative noise to the unknown parameters or quantization error to the dictionary. To tackle this issue, in this paper, robust algorithms are developed to enhance the estimation accuracy by utilizing the robust optimization techniques such as stochastic robust and worst case optimizations. As a result, an extra $\ell_2$-norm constraint on parameter of interest is introduced to increase the estimation robustness. In addition, both theoretical analysis and simulations show that the proposed robust sparsity recovery approaches are superior in performance to other recovery schemes.

MSC:
94A12 Signal theory (characterization, reconstruction, filtering, etc.)

Keywords:
dictionary; sparsity; basis mismatch; robustness

Software:
CVX

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References: