Preface

Special Issue on Advances in Damage Diagnosis and Dynamic Behaviour Analysis of Complex Structures

Structural damage diagnosis is a comprehensive issue involving many subjects and specialties, which is one of the most challenging issues in the field of civil and mechanical engineering. However, many structural damage identification methods based on vibration data face the following difficulties: (1) the measured information is insufficient, usually only the first few modes of the dynamic structure can be obtained; (2) the measurements contain inevitably errors in the modal testing and modal analysis; (3) the model error and data processing error increase the uncertainty of the information. Large complex structures may have unusual dynamic behaviour, which makes it more difficult to correctly assess damage in these structures. Therefore, it is necessary to propose new methods for reliably identifying damage in complex structures, and further to investigate the dynamic behaviour of the complex structures under different operation conditions.

The special issue on "Advances in Damage Diagnosis and Dynamic Behaviour Analysis of Complex Structures" aims to share the latest development in theoretical and experimental investigations of advanced techniques for damage diagnosis and prognosis of complex structural systems. The scope of the special issue includes the latest advancement on theory, techniques and methods to advance knowledge in the areas of structural damage diagnosis and dynamic response analysis, such as structural damage identification, finite element model updating, numerical simulations, dynamic responses, damage evaluation, uncertainty analysis, and case studies.

This special issue includes a total of 11 peer-reviewed papers. The research on structural damage diagnosis and dynamic behaviour analysis is widely investigated in this issue. In the first 5 papers, various methods for structural damage diagnosis using vibration measurements are presented. In the paper "Multi-strategy structural damage detection based on included angle of vectors and sparse regularization" by Liu *et al*., a multi-strategy structural damage diagnosis method is proposed based on the included angle of vectors and sparse regularisation. The proposed method can effectively reduce the influence of noises, and it has good ability in locating structural damages and quantifying damage degrees. The paper "Simulation of nonstationary wind in one-spatial dimension with time-varying coherences by wavenumber-frequency spectrum and application to transmission line" by Yang *et al*. is proposed to conduct the numerical simulations of nonstationary fluctuating wind field in one-spatial dimension with time-varying coherence, based on the wavenumber-frequency spectrums. The simulated multivariable nonstationary wind field with time-varying coherence is transformed into one-dimensional nonstationary random waves in the simulated spatial domain, and then the simulation by wavenumber frequency spectrum is derived. On the basis of the semi-analytical finite element (SAFE) method, an analytical model of 59R2 grooved rail is presented in the paper "Propagation characteristics of ultrasonic guided waves in tram rails" by Sun *et al*. The optimal guided wave mode, optimal excitation point and excitation direction suitable for detecting rail integrity are identified by analysing the frequency, number of modes and mode shapes, which will be used for damage detection in rails. In order to provide enough identification accuracy and efficiency of the structural damage identification method in practice, a novel whale optimization algorithm (WOA) based method is proposed in the paper "A novel WOA-based structural damage identification using weighted modal data and flexibility assurance criterion" by Chen and Yu. Furthermore, the paper "Load bearing capacity deterioration of corrosion damaged reinforced concrete structures" by Chen and Nepal aims to investigate the effects of reinforcement corrosion on the load bearing capacity deterioration of the corrosion damaged reinforced concrete structures. A new analytical method is proposed to predict the crack growth of cover concrete and evaluate the residual strength of concrete structures with corrosion damaged reinforcement failing in bond.

The dynamic behaviours of different types of engineering structures are analysed using various numerical techniques, which could give an in depth knowledge for structural damage diagnosis and prognosis using dynamic parameters. In the paper "The nonlinear galloping of iced transmission conductor under uniform and turbulence wind" by Liu *et al*., the analytical approach for stability and response of iced conductor under uniform wind or turbulent wind is presented, which shows that the fluctuating component of wind has little influence on the stability of iced conductor, but could increase galloping amplitude. The paper "Anti-sparse representation for structural model updating using l∞ norm regularisation" by Luo *et al*. provides a novel anti-sparse representation method for structural model updating. Based on sensitivity analysis, both frequencies and mode shapes are used to define an objective function, and then, by adding l∞ norm penalty, an optimization problem is established for structural model updating. In the paper "Numerical simulation of unsteady galloping of two-dimensional iced transmission line with comparison to conventional quasi-steady analysis" by Yang *et al*., a two dimensional (2-D) unsteady numerical analysis of the ice-covered transmission line galloping is performed. Wind tunnel tests of a typical crescent-shapes iced conductor are conducted to check the unsteady and the conventional quasi-steady numerical analysis results. Moreover, the paper "Study on vibration energy characteristics of vehicle-track-viaduct coupling system at contact loss beneath track slab" by Liu *et al*. analyses the CRTS-I type track structure vibration response, while the track slab is disengaging with the power flow evaluation method. In order to accurately and effectively analyse the characteristics of low-frequency noise, the paper "Prediction and analysis of structural noise of a box-girder using the FE-SEA hybrid method" by Luo *et al*. proposes a prediction model for the vibration of box girder on the basis of the hybrid FE-SEA method. Finally, in order to analyse the uncertainty of the vehicle-track coupling system, a method for predicting the bounds of the vehicle-track coupling system responses with uncertain parameters is proposed in the paper "Dynamic response uncertainty analysis of vehicle-track coupling system with fuzzy variables" by Ye *et al*. These proposed approaches analyse the dynamic behaviours of different engineering structures under different conditions, which gives the insight into the damage diagnosis and prognosis of structural dynamic systems using vibration data.

As the Guest Editors of the special issue, we would like to express our sincere appreciation to the authors who contributed their work to this special issue and particularly to the reviewers for their great efforts on shaping and improving this issue. The Guest Editors would also like to express our sincere gratitude to the Editors-in-Chief of the journal Structural Engineering and Mechanics, Prof. Chang-Koon Choi and Prof. Phill-Seung Lee, for their kind guidance and support leading to success of this special issue.

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