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Special Issue: Automatic Detection and Assessment of Bridge Structures

GUEST EDITORIAL: AUTOMATIC DETECTION AND ASSESSMENT OF BRIDGE STRUCTURES

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As the key node and multi-purpose project of transportation network interconnection, bridges play a paramount role in promoting regional economic development and improving the service quality of the city. With an extension in service years, bridges inevitably suffer from performance deterioration. Bridge detection and evaluation is a crucial work in the process of bridge operation, which has vital scientific research significance and engineering application value for ensuring the safety of bridge operation and road network unblocked.

The accelerated integration and convergence of civil engineering, materials science, and computing over the last decade has inspired researchers from a variety of disciplines to become interested in the challenges of the emerging bridge diagnosis methods. Research on automatic detection and assessment in transportation infrastructure has made significant progress in both theoretical investigation and practical applications. This special issue is devoted to new activities in automatic detection and assessment in bridge. It is aiming to publish the frontier of detection and assessment with applications to the bridge field, in which automation and intelligence play important roles. The focus of this issue will be to present several theoretical and practical problems related to detection and assessment, and new discoveries and innovative ideas and improvements made in the field of automatic detection and assessment in bridge.

In this issue, 11 articles on automatic detection and assessment of bridge structures are selected through a peer review process.

Among the 11 articles, 4 articles are about an automatic detection of bridge structures. X.K. Guo *et al.* presented a void detection method for concrete filled steel tubular arch bridge based on eddy current thermography. Through the analysis of the factors affecting the effect of void detection, such as the thickness of the void, the wall thickness of the steel pipe, the heating power, and the heating time, it is found that the heating rate had positive linear relationships with the stripping thickness and heating power, while negative linear correlation with the wall thickness. M.S. Sun *et al.* presented a line shape detection method based on the three-dimensional (3D) laser scanning technology. The monitoring accuracy of 3D laser scanning technology has been verified in the line shape detection of long-span arch bridge under temperature fluctuation. Different from the conventional line shape monitoring method, which can only collect observation data of multiple independent points, the 3D laser scanning technology is employed to expand the bridge monitoring range, improve measurement efficiency, and accuracy. H. Ma *et al.* proposed a stress monitoring method of a cracked steel box girder based on self-magnetic flux leakage (SMFL). The experimental study and the numerical simulation of the steel box girder were carried out based on the SMFL technology. The variation of SMFL signals of the loading cracked steel box girder was acquired, and the influence of the crack dimension on the magnetic flux leakage signal was analysed. J. Chen *et al.* employed an SMFL monitoring method to monitor the stress of internal reinforcements. The correlation between the stress and SMFL signal was analysed, and the phenomenon is explained theoretically based on the Jiles–Atherton force magnetic coupling model and the dislocation theory.

7 articles are about the assessment of bridge structures. L. Liu *et al.* carried out a metal magnetic memory signals acquisition experiment of the concrete rectangular beams subjected to increasing and decreasing loads. A new parameter called "difference of deviation rate curve (dDr)" was proposed to evaluate the stress damage of tensile steel bars in the test beams. The experimental results show that the index was capable of realizing the stress damage grading evaluation. L. Fu *et al.* proposed a reliability evaluation method based on the response surface method and the Bayesian modification. The example verification

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was carried out to examine the feasibility and accuracy of the method. According to the mechanical characteristics of reinforced concrete ribbed arch bridges, X.J. Li *et al.* established a mathematical model for reliability analysis of reinforced concrete ribbed arch bridge system. The failure of such a system was studied by the method of critical strength with support constraints. Y.X. Zhou *et al.* proposed a new evaluation method of a hollow plate girder bridge. The effects of hinge joints, cracks, and permanent deformation on the safety performance of hollow plate girder bridges with different spans were analysed based on the finite element model. The simplified algorithm of the permanent deformation limit of the hollow plate girder bridges was established based on the assumption that the concrete in the compression zone of the main girder reaches the ultimate strain. The research results can provide a reference for the safety evaluation of the hollow plate girder bridges. To analyse the static mechanical properties evolution law of a twin-tower double cable plane concrete cable-stayed bridge with a main span of 250 m, X.G. Li *et al.* proposed an evaluation mode based on the parameter time-dependent effect change rate. Finite element method (FEM) analysis was performed, considering the time-dependent change effect (including concrete shrinkage creep, materials' strength, and cable elastic modulus) after 2 years of service since bridge completion. The FEM model can be modified using the measured parameters obtained from the structural health monitoring (SHM) system, so the static mechanical evolution can be effectively predicted. The measured data can objectively describe the static mechanical properties evolution law based on the change rate index of the parameter time-dependent effect. J.X. Wang *et al.* carried out the experimental research on the ultimate bearing capacity of reinforced concrete composite arch ring. Considering the influence of the initial stress, the thickness of reinforcement layer and the eccentricity of the load before reinforcement, materials' performance, bearing capacity, failure mode, and load–strain relationship were analysed. The mechanical properties of the strengthened arch bridge were evaluated. L. Zhang *et al.* derive the relationships between the sectional steel ratio and the confinement coefficient, degree of initial stress in the steel tube, and concrete creep. Based on the finite element analysis, the influence of the earlier mentioned parameters on the safety performance of the structure was evaluated.

Biographies

Jingzhou Xin received his Ph.D. degree from Chongqing Jiaotong University. His research interests include bridge state perception and performance improvement

Leng Liao received his Ph.D. degree from Institute of Physics, Chinese Academy of Science, in 2009. Since 2011, he has been a Professor in School of Materials Science and Engineering, Chongqing Jiaotong University. His research interests include nondestructive test techniques for structures and innovative constructive and building materials. More than 30 of his articles have been published in well-known academic journals, such as *CBM*, *ES*, *APL*, and *Carbon*. His work has been supported by Chinese government such as ISIS, NKRDP