Passive structural control strategies such as base isolation systems, supplemental dampers, and tuned mass dampers, are widely used for protecting structures against dynamic loading due to natural or man-made hazards. Active structural control strategies offer an alternative means in cases where passive structural control may have limitations.

In the past two decades, research and development of passive and active structural control has received wide attention, with particular emphasis on alleviation of wind and seismic response of buildings and bridges. Full-scale implementation of passive control systems such as base isolation, fluid dampers, tuned mass dampers, and tuned liquid dampers has been accomplished in numerous buildings and bridges, around the world particularly in USA, Europe, Japan, China, Korea, India, and other parts of the world. Full-scale implementation of active control systems and smart dampers has been accomplished primarily in Japan and China. Many recent tall buildings and long span bridges have also incorporated real time structural health monitoring, along with passive and active structural control strategies resulting in truly modern smart structures.

The most important and challenging problems in active and passive structural control systems are the formulation and solution of optimal control and nonlinear constrained optimization needed to develop appropriate closed loop feedback control algorithms and the optimal placement, which is the central focus of this book. State-of-the-art techniques for optimal design of passive and active control systems are described in detail in various chapters written by researchers around the world. I welcome this new book for offering a very good overview of the current developments in the field.

In Chapter 1 optimal placement of passive dampers is studied as a nonlinear constrained optimization problem and solved by computationally inexpensive heuristic search approaches. Chapter 2 presents a comparative study of optimal placement techniques based on two simple empirical rules—uniform and stiffness-proportional damping distributions, and three more advanced, iterative methods—the simplified sequential search algorithm, method based on minimizing transfer function drifts, and fully-stressed analysis/redesign approach. Chapter 3 deals with optimal design and placement of viscoelastic dampers. The optimization problem is solved using the sequential optimization method and the particle swarm optimization method. Chapter 4 explores sensitivity of optimal distribution of dampers to in-structure damping and the effect of inherent assumption of linearity of the parent frame on the optimality. It is shown that linearity assumption imposed on the parent frame in a major seismic event may not be justified. Chapter 5 presents the effectiveness of analytic hierarchy process and first-order optimization technique for seismic response control of long span suspension bridges. Chapter 6 deals with a two-stage optimum design procedure for multiple tuned mass dampers with stroke limitation. Chapter 7 presents the optimal design of tuned liquid column gas dampers and their applications in different configurations.

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in a range of structures. Chapter 8 presents optimal design of base isolation systems and semi-active dampers using genetic algorithms and fuzzy logic. Chapter 9 investigates hybrid clipped neuromorphic controller, as compared to classical optimal controllers and benchmark controllers, and its effectiveness in improving the seismic protection of structures with magnetorheological dampers. Chapter 10 presents analyses of amplification device configurations and placement of active control devices on the efficacy of a control system. In chapter 11 response control using passive compensator systems or tuned mass dampers is studied using evolutionary or bionic optimization. Chapter 12 presents optimal design of an energy dissipation device for seismic protection. In chapter 13 optimal fuzzy logic control, dynamic inversion control and integrator backstepping control for seismic protection of structures using magnetorheological dampers are presented. In chapter 14 multi-objective genetic algorithms for distribution of actuators and sensors and for structural response minimization are presented.

Overall, I commend this work for marking the progress made in this field, which can be very useful to a broad audience, ranging from practicing engineers to researchers and graduate students. The book can also be used for teaching purposes.

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