Empirical Mode Decompositions as data-driven wavelet-like expansions for stochastic processes

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During the last decade, wavelet-based techniques (and variations) have proved remarkably effective for representing and analyzing various stochastic processes, and especially those with scaling properties [1]. Amongst a number of reasons for this success stands first the adequacy between the multiscale nature of such processes and the built-in multiscale structure of wavelet decompositions, as well as companion benefits in terms of stationarization and reduced correlation. More recently, an apparently unrelated technique, referred to as *Empirical Mode Decomposition* (EMD), has been pioneered by Huang *et al.* [2] for adaptively representing functions as sums of zero-mean components with symmetric envelopes. Such a decomposition is based on an idea of locally extracting fine scale fluctuations in a signal and iterating the procedure on the (locally lower scale) residual. As such, EMD corresponds in some sense to a hierarchical multiscale decompositon but, in contrast with wavelet techniques, it is fully data-driven and relies on no a priori choice of filters or basis functions. Nevertheless, it has been shown that, when applied to broadband processes such as fractional Gaussian noise or fractional Brownian motion, EMD behaves spontaneously as a dyadic filterbank resembling those involved in wavelet decompositions [3]. We will here report on our findings in this direction and compare EMD with wavelet-based techniques in terms of decorrelation properties, Hurst exponent estimation and trend removal capabilities. The EMD approach is intuitive and appealing, but the decomposition is only obtained as the output of an algorithm for which no well-founded theory is available yet. The presented results will therefore be based on extensive numerical simulations performed with freeware Matlab codes [4].

References

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