Seminar

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Generalized sampling and infinite-dimensional compressed sensing

Compressed sensing has been one of the great successes of applied mathematics in the last decade. It allows one to reconstruct sparse signals from seemingly incomplete collections of measurements, and thereby circumvent the classical Nyquist barrier. However, compressed sensing is currently a finite-dimensional theory: it concerns the recovery of signals modelled as vectors in finite-dimensional vector spaces. With this in mind, the purpose of this talk is to introduce a new framework and numerical technique for infinite-dimensional signals. This generalizes finite-dimensional compressed sensing to the infinite-dimensional setting.

This new framework originates from recent developments in classical (i.e. Nyquist rate) signal recovery, known as generalized sampling. Generalized sampling allows for signal reconstruction in arbitrary bases in a manner which is both numerically stable and, in a certain sense, optimal. The infinite-dimensional compressed sensing framework extends this approach by allowing one to take advantage of sparsity to achieve significant subsampling.

Compressed sensing (whether finite or infinite-dimensional) relies on incoherence between the sampling and sparsity systems. The amount of incoherence limits the level of subsampling possible, and it is straightforward to construct examples for which this so-called coherence barrier prohibits recovery via random subsampling. Nevertheless, many problems, whilst coherent, possess so-called asymptotic incoherence. In the final part of this talk, I will discuss how to exploit this phenomenon to break the coherence barrier, and therefore achieve good recovery with subsampling.

This is joint work with Anders Hansen (Cambridge).