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ORIGINAL PAPER

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Editorial to special issue "Recent mechanics-based developments in structural dynamics and earthquake engineering"

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In structural dynamics, the inertia of accelerated masses and the cornucopia of phenomena that contribute to damping have a significant influence on the internal forces and deformation of building structures. Typical problems of structural dynamics are the prediction of the vibration response of dynamically excited structures, for instance, induced by earthquakes, the identification of structural parameters based on the dynamic response, and the design of vibration-mitigating measures from the fundamental study to the implementation. Many traditional methods of structural dynamics and earthquake engineering are based on empirical approaches rather than rigorous application of fundamental mechanical principles. However, dramatic advances in mechanics now make it increasingly possible not only to model but also to solve and predict complex phenomena in dynamics. We are very pleased that, in response to these advances, this special issue of Acta Mechanica provides an insight into the latest mechanics-based developments in various branches of structural dynamics and earthquake engineering. It contains 20 contributions that we selected based on the reactions and feedback we received to our invitation.

The first four papers deal with complex dynamic vehicle–bridge interaction (VBI). In the first paper, Homaei et al. [1] investigate the effect of VBI and highlight its similarities and differences to the effect of vibration dampers under earthquake excitation. Based on knowledge of recent experimental studies, König and Adam [2] present a new modeling approach for railway bridges under high-speed traffic, which takes into account both the horizontal and vertical interaction between track and structure. Hirzinger and Nackenhorst [3] apply a model-correction-based strategy for efficient reliability analysis of the uncertain VBI system, where a low-fidelity model is calibrated to the corresponding high-fidelity model close to the most probable point. The paper of Lei et al. [4] proposes a two-step bridge damage detection method based on wavelet transform analysis of the residual contact response of the moving front and rear vehicle wheels to reduce the impact of road surface roughness.

Suitably, the next paper by Yang et al. [5] uses a numerical model based on the wave finite element method of wave propagation and attenuation in periodic supported rail, capturing the complex cross-section deformation of the waves. Changing topics away from railways, Amendola et al. [6] also seek a waveform solution but of nonlocal nanobeams dissipating thermal energy by radiation, employing an extension of Type II Green–Naghdi theory. The paper by Abdelnour and Zabel [7] is devoted to the identification of the modal information of complex three-dimensional space truss structures characterized by closely spaced modes as well as global and local vibration mechanisms. Pirrotta and Russotto [8], on the other hand, develop a new

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operational modal analysis method based on signal filtering and the Hilbert transform of the correlation function matrix for dynamic system identification.

The next two papers deal with machine learning in structural dynamics. Milicevic and Altay [9] present a theoretical data generation framework for test-integrated modeling of nonlinear systems in structural dynamics. In particular, a feedforward neural network is used for inverse modeling of nonlinear restoring forces. On the other hand, Maqdah et al. [10] build an unsupervised machine learning model capable of detecting patterns in arch forms under seismic loading and distinguishing between their stress and displacement contours. In one of the three contributions on structures under seismic loads, Zakian and Kaveh [11] provide a comprehensive review on seismic design optimization of engineering structures. Refined probabilistic seismic response evaluation of high-rise reinforced concrete structures is subject of Lyu et al. [12]. In the third contribution, Karaferis et al. [13] present a roadmap for determining comprehensive fragility curves for individual or groups of spherical pressure vessels, tackling the thorny issues of correlation and operational realities.

Six other papers can be classified under the topic of vibration control. Rajana and Giaralis [14] introduce a nonlinear rooftop tuned mass damper-inerter system and numerically investigate its efficiency for seismic response mitigation of buildings. The hysteretic tuned mass damper system presented in Xiang et al. [15] is optimized for acceleration control of seismically excited structures. In Masnata et al. [16], both theoretical and experimental studies are conducted on the control performance of a sliding model of a tuned liquid column damper for short-period systems. The study of Li et al. [17] shows that the use of high-static–low-dynamic stiffness floating raft vibration isolation system is beneficial for the shock performance. De Castro Motta et al. [18] present a mechanical model for thermoplastic polyurethane membranes used as components in seismic isolators based on an experimental study. Sezer et al. [19], on the other hand, report the results of experimental investigations on the coefficient of friction at the interface of a PVC-sand-PVC layer, used as part of a low-cost geotechnical seismic isolation system. This special issue is completed with a paper by Minafò et al. [20] on the effect of interface model parameters on the numerical behavior of a finite element model for predicting the bond between fabric-reinforced cementitious matrix and masonry.

We would like to thank all the authors who accepted our invitation to contribute to this special issue and the reviewers for their thorough and valuable comments on these studies. Our particular thanks go to Professor Hans Irschik, Editor-in-Chief, for the opportunity to publish this special issue in "Acta Mechanica" and for his guidance during its development. We thank Dr. Michael Stangl, editorial assistant, for his continued support, always responding to our requests in an efficient and timely manner.

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