Improved Spectral Analysis Using Waveform-Aligned Adaptive Windows

Abstract: We propose a new pipeline for the Short-Time Fourier Transform (STFT) of harmonic signals based on adapting the analysis window size to the period of the harmonic signal. Pitch estimation is used to find \( f_0 \), and resampling ensures a window size as close as possible to a period which reduces spectral leakage almost to zero. The result is a highly accurate spectral representation with location and amplitude of spectral peaks represented as single frequency coefficients rather than a cluster of frequencies.

We also present a new display method based on this pipeline which greatly improves the spectrogram through enhanced distinction among partials. Finally, validation is performed by signal restoration on 40 clips, showing the superiority of the pipeline for true periodic signals and comparability for pseudo-periodic signals.