Sampling Moments and Reconstructing Signals with Finite Rate of Innovation: Shannon meets Strang-Fix

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Abstract:

Consider the problem of sampling signals which are not bandlimited, but still have a finite number of degrees of freedom per unit of time, such as, for example, piecewise polynomial or piecewise sinusoidal signals, and call the number of degrees of freedom per unit of time the rate of innovation. Classical sampling theory does not enable a perfect reconstruction of such signals since the band is not limited.

Recently, it was shown that by using an adequate sampling kernel and a sampling rate greater or equal to the rate of innovation, it is possible to uniquely reconstruct such signals. These sampling schemes, however, use kernels with infinite support and this leads to complex and unstable reconstruction algorithms.

In this talk, we show that many signals with finite rate of innovation can be sampled and perfectly reconstructed using kernels of compact support and a local reconstruction algorithm. The class of kernels that we can use is very rich and includes functions satisfying Strang-Fix conditions, Exponential Splines and functions with rational Fourier transforms. Our sampling schemes can be used for either 1-D or 2-D signals with finite rate of innovation.