CS 296.1: Sample Course Project

Democracy

The following paper introduces the concept of *democracy* in which the individual bits in a coarsely quantized representation of a signal are all given equal weight in the approximation to the original signal. Democracy is characteristic of sigma-delta quantization schemes which might be suboptimal in terms of accuracy but have the virtue of low complexity. The paper explores the pros and cons of democracy and proves that certain democratic representations cannot achieve the same accuracy as optimal non-democratic schemes.

A.R. Calderbank and I.C. Daubechies, The Pros and Cons of Democracy*, IEEE Transactions on Information Theory*, vol. 48 (6), pp. 1721-1725, June 2002.

The next paper explores the fact that certain CS measurement systems are democratic, which means that each measurement carries roughly the same amount of information about the signal being acquired. It explores how to quantize the compressive measurements in practical CS systems. If we were to apply the conventional wisdom gained from conventional Shannon-Nyquist uniform sampling, then we would scale down the analog signal amplitude (and therefore increase the quantization error) to avoid the gross saturation errors that occur when the signal amplitude exceeds the dynamic range of the quantizer. It argues that a CS system achieves the best performance when operated at a significantly nonzero saturation rate.

J.N. Laska, P.T. Boufounos, M.A. Davenport and R.G. Baraniuk, Democracy in action: Quantization, saturation and compressive sensing, preprint available at the Rice webpage

Start by reflecting on the value of democracy in general and on the value in compressive measurement in particular.

Guides: Marco Duarte and Sina Jafarpour

Course Project: Explore the value of democracy in the context of the Reed Muller Sieve.

We have in hand theoretical results on performance in the presence of noise in both the data and the measurement domain as well as fast code for running experiments.