RICE

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

CEVE *Specialty Seminar*

Bidimensional Hilbert-Huang Transform Analysis for Civil Infrastructure Condition Assessments

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The use of images in infrastructure condition assessments and monitoring is becoming a preferred approach to record, archive, and analyze various types of exterior damage to infrastructure. The images have been used to assess the condition of bridges, pavements, sewers, and other infrastructure facilities. Various infrastructure management systems have used computer vision and image processing techniques to automate the process. Proper analysis and interpretation of the images can provide useful information on the condition and performance of the infrastructure. Various methods have been used in these endeavors, including image-based neural networks, the Markov random field model, and Bayesian analysis. This presentation will describe an emerging technique, Bidimensional Hilbert Huang Transform/ Empirical Mode Decomposition, in infrastructure condition assessment. The empirical mode decomposition (EMD) technique has been developed recently with a view to analyze time-frequency distribution of nonlinear and nonstationary data. It is an adaptive decomposition with which any complicated signal can be decomposed into its intrinsic mode functions (IMFs), providing well-defined instantaneous frequency information about a signal. This decomposition technique has also been extended for analyzing images or 2D data known as bidimensional EMD and/or 2D EMD. In addition to the study of time frequency distribution, BEMD facilitates various image processing applications.

BEMD decomposition and the resulting intrinsic mode functions (IMFs) are governed by the method of extrema detection, criteria for stopping the iterations for each IMF and interpolation techniques. Although all of these factors are important for successful decomposition, the interpolation method may be considered the most crucial. Most of the scattered data interpolation techniques to produce 2D surfaces are themselves iterative processes. In the case of BEMD, it is very likely that the maxima or minima map does not contain any interpolation centers at the boundary region, which may be more severe for the later residue modes. Although a few 2D scattered data interpolation techniques are employed for the BEMD process, there is no work that compares the performance for various interpolation techniques. In this seminar, BEMD simulation is performed using radial basis function (RBF) based interpolations and Delaunay triangulation (DT) based interpolations. The presentation will show the theoretical underpinnings of BEMD and provide case studies from analyzing various infrastructure condition images using the method. The case studies will include bridge decks, pavement conditions, and pipeline defects.

Bio for Nii Attoh-Okine.
Dr. Attoh-Okine is an Associate Professor at the University of Delaware. He conducts research in the area of civil infrastructure systems, belief functions, graphical networks and models, and Hilbert-Huang transform.

Friday, December 1, 2006
3:00 PM
Ryon Lab, Room 201
Refreshments will be served at 2:45 PM