Sampling Finite-Support Sobolev Signals and Images

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Abstract

Considering finite-support signals, it is shown that the ideal sampling process can be described by means of an orthogonal projection within a Sobolev space. This interpretation is shown to account for non-uniform and for non-ideal sampling schemes as well. It further enables one to derive a minimax approximation scheme for an arbitrary linear bounded functional while utilizing the sampled version of the signal as the only available data. The paper extends and generalizes recent results derived for the infinite-support case, and proposes accordingly applications suitable for the more practical situation of finite-support signals (images) such as approximation of representation coefficients, Fourier transform evaluation and derivative calculations. The new approach offers further insight into the intertwining relationship between the analog and the discrete domains, suggesting improved methods for multi-dimensional signal processing applications.