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Arbitrary-Order Hilbert Spectral Analysis: Theory and Application in Turbulence Research

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Multiscale statistics are relevant in many phenomena since different spatial and temporal scales are involved. Meanwhile, there are intrinsically nonlinear and nonstationary on different scales in these multiscale phenomena. Traditional statistical methods, such as, Fourier power spectrum analysis, structure-function analysis, etc., are failed to handle the nonlinearity and nonstationarity of the collected data from either laboratory experiments or the real world observations. The Empirical Mode Decomposition (EMD) is proposed by N.E. Huang in 1998 to overcome some potential shortcomings of the traditional method to handle the nonlinearity and nonstationarity by combining the classical Hilbert spectral analysis (HSA). Later, we generalized this Hilbert-based method into an arbitrary-order version, namely arbitrary-order Hilbert spectral analysis, to characterize the scale invariant property of a scaling process in a joint frequency-physical domain. In this talk, we present first the basic idea of this Hilbert-based methodology. It is then validated by numerical experiments and is applied in different turbulent systems, e.g., Eulerian velocity, passive scalar turbulence, two-dimensional turbulence, etc., to show the efficiency of this Hilbert-based method.

Reference

1. Huang Y, Schmitt F, Lu Z and Liu Y 2008 Europhys. Lett. 84, 40010.
2. Huang Y, Schmitt F, Lu Z and Liu Y 2009 J. Hydrol. 373, 103–111.
3. Huang Y, Schmitt F, Lu Z, Fougairolles P, Gagne Y and Liu Y 2010 Phys. Rev. E 82(2), 026319.
4. Huang Y, Schmitt F G, Hermand J P, Gagne Y, Lu Z and Liu Y 2011 Phys. Rev. E 84(1), 016208.
5. Huang Y, Biferale L, Calzavarini E, Sun C and Toschi F 2013 Phys. Rev. E 87, 041003(R).
6. Tan H.S., Huang Y. and Meng J.-P. 2014 Phys. Fluids 26, 015106.