EGU2020-7063
https://doi.org/10.5194/egusphere-egu2020-7063
EGU General Assembly 2020

New insights and best practices for the succesful use of Empirical Mode Decomposition, Iterative Filtering and derived algorithms in the decomposition of nonlinear and nonstationary signals

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Nonlinear and nonstationary signals are ubiquitous in real life. Their time–frequency analysis and features extraction can help in solving open problems in many fields of research. Two decades ago, the Empirical Mode Decomposition (EMD) algorithm was introduced to tackle highly nonlinear and nonstationary signals. It consists of a local and adaptive data–driven method which relaxes several limitations of the standard Fourier transform and the wavelet Transform techniques, yielding an accurate time-frequency representation of a signal. Over the years, several variants of the EMD algorithm have been proposed to improve the original technique, such as the Ensemble Empirical Mode Decomposition (EEMD) and the Iterative Filtering (IF).

The versatility of these techniques has opened the door to their application in many applied fields, like geophysics, physics, medicine, and finance. Although the EMD– and IF–based techniques are more suitable than traditional methods for the analysis of nonlinear and nonstationary data, they could easily be misused if their known limitations, together with the assumptions they rely on, are not carefully considered. Here we call attention to some of the pitfalls encountered when implementing these techniques. Specifically, there are three critical factors that are often neglected: boundary effects; presence of spikes in the original signal; signals containing a high degree of stochasticity. We show how an inappropriate implementation of the EMD and IF methods could return an artefact–prone decomposition of the original signal. We conclude with best practice guidelines for researchers who intend to use these techniques for their signal analysis.