

## PREFACE

This special issue of *Smart Structures and Systems, an International Journal of Mechatronics, Sensors, Monitoring, Control, Diagnosis, and Life Cycle Engineering* reflects the constructive scientific interaction attained during the *Third International Conference on Earthquake Engineering – New Frontier in Research Transformation* that was organized by the Nanjing University of Technology in Nanjing P. R. China, on 19-20 October 2004.

This special issue brings together a host of excellent papers with the generic focus on sensors and smart sensing technologies for system identification, structural damage assessment, and structural health monitoring. A common theme in these papers is the multifunctional active role that active materials and ancillary devices are slated to have in the realization of sensors and smart structures technologies for present and future structural systems.

In their paper “Smart sensors for monitoring crack growth under fatigue loading conditions”, Giurgiutiu, Xu, Chao, Liu, and Gaddam present interesting experimental results of using piezoelectric wafer active sensors (PWAS) for monitoring fatigue crack growth using Lamb waves in both standing (electromechanical impedance method) and propagating modes.

The paper “Terra-Scope – a MEMS-based vertical seismic array” by Glaser, Chen, and Oberheim introduces a microprocessor-controlled shaft-mounted vertical sensor-array capable of capturing with accuracy the arrival and progression of a seismic wave ahead of its arrival at the Earth surface. Networking through wireless communication allows such an array system to image a large area and correctly predict the seism’s properties and damage potentiality.

Sun and Chang consider in their paper “Covariance-driven wavelet technique for structural damage detection” the use of wavelet transform methods to estimate the stiffness matrix changes in a building structure as indicative of structural damage. The method is numerically tested and experimentally verified on a three degree-of-freedom model representative of a three-story building.

The paper “HHT method for system identification and damage detection: an experimental study” by Zhou and Yan introduces the novel signal processing technique – Hilbert-Huang transform (HHT) – and applies it to damage detection in a three degree-of-freedom structural model representative of a three-story building. Two damage cases were experimentally induced and then detected with the HHT approach.

In their paper “Application of magnetoelastic stress sensors in large steel cables”, Wang, Wang, Zhao, Chen, and Sun consider the use of the magnetoelastic effect for non-contact measurement of stresses in the suspension hanger cables and post-tension cables of the Qiangjiang 4th Bridge in Hangzhou, P. R. China. A careful in-situ calibration method was followed by an extensive monitoring exercise that produced very impressive results.

Peng, Yuan, and Xu show in their paper “Damage detection in two-dimensional structure based on active Lamb waves” how piezoelectric wafer active sensors can be used to detect the presence of damage in a composite plate. The method is based on Lamb waves transmission and reception followed by wavelet transform and empirical mode decomposition.

The paper “Sensor placement selection of SHM using tolerance domain and second order eigenvalues sensitivity” by He, Zhang, and Ou treats the problem of optimal sensor placement selection for the monitoring of large structures, such as a 76-story 306-meter office tower proposed for the city of Melbourne, Australia and the JZ202-MUQ offshore platform that lies in Liaodong gulf of the Bo sea in East China. The method selects the number and placement of sensors on structure through the tolerance-domain statistical inference algorithm combined with a second order sensitivity analysis.

I hope the reader will find this special issue interesting and compelling. I wish to express my thanks to the contributing authors, which have shown perseverance in successfully present their excellent research in written form. Appreciation and recognition is due, in unlimited amount, to the team of reviewers, which have invested their time and effort in examining the manuscripts and making a host of valuable comments and suggestions; my debt and gratitude to them is unbounded, alas the rules of confidentiality do not allow me to mention their names explicitly. Thanks and appreciation are expressed to the organizers of the organizers of the 2004 Nanjing conference (Professors Weiqing Liu, Fuh-Gwo Yuan, Peter C. Chang) for selecting the relevant manuscripts from their proceedings of their conference. I am extremely grateful to Professor Chang-Koon Choi, the responsible Editor in Chief, for his help and infinite patience in understanding the tortuous process of manuscript reviewing and revision. An last but not least, unbounded gratitude is expressed to Dr. Shih-Chi Liu, the spirit and driving force behind this whole enterprise.

#### **BRIEF BIOGRAPHY:**

**Education:** Imperial College, London, UK: PhD (1977) Aeronautical Structures; BS (1972) Aeronautics.

**Research:** Adaptive Materials and Smart Structures, Structural Health Monitoring, Mechatronics; Ultrasonic NDE with Piezoelectric Wafer Active Sensors (PWAS); Active Biomedical Sensors, Integrated Nano Sensors.

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