Editorial

Noncontact Measurements for Vibration-Based SHM and NDE

Piotr Kohut ¹, **Alessandro Sabato** ², **Elías López-Alba** ³, **Krzysztof Holak** ¹,
and **Francisco A. Diaz** ³

¹AGH University of Science and Technology, Cracow, Poland

²University of Massachusetts, Lowell, MA, USA

³Universidad de Jaén, Jaén, Spain

Correspondence should be addressed to Piotr Kohut; pko@agh.edu.pl

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Noncontact technologies for measuring and analysing the dynamics of various engineering systems and employing structural health monitoring (SHM) and nondestructive evaluation (NDE) framework are becoming increasingly popular among the research community and the industry. A large number of experimental and modeling techniques have been developed and applied to monitor the structural response including vision- and radar-based approaches, model updating, structural self-excitation, numerical modelling, and soft computing methods. These approaches enable a straightforward assessment of the physical and dynamics condition of large-sized and real-world structural components. To accelerate the adoption of these new emerging applications, several important issues have been addressed such as deployment modalities, fusion, signal processing, as well as investigation in the theories, algorithms, and methods with emphasis on vibration analysis applications. In this special issue on noncontact vibration-based SHM and NDE, we have invited the following articles to address such issues.

In the first paper of this special issue, the combination of phase-based motion magnification and 3D-DIC has been employed to evaluate the modal behaviour of an aircraft cabin under random excitation. The study was focused on the passenger window area due to its significance to the structural integrity as a discontinuity of the peel. Operational deflection shapes at different resonances were characterised by magnifying a single resonance in the spectrum and then measuring with 3D-DIC. These measurements were validated with those obtained in forced normal mode tests.

The second paper proposes a computer vision-based method of displacement measurement for the field of earthquake engineering. The presented method makes use of

relative displacement data recorded by a vision sensor and numerical modeling for the absolute ground displacement estimation. The proposed system is capable of real-time ground deformation observation and provides valuable data for earthquake mechanics understanding.

The third paper presents the practical results of the evaluation of the data obtained by ground-based radar interferometer during measurements carried out on bridge structures. A comprehensive method of data analysis was proposed. The effective use of vehicles as a source of bridge excitation allowed to first develop a method for determining the damping parameters resistant to potentially occurring beating frequencies. As a result, it is possible to determine these subsets of data registered with radar, for which it is possible to assume compliance with linear systems.

The fourth paper investigates the Kriging model and updating strategy using frequency response function to the damage identification of a truss structure. To improve the Kriging model, new sample points are added according to mean square error criterion and the model is updated iteratively. Cuckoo algorithm is employed to optimize the parameters. The proposed method is applied to a plane truss model, and the results are compared with the second-order response surface model and the radial basis function model.

The fifth paper presents a numerical simulation of a concrete footing-soil foundation interaction under seismic conditions. Authors provide an analysis of displacement, stress and strain, and seismic acceleration load response at the base of the concrete footing. The results show how the height of embedded footing affects displacements of the concrete footing, strain energy, and stress paths.

The sixth paper addresses the possibility to use changes recorded in the dynamic response of a cement asphalt mortar track to evaluate the degree of disengagement of the system. The method hereby described relies on an improved genetic algorithm (i.e., Mortar Disengagement Degree Estimation Algorithm). The proposed method is compared with traditional genetic algorithms for validating its robustness under different operational conditions.

The last paper presents a novel method for detection of rail corrugation wavelength and depth. An ensemble empirical mode decomposition (EEMD) is employed to estimate the wavelength, and a support vector machine (SVM) is applied for depth classification based on bispectrum features extracted from the vibration signal. The numerical simulation is carried out to assess the accuracy of the method.

Hoping the issue findings are of interest for research scientists and technical community readers, we wish a fruitful reading.

Conflicts of Interest

The editors declare that they have no conflicts of interest.

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Piotr Kohut
Alessandro Sabato
Eliás López-Alba
Krzysztof Holak
Francisco A. Díaz