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Nonlinear mode decomposition: a new algorithm of interest for the biomedical field?

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The empirical mode decomposition (EMD) has been proposed by Huang *et al.* to adaptively decompose a signal into a few intrinsic mode functions (IMFs) that are zero-mean AM-FM components [1]. Since its introduction in 1998, EMD has been used in a variety of fields. Nevertheless, EMD suffers from some drawbacks as pointed out by many authors (see, e.g., [2]). This is why other EMD-based approaches have emerged, as [2-6] to cite only a few.

Recently, the nonlinear mode decomposition (NMD) has been proposed as another adaptive algorithm to decompose a signal into oscillations, simultaneously removing the noise [7]. From its performances on synthetic and real biomedical data, NMD has shown to overperform other methods [7].

NMD is based on a combination of a time-frequency analysis [8], surrogate data tests, and a harmonic identification [9]. More precisely, the algorithm relies on four steps [7]: (i) the extraction of the fundamental harmonic of an NM from the signal time-frequency representation [8]; (ii) the search of all its possible harmonics; (iii) the identification of the true harmonics; (iv) the reconstruction of the full NM from the summation of the true harmonics; the subtraction of this NM from the signal; this is iterated on the residual till a stopping criterion is met.

In its cornerstone paper, NMD has been applied on simulated signals as well as on real life data [7]. For the latter case, laser Doppler flowmetry (LDF) signals that reflect microvascular blood flow have been processed [7]. The results revealed that NMD is able to decompose data into oscillations linked with physiological activities. NMD has also shown success in removing cardiac artifacts from electroencephalogram signals [7].

From its performances, NMD can become of great interest for the biomedical field. Many applications are expected to emerge in medicine and biology. Moreover, the code for running NMD can be downloaded for free (http://www.physics.lancs.ac.uk/research/nbmphysics/diats/nmd/).

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