Streaming signal reconstruction from generalized measurements

Justin Romberg, Georgia Institute of Technology

The central theme of this talk is reconstructing a signal from a stream of generalized samples. This problem has a long history in the signal processing literature. To date, the majority of the results revolve around systems which take samples of and reconstruct the signal using filterbanks with multiple channels, or reconstruct the signal in ``batch mode'' by collecting a large number of measurements and then perform the inversion of the entire signal by solving a system of linear equations. In the first part of this talk, we will present a method for reconstructing a signal online that lies in between these two approaches. We set the reconstruction up as a linear inverse problem, and then show how to solve the system in an "online" manner.

In the second part of the talk, we show how these ideas can be extended to sparse reconstruction, where we are solving an l1-regularized inverse problem. We present a collection of homotopy-based algorithms that dynamically update the solution of the underlying L1 problem as the system changes.

Finally, we will discuss a continuous time "algorithm" (i.e. a set of coupled nonlinear differential equations) for solving a class of sparsity regularized least-squares problems. We characterize the convergence properties of this neural-net type system, with a special emphasis on the case when the final solution is indeed sparse. We will also how well this system can "track" a dynamically changing signal.