Compressive sensing with structured random matrices

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Compressive sensing predicts that sparse and compressible signals can be recovered from what was previously believed to be incomplete linear measurements via efficient algorithms such as l1-minimization. Remarkably, all optimal measurement matrices modelling the linear information acquisition process known so far are based on randomness. While Gaussian and Bernoulli matrices provide simple models of such random matrices, they are of limited practical use. In fact, applications demand for structure, both for physical/modelling reasons and in order to have fast matrix computations. This motivates to study structured random matrices.

An important scenario considers the interpolation of functions having a sparse expansion with respect to certain orthonormal system. Choosing the interpolation points at random leads to the study of random sampling matrices including for instance random partial Fourier matrices as a special case. Another example is concerned with sparse recovery from subsampled random convolutions. Moreover, we will discuss random scattering matrices arising from remote sensing. We will present the currently best available sparse recovery guarantees for the various structured random matrices.