Editors

Nikos E. Mastorakis

J. D. Yau

Recent Advances in Fluid Mechanics and Thermal Engineering

- *Proceedings of the 12th International Conference on Fluid Mechanics & Aerodynamics (FMA '14)*

- *Proceedings of the 12th International Conference on Heat Transfer, Thermal Engineering and Environment (HTE '14)*

Geneva, Switzerland, December 29-31, 2014

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Recent Advances in Mechanical Engineering Series | 12

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Preface

This year the 12th International Conference on Fluid Mechanics & Aerodynamics (FMA '14) and the 12th International Conference on Heat Transfer, Thermal Engineering and Environment (HTE '14) were held in Geneva, Switzerland, December 29-31, 2014. The conferences provided a platform to discuss mathematical modeling in fluid mechanics, hydrodynamics, fluid mechanics for civil engineering, aerodynamics, heat and mass transfer, conduction problems, heat storage, renewable energy, energy applications etc. with participants from all over the world, both from academia and from industry.

Their success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of these conferences are published in this Book that will be sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to many Journals for further evaluation.

Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Study on Interaction Aerodynamics of Vehicle-Bridge System under Wind Actions

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Abstract: In this study, a computational framework for performing vehicle-bridge interaction dynamics under wind actions was presented using iterative method. To investigate the interaction aerodynamics of a vehicle running on a bridge in cross wind actions, a 3D finite element model of a cable-stayed bridge subjected to moving vehicles is represented. Here, the cross winds including both steady and unsteady aerodynamic forces acting on the vehicle-bridge system are generated using spectral representation method and simulated (measured) aerodynamic coefficients along the bridge in the temporal and spatial domain. With the simulated wind forces, the vehicle-bridge system in cross winds can be composed into two subsystems: bridge-wind subsystem and vehicle-wind subsystem, and then an iterative schemes is employed to compute the interaction response between the two subsystems. By the present vehicle-bridge-wind coupling model, the aerodynamic response of a vehicle running on a cable-stayed bridge in cross winds will be presented in numerical examples.

Brief Biography of the Speaker: Dr. J.D. Yau got his Ph.D. from National Taiwan University (NTU) in 1996. After serving as a chair-engineer at the Kuan-Tech Engineering Consultants Co. at Taichung in Taiwan (1997-1999), he joined the faculty at TamKang University (1999) where he has served as Assistant Professor (1999-2003), Associate Professor (2003-09), and Chair (2004-2007) in the Department of Architecture and Building Technology. In 2010, Dr. Yau became a Professor of Tamkang University, and an Adjunct Professor of Zhejiang University (2011-2013), a Visiting Professor of East China Jiao Tong University in China (2011-2014). He is also a Supervisor of the Chinese Taiwan Association of Wind Engineering (CTAWE, 2014-2016). Dr. Yau has published over 60 referred journal papers and articles. His research area of interest is centered on:
1. Interaction aerodynamics of vehicle-bridge system
2. Maglev dynamics of vehicle/guideway interaction
3. Vibration problems of high speed rails

Selected publications (2010~2014):

1. Yau, J.D*. (2010), Response of a maglev vehicle moving on a two-span flexible guideway, J. of Mech., 26(1), 95-103.
2. Yau, J.D*. (2010), Aerodynamic vibrations of a maglev vehicle running on flexible guideways under oncoming wind actions, J. Sound & Vibration, 329, 1743-1759.
3. Yang, Y.B. and Yau, J.D*. (2011), An iterative interacting method for dynamic analysis of the maglev train–guideway/foundation–soil system, Engineering Structures, 33, 1013-1024.
4. Yau, J.D. (2012). Lateral vibration control of a low-speed maglev vehicle in cross winds. Wind and Structures, 15(3), pp263-283.
5. Kuo, S.R.and Yau, J.D*. (2011), A fast and accurate step-by-step solution procedure for direct integration, Intl. J. Struct. Stab. and Dyna., 11(3) 473-493.
6. Kuo, S.R., Yau, J.D*, and Yang, Y.B. (2012), A robust time-integration algorithm for solving nonlinear dynamic problems with large rotations and displacements, Intl. J. Struct. Stab. and Dyna., 12(6) 1250051 (24pages).
7. Yau, J.D. (2013) Wave passage effects on the seismic response of a maglev vehicle moving on multi-span guideway. Latin American Journal of Solids and Structures, 10(5) 981 – 1000.
8. Yau, J.D. and Fryba, L. (2014), A Quasi-Vehicle/bridge Interaction Model for High Speed Railways, Journal of Mechanics (in print).

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Plenary Lecture 2

Advanced Cooling Technology for Designing Hot Components in Gas Turbine

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Abstract: Since the invention of the gas turbine engine, it has been regarded as an appropriate alternative for traditional power generating systems such as coal fired steam plant and diesel power plant. The foremost advantage of gas turbine over other combustion engines is its prominent thermal efficiency. Its simple cycle efficiency has been increased up to 40% and the combined cycle efficiency exceeds 60% in these days. The principle of higher efficiency of gas turbine engine is the higher operating temperature compared to that of others. Similar to the other thermal power generation systems, power output and thermal efficiency of the gas turbine engine proportional to its operating temperature which means that higher firing temperature offers higher performance.
For that reason, a lot of attempts have been made to raise its operating temperature therefore major parts in advanced gas turbine engine such as combustor, nozzle and blade are exposed to extremely high temperature which exceeds melting temperature of its material. Therefore, cooling is essential element for designing of high performance gas turbine engine and various advanced cooling methods were developed to protect gas turbine parts from high temperature environment. For example, internal cooling, impingement cooling and film cooling method are applied most of the recent gas turbine engines. However, as cooling technology is applied, large temperature gradient is presented in on parts and it could induce thermal stress, which is major cause of failure in gas turbine engine. Moreover, the strength of material is deteriorated in high temperature condition so that the turbine parts are more vulnerable to the thermal stress in operation. Hence, designing method for hot components plays a key role in developing gas turbine engines to guarantee its performance and service lifetime.
In this lecture, the advancement of cooling technology and thermal design process for hot components is introduced. In terms of cooling technology advancement, details of cooling methods will be covered from single cooling element to combination of each cooling elements referring experimental study in the laboratory. In addition, general heat transfer characteristics on turbine components are also introduced based on experimental results. Finally, designing method for advanced cooling is demonstrated which is aiming reduced metal temperature as well as thermal stress for hot components in gas turbine engine.

Brief Biography of the Speaker: Hyung Hee Cho received Ph.D. degree in mechanical engineering from the University of Minnesota, Minneapolis, USA in 1992. Since 1995, he has been with Yonsei University, Seoul, Korea, where he is professor in the Department of Mechanical Engineering. Currently, he is the president of Korean Society for Fluid Machinery and he is also a fellow of American Society of Mechanical Engineers.
Some Distinctions:
1995~ Professor, Dept. of Mechanical Engineering, Yonsei University
2003~05 Chairman, Dept. of Mechanical Engineering, Yonsei University
2005~07 Associate Dean, College of Engineering, Yonsei University
2012~14 Director, Yonsei Institute of Green Technology
2012~ Director, Innovation Center for Engineering Education
1998~ Scientific Council Member, Int. Center for Heat and Mass Transfer
2008~ Editorial Board, Advances in Mechanical Engineering
2008~ Associate Editor, International Journal of Fluid Machinery and Systems
2009~ Fellow, ASME
2010~11 Editor in Chief, Journal of Fluid Machinery
2014~ President, Korean Society for Fluid Machinery
2014 Conference President, 15th Int. Symp. on Transport Phenomena and Dynamics of Rotating Machinery

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