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Automatic Time-Frequency Based Method for Signal Component Instantaneous Frequency Estimation

The field of time-frequency analysis provides a set of powerful tools for analyzing and processing nonstationary signals, i.e. signals with time-varying spectra. Majority of real-life signals are generally classified as nonstationary; some examples being acoustic signals, seismic signals, communication signals, etc. Time-frequency representations provide valuable information on the nature of analyzed signals, which is unavailable when the classical methods (instantaneous power or magnitude spectrum) are employed. Those time-frequency distributions of signal energy allow for detection and extraction of signal components by identifying dominant "ridges" in the joint time-frequency plane. From the local peaks of the ridges, the estimates of the components instantaneous frequency (IF) laws can be obtained. In this paper, we present an automatic method for detection of multicomponent signals individual components, and estimation of their respective instantaneous frequencies. The method is based on the cross Wigner-Ville distribution, and unlike many existing time-frequency techniques, it does not require prior information on the analyzed signal nor often cumbersome kernel filter parameters optimization techniques. The method is tested on both synthetic and real-life (sonar) signals, resulting in highly accurate IF estimates that outperform those obtained by using another recently proposed time-frequency IF estimation technique.

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