Adaptive sampling of variable bandwidth functions

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Abstract

Classical sampling theory targets functions with limited spectra (band-limited) and provides for a perfect reconstruction, via the translates of a single atom g, where g has to satisfy certain frequency constraints. However, real-world signals are often not band-limited, but rather possessing variable bandwidth (VB), which requires an adaptive sampling atom and rate for optimal results.

The short-time Fourier transform allows defining the approximate bandwidth of a signal locally and describes well the changes in the frequency content in time. Applying techniques from amalgam spaces to Gabor frames and Wilson bases, we develop combined sampling strategies for VB-functions, which give a satisfying approximation on a restricted sampling area. We give a setting in which it is possible to recover functions with variable bandwidth from appropriately sampled sampling sequences. In our VB-setting, having the freedom to choose the sampling strategy related to the bandwidth is extremely beneficial. Improving the locality is done well with choosing a well-localized analyzing atom and sampling rate, so we achieve good local approximation.

Knowing the samples of a VB-function f over a sampling set, we cannot expect to achieve perfect reconstruction, but a well-quantified approximation with a small error, as the high frequency components of f should be small. The achieved approximation quality depends on the local bandwidth.

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