EDITORIAL NOTES

This special issue contains a number of selected papers from the Second International Conference on the Advances of Hilbert-Huang Transform and its Applications held from December 14 to 17, 2008, in Sun Yat-Sen University in Guangzhou, China. As the Hilbert-Huang Transform method is still in developing stage, we found it necessary to hold conference periodically to summarize the advances as a guide for the future research directions. This second international conference is a sequel to the first one held in December 2003, at National Central University, Chungli, Taiwan. The salient results of the first conference had appeared in the inaugural issue of this journal. It is therefore fitting to have the selected papers of the second conference also appear in this journal. This special issue is edited jointly by Professors Yuesheng Xu and Lihua Yang. It contains 13 papers which cover various topics related to the Empirical Mode Decomposition (EMD) and Hilbert-Huang Transform (HHT). Roughly speaking, it consists of three major classes of papers. Class one regards algorithmic development of the EMD and HHT, class two focuses on engineering applications of the HHT, and class three is surveys on recent development of certain important research directions of the EMD and HHT. From this special issue, the readers will observe exciting rapid development of the EMD in its mathematical development and engineering applications.

Class one contains seven technical papers, which address crucial issues in algorithmic development of the EMD or a related topic. Below, we discuss the contribution of these papers.

A paper on a variant of the EMD method for multi-scale data is contributed by Thomas Y. Hou, Mike P. Yan and Zhaohua Wu. It proposes a variant of the EMD method to decompose multiscale data into their Intrinsic Mode Functions (IMFs). Under the assumption that the multiscale data satisfy certain scale separation property, it is shown that the proposed method can extract the IMFs accurately and uniquely.

Gastón Schlotthauer, María E. Torres, Hugo L. Rufiner and Patrick Flandrin's paper investigates the EMD of Gaussian white noise. Specifically, they study effects of signal length and sifting number on the statistical properties of IMFs. The paper discusses the probability density function of IMFs generated by the EMD for the Gaussian white noise, based on experimental simulations. The influence on the probability density functions of the data length and of the maximum allowed number of iterations is analyzed by means of kernel smoothing density estimations. The obtained results are confirmed by statistical normality tests indicating that the IMFs have non-Gaussian distributions. It also indicates that large data length and high number of iterations produce multimodal distributions in all modes.

The paper by Daniel Van Vliet studies the properties of Blaschke products. A special inner product is constructed to form orthonormal bases for the space

$H^2(D)$. Using these sets of Blaschke products as approximants, a greedy algorithm decomposition is implemented.

Luan Lin, Yang Wang and Haomin Zhou contribute their paper on developing an alternative algorithm for EMD based on iterating certain filters, such as Toeplitz filters. This approach yields similar results as the more traditional sifting algorithm for EMD. In many cases, the convergence can be rigorously proved. The convergence of this algorithm is discussed in a sister paper by Chao Huang, Lihua Yang and Yang Wang for signals of continuous variables. It is also proved there that the limit function of this iterative algorithm is an ideal high-pass filtering process.

The paper by Xiyuan Hu, Silong Peng and Wen-Liang Hwang consider estimation of instantaneous frequency parameters of the operator-based signal separation method. The main function of the operator-based signal separation approach is to construct an operator from a signal and use it to decompose the signal. A variational approach to estimate the parameters of the operator for signal separation is proposed in this paper. It imposes a global constraint on the operator's parameter. The estimated parameters are more robust than those derived from the local extrema of the signal. They also compare the signal separation results with those obtained by using EMD.

The article on adaptive frequency estimation algorithm from multiple undersampled sinusoidal signals based on an adaptive IIR notch filter and a robust Chinese remainder theorem (CRT) is contributed by Hong Liang, Xiaowei Li and Xiang-Gen Xia. The proposed algorithm can significantly reduce the sampling rates and provide more accurate estimates than the method based on adaptive IIR notch filter and sampling rates above the Nyquist rates does. Although this paper does not directly related to EMD, it is concerned with adaptive data analysis. Therefore, we include it in this special issue.

Class two has four research papers. They all consider issues in applications of HHT. The contributions of these papers are summarized as follows.

The paper by Jun Chen considers an application of EMD in structural health monitoring. The paper summarizes some research experiences gained from application of EMD and HHT in structural health monitoring system with a focus on pre-processing raw data, structural parameter identification and damage detection. Issues concerned for further practical applications of EMD are highlighted and discussed in the paper.

Zhijing Yang, Zhihua Yang and Lihua Yang's paper reports their research finding in iris recognition based on HHT. In the paper a new method for iris recognition is proposed based on HHT. The main frequency center information based on HHT is used to form the feature vector. The proposed method is shown to have nice properties, such as translation, scale, rotation, and illumination invariance. Experimental results are encouraging and comparable to the existing iris recognition algorithms.

Jordan Camp, Alexandar Stroeer, John Cannizzo and Robert Schofield present their results on searching for gravitational waves with the HHT. Gravitational waves

are a consequence of Einstein's theory of general relativity applied to the motion of very dense and massive objects such as black holes and neutron stars. Two projects, LISA and LIGO, are underway to attempt the detection of gravitational waves. This paper shows that the unique capabilities of the HHT, the extraction of intrawave modulation and the characterization of nonlinear and nonstationary signals, have a natural application to both signal detection and experimental characterization of the detectors.

Alexander Ruzmaikin and Joan Feynman report their research results on searching for climate trends in satellite data by using EMD. Unambiguous determination of trends is the central theme of climate change studies. Standard methods of trend determination usually require sufficiently long time series and thus are not effective for the analysis of satellite data. This paper applies the EMD and find it be more efficient in the search for climate trends in the relatively short time series provided by satellites. In this paper the authors present examples of climate time series analysis using the EMD and discuss the problems they encounter in calculation and interpretation of trends extracted from the data limited in time extent.

In class three, there are two survey papers. One is written by Yuesheng Xu and Haizhang Zhang, on recent mathematical developments on the EMD. The paper takes the point of view of adaptive representations of nonlinear and nonstationary signals in reviewing the recent progress in algorithmic development of EMD. The second survey paper is contributed by Tao Qian, Yan-Bo Wang and Pei Dang, on adaptive decomposition of a signal into mono-components. Recent progress made by the authors and their collaborators on adaptive signal decomposition into mono-components are discussed.

As the editor-in-chief of the journal and editors for this special issue, we would like to express our sincere thanks to all authors and referees of this issue. Without their hard working it is not possible to have this high quality issue. We are looking forward to future conferences to report the continuing developments of this important field in nonlinear and nonstationary data analysis.

Yuesheng Xu, Lihua Yang and Norden E. Huang