Wavelets in Neurophysiology

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Wavelets have become a more and more popular tool for signal and image processing and can also be applied successfully for the analysis of neurophysiological data. Due to the good time-frequency localization of wavelets, the well-known problems arising from applying the short-time Fourier transform to time-localized signals can be circumvented.
We introduce the two major concepts of wavelet analysis, namely, the continuous wavelet transform from harmonic analysis and the discrete wavelet transform from signal processing and explain the application of these concepts to neurophysiological data, in particular, EEG measurements. To illustrate their performance in applications, we also point out how the associated transforms can be efficiently implemented in terms of the fast Fourier transform (FFT) and filter banks, respectively. In addition, we present a natural analog of coherence for the wavelet domain which allows for the detection of transient coherent events even in the presence of noise whose amplitude significantly exceeds that of the signal.
All these applications are illustrated by practical numerical experiments.