Editorial: New Trends and Developments on Structural Control & Health Monitoring

Ersin Aydin[1], Baki Ozturk[2], Ehsan Noroozinejad Farsangi[3] and Aleksandra Bogdanovic[4]

[1] Department of Civil Engineering, Niğde Ömer Halisdemir University, Niğde, Turkey, [2] Department of Civil Engineering, Hacettepe University, Ankara, Turkey, [3] Faculty of Civil and Surveying Engineering, Graduate University of Advanced Technology, Kerman, Iran, [4] Department of Dynamic Testing and Informatics, Institute of Earthquake Engineering and Engineering Seismology, Ss. Cyril and Methodius University, Skopje, North Macedonia

Editorial on the Research Topic

New Trends and Developments on Structural Control & Health Monitoring

Structural control, damping energy principles and technological control tools have significantly developed during the postmodern structural engineering era. These structural control tools are implemented for rehabilitation of deficient or aging structures and natural hazard mitigation. Through several advanced procedures, it is possible to control the structural vibrations. These procedures include passive, active or semi-active reverse forces, modifying rigidity, mass and damping. Referring to structural health monitoring, the observation, and analysis of structural system properties *in situ* to make sure the structure damage and deterioration is observed and to bring forward the changes that have caused it.

Six research papers are parts of the Special Issue named "New Trends and Developments on Structural Control & Health Monitoring." A brief description of the findings and scope is presented.

The viscous dampers' (VDs) optimal design and distribution for shear building structures under seismic excitations have been analyzed in the initial paper (Cetin et al.). In this case, for shear building, the VD optimal design and distribution is stated based on critical excitation through the use of random vibration theory within frequency domain. For the top floor displacements, Differential Evolution (DE) algorithm has been applied within the context of objective functions keeping in mind the VD damping coefficient lower and upper limits. The research results indicate that the research is successful and compatible in terms of being able to reduce the response of the structure when subjected to various ground conditions.

A research was conducted by Chouinard et al. as part of the second paper. They analyzed the wavelet analysis reliability for mode shapes during the beam damage early detection. For the application, the safety index applied provides a uniform criterion for the damage at any beam location. This is specifically for a pure bending beam. From the steel beam, experimental data have been attained which indicates that the damage level is controlled along the length of two kinds

of locations. According to the results, the wavelets procedure is quite efficient as compared to the natural frequencies which detect and localize the low damage levels.

Within the third paper by Noormohamed et al., a screw jack device and an open-loop linear quadratic Gaussian controller have been used to research the optimal active control of structures. The screw jack is being researched for active structural control for the first time ever. Analysis has been carried out upon its dynamic features by applying the open-loop control. The results indicated that there was a significant delay between the measured and the command forces. The SDOF systems were subjected to numerical simulations and parametric research along with an LQG-controlled screw jack. Results indicated that structural performance enhanced at four kinds of control effort levels. Seven ground motion records were used to carry out an experiment under the loop simulation procedure. The structural response advantages were based upon the earthquake type and the advantages were higher for the greater low-frequency content records.

The fourth paper includes the method developed by Hesam et al. to estimate the restoring force and viscous damping ratio effectiveness based on the structures dynamic response data. It has been advised that an effective viscous damping estimate must be applied considering the research upon real structures actual response to the dynamic loads. When the strain levels are low, the effective viscous damping and restoring force can be estimated empirically through the structures dynamic response stated. An explicit inelastic response is used by the presented procedure where various computational simulation models are tested through several hysteretic behaviors and indicate constant viscous damping ratio for the algorithm verification. Data have been attained from the reinforced concrete test specimens subjected to design-level base excitations on an earthquake simulator to illustrate the procedure.

Nguyen et al., within the fifth paper, have extended a kernel-based procedure for the modeling of non-harmonic periodic phenomena in Bayesian dynamic linear models. A novel procedure is extended through this approach which integrates the kernel-based method and the Bayesian dynamic linear models for management of the time series periodic patterns. The Tamar Bridge traffic load and the piezometric pressure below the dam is modeled through this approach. According to the research results, the mentioned method is successful for the modeling of period patterns, both stationary and non-stationary, in the two case studies.

Koo et al. conducted a time synchronization of the wireless sensors as part of the last research paper. The Arduino and low cost GPS module have been applied. A new time synchronization procedure was established which functions in an independent manner upon each node without having to exchange the time-sync packets throughout the nodes. Upon each node, a GPS module is applied and the time-stamped data is re-sampled to attain data that is time synchronized. Pulse-Per-Second (PPS) signals and NMEA (National Marine Electronics Association) sentences are used for the time-stamping procedure. These were generated through a GPS module at low cost along with the Arduino internal timer/counter unit. Using the output-only modal analysis, it was observed that the wired acceleration sensors and the estimated modal parameters were in-sync. With the help of these observations, it can be stated that the proposed time-synchronization procedure has been successfully implemented.

Hence, it can be stated that the research subject aims at objectives revolving around the structural control, smart materials, controlled structures, and health monitoring theoretical, experimental and technological features. This Special Issue provides original research studies that have been carried out using analytical, experimental, and computational procedures applied upon structural control. The aspects which can make use of these papers are monitoring studies, seismic code requirements, controlled structures, soil-structure interaction issues, regulations for damper design and earthquake resistant design codes' instructions, control theory development, new algorithms, control tools design, structural control applications, damped structural systems and devices, optimization, structural retrofit and earthquake resistant design control procedures as well as dynamics and control.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication. BO wrote the original draft of the Editorial. EA, EN, and AB revised it. BO submitted it.