THE UNIVERSITY OF CHICAGO

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Imaging With Highly Incomplete and Corrupted Data

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ABSTRACT

We consider the problem of imaging sparse scenes from a few noisy data using an l1-minimization approach. This problem can be cast as a linear system of the form Ax=b. The dimension of the unknown sparse vector x is much larger than the dimension of the data vector b. The l1-minimization alone, however, is not robust for imaging with noisy data. To improve its performance we propose to solve instead the augmented linear system [A|C]x=b, where the matrix C is a noise collector. It is constructed so as its column vectors provide a frame on which the noise of the data can be well approximated with high probability. This approach gives rise to a new hyper-parameter free imaging method that has a zero false discovery rate for any level of noise. We further apply the idea of the noise collector to signal recovery from cross-correlated data matrix bb'. Cross-correlations naturally arise in many fields of imaging, such as optics, holography and seismic interferometry. The unknown is now a matrix xx' formed by the cross correlation of the unknown signal. Hence, the bottleneck for inversion is the number of unknowns that grows quadratically with dimension of x. The noise collector helps to reduce the dimensionality of the problem by recovering only the diagonal of xx', whose dimension grows linearly with the size of x. I will demonstrate the effectiveness of our approach for radar imaging. The method itself, however, can be applied in, among others, medical imaging, structural biology, geophysics and high-dimensional linear regression in statistics. This is a joint work with M. Moscoso, G.Papanicolaou and C. Tsogka.

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