RIPless “block-based“ Compressed Sensing with Analysis Prior and Applications to Magnetic Resonance Imaging

Maximilian März
Technische Universität Berlin
Department of Mathematics
Straße des 17. Juni 136, 10623 Berlin
maxmaerz@gmail.com

Compressed Sensing (CS) is a powerful theory which guarantees the reconstruction of an unknown *sparse* signal from a relatively small number of linear measurements. Theoretical recovery results in CS are usually stated for certain types of isolated random measurements. However, due to physical constraints, most acquisition systems measure the unknown signal in form of *block measurements*, such as lines in the k-space for magnetic resonance imaging (MRI). Furthermore, medical images are typically not sparse themselves but have sparse *analysis coefficients* in certain dictionaries, e.g. wavelets or shearlets. A possible approach for redundant dictionaries is therefore the *analysis formulation* of CS, for which only few results are known so far.

Recently, a new approach was proposed by J. Bigot et al., which yields recovery results for linear random *block measurements* under certain *intra-* and *inter-support block coherence* assumptions. In the first part of this talk we present a similar *non-uniform, RIP-less* recovery result for *analysis-sparse signals* obtained through *block measurements*. The proof of this novel result relies in particular on the construction of a suitable *dual certificate* and the *Golfing-scheme*.

In the last part of the talk, we present numerical results for CS in analysis formulation in the case of MRI-images which are measured along lines in the k-space. We propose a regularization method which is inspired by an approach of W. Guo et al. It combines a *shearlet* based regularizer in *analysis formulation* and a *total generalized variation* regularizer. The resulting optimization problem is efficiently solved via a *Split-Bregman* approach. A key observation here will be that in order to obtain accurate reconstructions, the *sparsity in levels* of the shearlet transform has to be used appropriately.