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Cím: Nonstationary signal processing - methods and applications

Absztrakt:
Nowadays, nonstationary signal processing has found its applications in various technical areas, such as biomedical signal processing, image and video processing, speech processing, sonar, radar and other sensor array processing, seismology, etc. Classical approaches to analyze nonstationary signals utilize the Fourier transform for the signal spectral analysis. The Fourier transform of signals results in their spectral decomposition enabling quantification of their features in the frequency domain. However, being a stationary time-series analysis tool, the Fourier transform does not render significant information concerning spectral peak timing.
Furthermore, in the case of the signals obscured by the noise, classical mathematical tools, such as the Fourier transform, exhibit strong limitations. In addition, filtering the noisy signal in order to suppress additive noise using the standard filters in frequency domain may be applied only if the noise is located and limited just to a specific pre-known frequency band. However, this is not the case in numerous real-life applications.
Therefore, real-life signal analysis requires utilizing computationally more demanding tools suitable for nonstationary signal analysis both in noise and noise-free environments, such as joint time-frequency processing techniques, i.e. time-frequency distributions (TFDs). TFDs provide a two-dimensional representation of the EEG signal frequency content varying over time, and thus enable detection of the number of signals components and their frequency ranges. TFDs also allow the estimation of signal instantaneous frequency (IF), making them a natural approach for the nonstationary signal analysis and classification.

One of the recently proposed time-frequency based approaches to extract signal components is based on the modification of the Renyi entropy, called short-term Renyi entropy (STRE). The STRE may be upgraded by the component extraction procedure and the IF estimation algorithm, and applied to biomedical signal analysis and classification (such as for example EEG records).

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