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*Editorial*

# Smart Control Algorithms and Technology in Civil Infrastructures

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Structural control technology has made considerable progress by developing theoretical and experimental researches. Following the emerging of complex structures such as the ultrahigh and long-span infrastructure, the conventional control strategy for structures in civil engineering gradually exposes limitation in the computation time, robustness, stability, and so forth, while smart control algorithms and technologies being introduced or incorporated in the structural control technology solve the above problems. In addition, new smart materials, for example, shape memory alloy, replacing traditional general materials, such as steel and rubber, improve controllers' performance.

This special issue accepted and published 9 papers, the content of which falls into two broad categories: smart control algorithms and smart materials (or controllers). These novelty research works were applied widely to infrastructure engineering, for instance, steel framed structures, reinforced concrete buildings, and power transmission tower-line system.

The market-based control as a control strategy is developed based on an analogy between the control force-energy source in the structural area and the supply-demand in the free market. Since the supply-demand relation model and iteration procedure for the optimal price solution are necessary and relatively hard to understand and perform for civil engineers, therefore, G. Li et al. established an equivalent fuzzy logical rule to replace the existing market-based control method.

L. Huo et al. conducted the optimal design of liquid dampers for the seismic response control of structures and selected the $H_\infty$ norm of the transfer function from the ground motion to the structural response as the optimal objective. The optimization procedure is carried out by using genetic algorithms in order to reach an optimal solution. The proposed method has the unnecessary advantage to solve the equation of motion for the control system, and the obtained optimal parameters of dampers are not dependent on the ground motion records. The results show that the structural responses can be effectively reduced and subjected to earthquake excitation at different sites.

A semiactive control platform based on magnetorheological dampers comprising the Bouc-Wen model, the semiactive control law, the shear wall damage criteria, and steel damage material model is developed in LS-DYNA program, based on the data transferring between the main program and the control platform by L. Xu et al. The nonlinear seismic control effectiveness is verified by the numerical example of a 15-story steel-concrete hybrid structure, and results indicate that the control platform and the numerical method are stable and fast; the relative displacement, shear force, and damage of the steel-concrete structure are largely reduced using optimal designed MR dampers; and the deformations and shear forces of the concrete tube and frame are better consorted by the control devices.

Y. Shen et al. presented a static control algorithm for adaptive beam string structures based on the nonlinear finite element method and simulated annealing algorithm. An optimization model of adaptive beam string structures with multiple active struts is established, which uses a sensitivity analysis method. A nonlinear iteration procedure is used afterwards to calibrate the results of linear calculation.

H. Qian et al. investigated the properties of superelastic NiTi shape memory alloys and emphasized on the influence of strain rate on superelastic behavior under various strain amplitudes by cyclic tensile tests. A novel constitutive equation is proposed to describe the strain-rate dependent hysterestic behavior of superelastic shape memory alloys at different strain levels. Numerical simulation results based on the proposed constitutive equation and experimental results are in good agreement. The findings in this paper will assist the future design of superelastic SMA-based energy dissipation devices for the seismic protection of structures. Moreover, H. Qian et al. presented a preliminary study on the evaluation of an innovative energy dissipation system with the shape memory alloys for structural seismic protection. A recentering shape memory alloy damper was utilized as energy dissipation components, and improved constitutive equations based on the existing model were proposed for superelastic Nitinol wires and used in the damper. Cyclic tensile-compressive tests on the damper with various prestrain under different loading frequency and displacement amplitude were conducted.

L. Tian et al. carried out the seismic control of power transmission tower-line coupled system subjected to multicomponent excitations. The schematic of tuned mass damper is introduced, and equations of motion of a system with the tuned mass damper under multicomponent excitations are proposed. The time domain analysis takes into account the geometric nonlinearity due to the finite deformation. The optimal design of the transmission tower-line system with the tuned mass damper is obtained according to the different mass ratio.

In summary, the topics of smart control algorithms, materials, and technologies in infrastructure engineering are discussed in this special issue. Most problems, which are relatively difficult to answer using the traditional methods, such as actuators optimization, robustness improvement, and control law rule simplifications, were solved with various degrees. We hope that smart control algorithms and technologies are thought to have tendency and the effective approach to handling current issues existing in the structural control area, and the involved papers contribute to further advance in the area of smart control in civil engineering.

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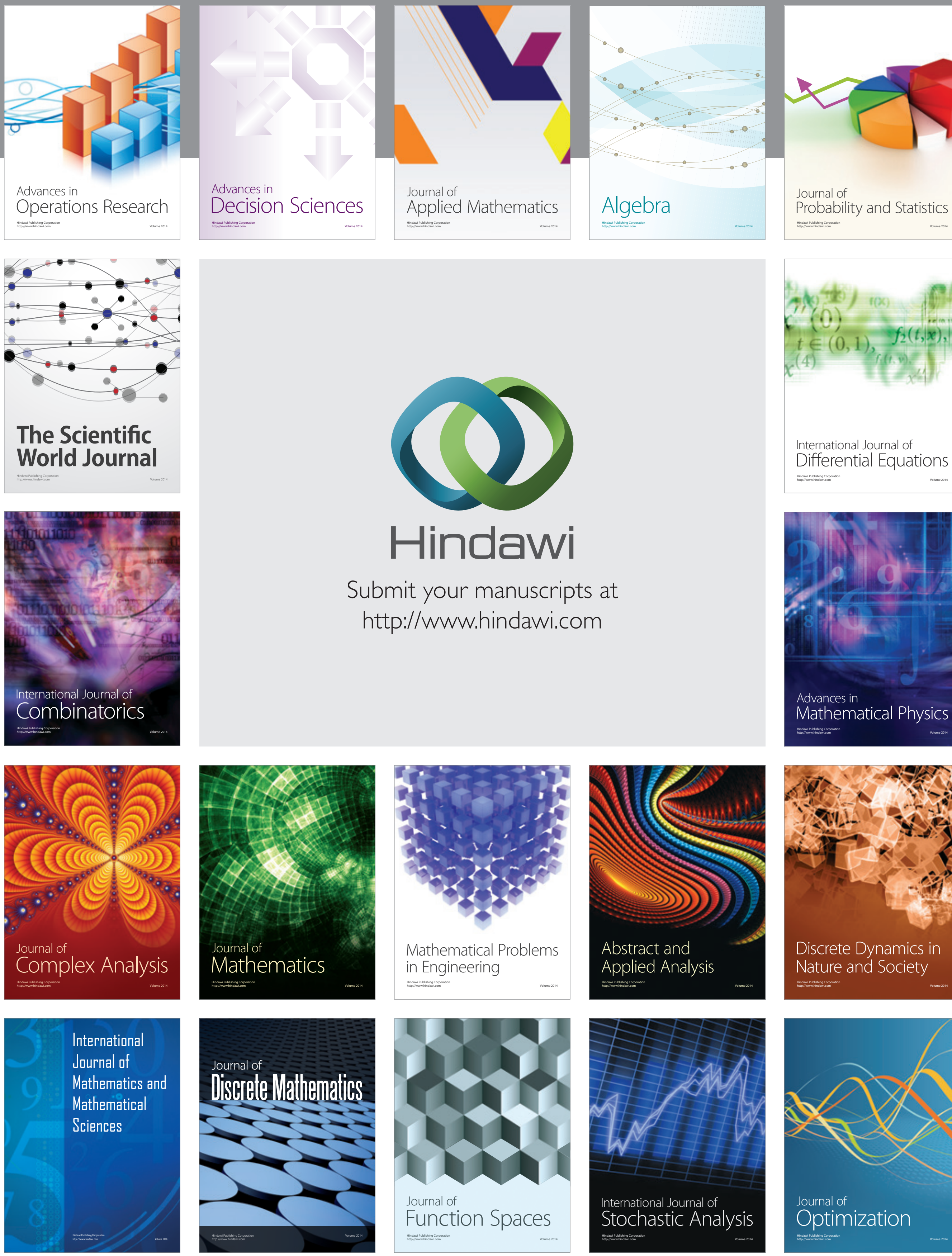

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