ALI PEZESHKI, Colorado State University
Sense and Sensitivity: Model Mismatch in Compressed Sensing

We study the sensitivity of compressed sensing to mismatch between the assumed and the actual models for sparsity. We start by analyzing the effect of model mismatch on the best k-term approximation error, which is central to providing exact sparse recovery guarantees. We establish achievable bounds for the ℓ_1 error of the best k-term approximation and show that these bounds grow linearly with the signal dimension and the mismatch level between the assumed and actual models for sparsity. We then derive bounds, with similar growth behavior, for the basis pursuit ℓ_1 recovery error, indicating that the sparse recovery may suffer large errors in the presence of model mismatch. Although, we present our results in the context of basis pursuit, our analysis applies to any sparse recovery principle that relies on the accuracy of best k-term approximations for its performance guarantees. We particularly highlight the problematic nature of model mismatch in Fourier imaging, where spillage from off-grid DFT components turns a sparse representation into an incompressible one. We substantiate our mathematical analysis by numerical examples that demonstrate a considerable performance degradation for image inversion from compressed sensing measurements in the presence of model mismatch.

This is joint work with Yuejie Chi, Louis Scharf, and Robert Calderbank.