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Near–Optimal Encoding for Sigma–Delta Quantization

Analog–to–digital (A/D) conversion is the process by which real world "signals" (e.g., bandlimited functions or finite–dimensional vectors) are replaced by bit– streams to allow for digital storage, transmission, and processing. Typically A/D is thought of as being composed of sampling and quantization. Sampling consists of collecting inner products of the signal with appropriate vectors. Quantization consists of replacing these inner products with elements from a finite set. In particular, a good A/D scheme allows for accurate reconstruction of the original object from its quantized samples. In this talk we investigate the coding efficiency, i.e., the reconstruction error as a function of the bit–rate, of Sigma–Delta quantization, a popular class of quantization algorithms in the oversampled regime. We prove that a simple and practical encoding of the Sigma–Delta bit–stream allows for near–optimal error rates when coupled with an appropriate (linear) reconstruction algorithm. This is true, both in the case of finite–frames (joint work with Mark Iwen) and bandlimited functions (joint work with Ingrid Daubechies).