Sparse optimization techniques for solving multilinear least-squares problems with application to design of filter networks

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Abstract:

The multilinear least-squares (MLLS) problem is an extension of the linear least-squares problem. The difference is that a multilinear operator used in place of a matrix-vector product. The MLLS is typically a large-scale problem characterized by a large number of local minimizers. Each of the local minimizers is singular and non-isolated. The MLLS problem originates, for instance, from the design of filter networks.

For the design of filter networks, we consider the problem of finding optimal sparsity of the sub-filters that compose the network. This results in a MLLS problem augmented by an additional constraint that poses an upper limit on the number of nonzero components in the solution. This sparse multilinear least-squares problem is NP-hard. We present an approach for approximately solving the problem. In our numerical experiments, a greedy-type sparse optimization algorithm is used for designing 2D and 3D filter networks.

The efficiency of our approach is illustrated by results of numerical experiments performed for some problems related to the design of filter networks.