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Colored Coded Aperture Design by Concentration of Measure in Compressive Spectral Imaging

Abstract:

Compressive spectral imaging (CSI) senses the spatio-spectral information of a scene by measuring 2D coded projections on a focal plane array. A ℓ_1-norm-based optimization algorithm is then used to recover the underlying discretized spectral image. The coded aperture snapshot spectral imager (CASSI) is an architecture realizing CSI where the reconstruction image quality relies on the design of a 2D set of binary coded apertures which block-unblock the light from the scene. This paper extends the compressive capabilities of CASSI by replacing the traditional blocking-unblocking coded apertures by a set of colored coded apertures. The colored coded apertures are optimized such that the number of projections is minimized while the quality of reconstruction is maximized. The optimal design of the colored coded apertures aims to better satisfy the restricted isometry property in CASSI. The optimal designs are compared with random colored coded aperture patterns and with the traditional blocking-unblocking coded apertures. Extensive simulations show the improvement in reconstruction PSNR attained by the optimal colored coded apertures designs.