Geophysical Research Abstracts
Vol. 20, EGU2018-18195, 2018
EGU General Assembly 2018

Multitaper spectral estimation for the continuous wavelet transform

Guillaume Lenoir
Université Catholique de Louvain, ELI, ELIC - TECLIM, Louvain-la-Neuve, Belgium (guillaume.lenoir@uclouvain.be)

The multitaper method (MTM), introduced in 1982 by Thomson [4], is widely used for the estimation of the Fourier power spectrum of a discrete-time stationary process from one of its samples. Adapting the MTM to the continuous wavelet transform (CWT) is possible and allows to build an estimator of the wavelet power spectrum of a continuous-time nonstationary process from one of its samples. Compared to the scalogram, such an estimator efficiently reduces the variance while minimizing the leakage outside a predefined area in the time-scale plane. But this has been so far studied for only a two-parameter family of wavelets including the Paul wavelet, in Daubechies and Paul [1], and Olhede and Walden [3], where analytical results were derived from a localization problem. The analytical approach is probably not generalizable to any mother wavelet, and in particular to the Morlet wavelet. Given the extensive use of the Morlet wavelet in various fields and its ideal time-frequency localization, I derive numerical tapers of the Morlet localization operator [2], based on a general numerical scheme that can be applied to any well-localized progressive wavelet. To this end, I adopt the same localization operator as in [1], giving tapers with the required invariance properties for the problem to be numerically solvable. The numerical scheme is first applied to the Paul wavelet and is able to reproduce the analytical results of [1]. Finally, the technique is illustrated with geophysical time series.

References

[1] I. Daubechies and T. Paul. Time-frequency localisation operators - A geometric phase space approach: II. The use of dilations. Inverse Problems, 4(3):661, 1988.

[2] G. Lenoir. Multitaper Spectral Estimation for the Continuous Wavelet Transform: A General Numerical Approach and an Application to the Morlet Wavelet. To be submitted to Biometrika.

[3] S.C. Olhede and A.T. Walden. Generalized Morse wavelets. IEEE Transactions on Signal Processing, 50(11):2661-2670, November 2002.

[4] D.J. Thomson. Spectrum estimation and harmonic analysis. Proceedings of the IEEE, 70(9):1055-1096, September 1982.