Perspectives on the Empirical Mode Decomposition (EMD) and the Hilbert Huang Transform (HHT)

Nii O. Attoh-Okine

This talk will focus on the empirical mode decomposition (EMD) and the bidimensional empirical model decomposition (BEMD) as well as the Hilbert-Huang Transform (HHT). The central idea of the HHT is the empirical mode decomposition, which decomposes a signal into basis function called intrinsic mode functions (IMFs). The Hilbert Transform can then be applied to the IMFs to generate energy-time-frequency spectrum called Hilbert Spectrum. Unlike the Fourier-based methods, the EMD decomposes a signal into its components adaptively without using a priori basis. The decomposition is based on local time scale of the data. The bidimensional empirical mode decomposition is an extension of the one-dimensional EMD applied to images. The images are decomposed with BEMD using different interpolation techniques/methods to extract IMFs. An important aspect of the BEMD is the construction of envelopes when sifting for the IMFs, which involves interpolation of scattered data formed by extreme of the data. In addition the salient properties of EMD/HHT, different types of EMD algorithms (EEMD-Ensemble Empirical Mode Decomposition, CEMD-Complex Empirical Mode Decomposition), some physical meaning of the IMFs, the effect of different interpolation techniques on the outcome of the BEMD results will be discussed. Finally parallel processing of the technique and some theoretical/mathematical problems of the technique and case studies will be covered.

Bio:

N*ii O. Attoh-Okine is a Professor in Civil and Environmental Engineering at the University of Delaware. He received his Dipl. Ing with distinction from Rostov Institute of Civil Engineering, Rostov-On-Don, Russia in 1986 and a PhD in Civil Engineering with Minor in Statistics from University of Kansas in 1992. His research interests are in the areas of Belief Functions in civil infrastructure systems, graphical probability models, and the Hilbert-Huang Transform. He has published many articles on management of uncertainty in civil infrastructure systems, the use of neural networks in infrastructure deterioration modeling, and the Hilbert-Huang Transform. His articles have appeared in journals such as IEEE Transaction on Systems, Man and Cybernetics–Part C, IEEE Sensors, ASCE Journal of Computing, ASCE Journal of Transportation Engineering and Canadian Journal of Civil Engineering. He serves as an Associate Editor of IEEE Transactions on SMC-Part C, ASCE Journal of Computing Civil Engineering and ASCE Journal of Pipeline Systems. He has served as the Chairman of the First International Symposium on Hilbert-Huang Transform held at the University of Delaware in 2004. He has served on the doctoral dissertation committees of ten students in Civil and Geological Engineering, seven of them as Chairperson of the committee.*