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THE EMPIRICAL MODE DECOMPOSITION : A NEW FORMULATION BASED ON CONSTRAINED OPTIMIZATION

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The *empirical mode decomposition* (EMD) is a relatively recent method introduced by Huang *et al* [2], whose purpose is to adaptively decompose any signal into zero-mean components, called *Intrinsic Mode Functions* (IMF). These IMF depend on the signal (EMD is a data-driven technique) and are in practice computed by a geometric and iterative procedure whose study is particularly complicated [1]. From the mathematical point of view, the definition of the IMFs is somewhat unclear. Moreover, the condition of "zero local mean" suggested by Huang *et al* [2] should not be fulfilled in many instances, and was leading to the introduction of *weak-IMF* by Sharpley and Vatchev [4].
In this talk, we present another approach for the definition of *weak-IMF* based on the direct construction of the mean envelope of the signal. The definition of the mean envelope is achieved through the resolution of a quadratic programming problem with equality and inequality constraints. Some numerical experiments illustrate the validity of the approach and comparisons are carried out with the classical EMD.

References

[1] P. Flandrin, G. Rilling and P. Goncalvès, Empirical Mode Decomposition as a Filter Bank, *IEEE Sig. Proc. Lett.,* **11**(2) (2004) 112-114.

[2] N.E. Huang, Z. Shen, S. R. Long, M.C. Wu, H.H. Shih, Q. Zheng, N.C. Yen, C.C. Tung and H.H. Liu, The empirical mode Decomposition and the Hilbert Spectrum for Nonlinear and nonstationary time series analysis, *Proc. of the Roy. Soc. London A*, **454** (1998) 903-1005.

[3] S. Meignen and V.Perrier, A New Formulation for Empirical Mode Decomposition Based on Constrained Optimization, *IEEE Sig. Proc. Lett.,* **14**(2) (2007) 932-935.

[4] R.C. Sharpley and V. Vatchev, Analysis of the Intrinsic Mode Functions, *Construct. Approx.*, **24** (2006) 17-47.