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A REVIEW ON RECENT PROCEDURE OF MOMENTARILY VIBRATION CONTROL

Ashkan Masoomabdi,[a] Morteza Jamshidi,[b]

[a]*Phd Student of Civil Engineering, Islamic Azad University, Chaloos, Iran*

[b] ***Assistant Professor*** *of Department of Civil Engineering, Islamic Azad University, Chaloos, Iran*

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Abstract

This paper present a the newest and general review of remarkable research accomplish in the area of smart structures of control algorithms and reviews papers on active and-semi active control of structures. Active vibration control has been introduced and used as one of the effective methods to subdue undesirable vibrations in different systems. successful efficiency of each vibration control method is dependent on to accurate design and suitable dynamics selection of the control unit. These methods have been Widespread studied in various studies in recent years. Each of these new methods are designed by a specific dynamic for a specific system. In this paper, we objective to present some of these recent methods in a brief discussion, and accustom the readers with these techniques. In utilization field, Engineers who desire to design suitable vibration controllers in distinct scales, from micro- to macro applications, will unquestionably design a further prosperous vibrational controller if they be aware moor about resembling procedures, and they can implement the innovations that other scholars have used.

Keywords: Vibration control, mechanical systems, Active Control, Semi-active Control, Control algorithms, integral-based, feedback control.

1.Introduction

Active vibration control has been used for **turn** down the unsought vibrations in different systems for many years. The problem of unsought vibrations levitates from an inherent problem in flexible structures that these systems are easily vibrated due to the task that they are earmark for, or due to severe ambient conditions. This problem is not restricted to one system or one design, and a wide variety of systems have suffered from this issue. This trouble happens when resonant modes of a piezoelectric stage are excited when scanning, or when a robot arm is moving under discontinuous forces at its end, or when a drone is being influenced by the wind in a severe weather. The key point in designing a successful controller design is first to understand the problem very well. When the system is studied and analyzed completely, the source of the disturbance is known and the model of the system is extracted, the engineer needs to find the proper place that an actuator can be set, and the way that the feedback can be collected. Having a feedback from the vibrating structure is essential in designing the active vibration controller. Thirdly, they type of available and accessible sensors and actuators should be specified. Having all these steps taken, it is the controller that lastly plays the most important role. The controller which is also known as the software of our system, can maximize the performance which can be obtained from the hardware of the system. To this end in this work, we present a brief review of the recent publications in this field. For each technique, we provide a brief discussion and provide an overview of the design in some cases.

a smart structure designed as a pre-arranged some of members to be actively controlled members. Each such member has a sensor, a feedback control device [77-79] and an actuator. The sensor measures the displacements along the degrees of freedom. The feedback control device determines the appropriate correction to the uncontrolled response, and the actuator applies the required force. Such a system consists of three physical components: sensors, actuators and a computer. There is also the need for a control algorithm that will determine the magnitude of control forces at any given time. However, there are other strategies and physical systems. The common goal in them all is to minimize the vibrations in real time. All of them require an effective control algorithm. Housner et al. [80] presented a thorough review of the field of structural control up to 1996. While the topic of smart structures is broader than structural control, they reviewed many of the papers published on the subject. The scope of the present review is limited primarily to journal articles published since 1997. A host of engineers are working in the area of smart structures including mechanical, electrical, materials and structural engineers. As such, the field of smart structures can be quite broad and multidisciplinary [81-100]. It can also include the field of smart materials.

In order to limit the range of this review within the limitations of a journal article, it has been limited mostly to civil structures, with only mention of relevant papers on smart materials. The review is presented in two companion articles. This article is allocating to the review of papers published on active and semi-active control of structures. It is presented forcefully in chronological order. Hybrid control systems and control strategies are reviewed in the companion paper [101] (this issue).

1.Human perception of structural vibrations

The most repeatedly quote reference for human understanding of vibration is by Reiher and Meister [137]. The Reiher–Meister scale is based on a displacement range of 0.01–10 mm and frequency range of 1–100 Hz. The modified Reiher–Meister scale was proposed by Lenzen [138] for vibrations due to walking impact. For floors with less than 5% critical damping, Lenzen suggested the original scale be applied if the displacement is increased by a factor of ten. Wiss and Parmelee [139] suggested that a constant product of frequency and displacement existed for a given combination of human response and damping. Allen and Rainer [140] developed vibration criteria in terms of acceleration and damping intended for quiet human occupancies such as residential buildings and offices. As damping increases, the steady- state response due to walking becomes a series of transient responses; resulting in a less significant response. Murray [141] suggested a human perception scale for required damping as a function of the product of initial displacement and frequency, which are the same parameters used in the Wiss–Parmelee scale. Allen et al. [142] suggested a design procedure for assembly floors subjected to rhythmic activities such as dancing and exercises. The International Standards Organization (ISO) [143] recommends vibration limits in terms of acceleration root-mean-squared (rms) and frequency. As shown in Fig. 1, a baseline curve is used by ISO and different multipliers are used for different occupancies. The vibration serviceability criteria for floors have been categorized into two broad categories. These are: criteria for steel beam and concrete slab construction, and wood/lightweight construction. The following sections describe the research in each category.

2.CONTROL OF STRUCTURES

2.1 PASSIVE CONTROL

In a passive control system to an external source of power is not needed for performance system, and system using the natural movement of structures Provides control forces. [R4]
If you have installed this system in the structure, there is no other possibility to create desired changes and moment changes. The effectiveness of the control

systems always need a reliable prediction of design loads and a detailed numerical model of the physical system. Usually in this system may not possible improve local control response. It is noted that the use of passive control systems because of the simplicity of installation and low cost of implementation and maintenance of engineering structures are very common. [R3]

2.2 ACTUATORS

Controllers have a role in regulating the internal parameters of the system state effect of changes in foreign forces have served, so by recognizing the state of the system during external stimulation, the control commands necessary to determine the algorithm of the controller and by means of appropriate physical devices apply to the system. Saleh and Adeli [102-104] present general parallel algorithms [105-123] for simultaneous optimization of control and structural systems through a judicious combination of vectorization on the innermost nested loops, microtasking (parallel processing at the outer loop level) and macrotasking (parallel processing at the function level) on high-performance shared memory multiprocessors, such as the CRAY YMP machine [124]. Begg and Liu [125] also discuss simultaneous optimization of control and structural systems. Adeli and Saleh [126] present a computational model for active control of large structures using distributed actuators subjected to various types of dynamic loading, such as impact, wind and earthquake loadings. The governing differential equations of the open loop and closed loop systems are formulated, and a recursive approach is presented to compute the response of the structure. A major bottleneck in optimal active control of large structures with hundreds or thousands of members, using distributed actuators and the LQR algorithm, is the solution of the complex eigenvalue problem encountered in the solution of the resulting Riccati equation, as well as the solution of both open loop and closed loop systems of equations. Saleh and Adeli [127] present robust and efficient parallelvector algorithms for solution of the eigenvalue problem of an unsymmetrical real matrix using the general approach of matrix iterations and exploiting the architecture of shared memory supercomputers. The algorithms are applied to large matrices including one resulting from a 21-story space truss structure. Saleh and Adeli [128] present robust and efficient parallel-vector algorithms for solution of the Riccati equations encountered in the structural control problems on shared memory multiprocessor machines, such as the Cray YMP 8/8128 supercomputer using the eigenvector approach. The algorithms are applied to three large examples. It is shown that the algorithms consistently provide stable results for problems of various sizes while other algorithms show numerical instability for large problems. Further, it is demonstrated that the parallel processing efficiency of the parallel-vector algorithms increases with an increase in the size of the problem. Hanagan and Murray [129] use actuators to reduce floor vibrations caused by occupant use. They evaluated the model on a full-scale test floor, representative of a typical floor in an office building structure. Numerical and physical experiments showed that vibrations caused by the ''heel drop excitation'' can be reduced effectively. Subsequently, Hanagan et al. [130] presented a method for optimal placement of actuators and sensors for reduction of vibrations in floor systems. During a severe event, an actuator may be unable to produce enough force to counteract the motion of the structure. In this case, the actuator is said to be saturated. Agrawal et al. [131] studied the effect of actuator saturation on the stability of a structure and found that saturated actuators were not detrimental to the structural stability of a 2D six-story frame. Djouadi et al. [132] use six actuators to control an active theoretical tensegrity model consisting of 24 cables, six 1.67-m long struts, and six active members under random excitation. Reductions in response in the x-, y- and z-directions of 97.78%, 97.66%, and 95.37%, respectively, were observed for the theoretical structure. Asano and Nakagawa [133] consider seismic response under a saturation control force based on a probabilistic approach. Chase et al. [134] discuss an $H\infty$ controller which is stable under actuator saturation for single and multiple actuator systems in a 2D five-story frame. Saleh and Adeli [135] present active control of three-dimensional (3D) irregular multistory building structures with curved beams and setback, representing both space moment-resisting and braced frames using computational models and high-performance parallel algorithms for the optimal control of large structures, as discussed earlier. They considered three types of dynamic loading: earthquake motions, periodic impulsive horizontal wind loading on the exterior joints of the structure, and asymmetric periodic impulsive wind loading on the exterior of the structure, intending to model a twister. They also investigate different schemes for the placement of controllers along the height of the structure. They conclude that controllers are more effective in unbraced moment-resisting frames than in braced frames, and the optimal arrangement for placement of controllers depends on the height and aspect ratio of the structure. Saleh and Adeli [136] present optimal control of adaptive multistory building structures subjected to blast loadings. Both internal blast loading at different floor levels and external blast loading from outside the structure are considered. Results are presented for several large regular and irregular moment-resisting space frame structures. It is demonstrated that through judicious placement of controllers and the selection of control forces, the response of a building structure can be reduced substantially to a fraction of the response of the uncontrolled structure.

٢,٢ INTEGRAL-BASED CONTROLLERS

Integral controllers are known as the most successful prospering for vibration control. These procedures have a first order integrator, which augment the damping of the system when they are used in a closed-loop form. In a study by Szabat and Teresa [1], an analysis of control structures for the electrical drive system with elastic joint is conducted. They have used a proportional-integral controller supported by different additional feedbacks. A method for a robust integral controller is presented by Hu [2], and problem of pulse-width pulse-frequency modulated input shaper for flexible spacecraft has been completely discussed in this work. Integral twist actuation of helicopter rotor blades have also been used for vibration control in [3]. A series of vibration control methods are developed based on PID control method. PID such as its numerous applications in different control design systems, they have also been used for vibration controller. In these systems however, the integrator plays a very important role. Some very useful examples of these techniques are found at [4-7].

2.4 ACTIVE CONTROL

An active control system is a system where an external source gives energy to one or more of the control system stimulant. And this stimulus forces in accordance with predefined states apply to structures. These forces may be used to add or dissipation energy structures [153].

In an active control system has been set up for electromechanical or electro-dynamics control system that forces applied to the structure, required a great source of energy. The control forces created based on feedback from sensors which measure the response of the structure or stimuli that are obtained. Since the active control systems need to function to an external energy source, at the time of occurrence of extreme events remains unchanged and damage and Structural integrity and performance is not affected. [152]

Hanagan and Murray [144] and Hanagan et al. [152] developed an active electromagnetic actuator that uses a piezoelectric velocity sensor and a feedback loop to generate control forces, thus adding damping to the supporting structure. Significant results were obtained on the office floor of a light manufacturing facility and a chemistry laboratory. High initial cost, maintenance, reliability, and the number of actuators needed to effectively reduce vibration levels were issues that were noted with this system.

2.5 SEMI-ACTIVE CONTROL

Semi-active control systems, batch control systems are structures in which foreign energy devices can be used to change the mechanical properties. [153] Semi-active control systems are essentially passive control systems that are able to change and adjust the mechanical properties of the system, and therefore often this control systems, so-called passive control devices (passive devices controllable). This system is based on feedback from the measured mechanical properties of structural response are set.

In a semi-active control scheme, a system controller (a computer) to measure feedback and based on a predetermined control algorithm, sends the appropriate signal to the semi-active devices. Control forces produced by using the structure itself and the appropriate set of structural and mechanical properties of semi-active control system. Moreover, given that most of the forces in control of semi-active control act in the opposite direction Structure, So the overall stability of the structure. [155]

During the 1980s, the auto industry researched, developed and tested various types of semi-active shock absorbers. That research produced a new type of control actuator that has applications in civil, mechanical, and aerospace engineering. These devices were developed in response to a need in the auto industry to provide improved ride comfort in vehicles. There are two broad classes of SA actuators: those that dissipate energy via damping and those that store energy by varying stiffness.

There has also been an intensive effort since the mid-1980s to develop control systems for civil structures. The past effort has produced a range of designs that include fully active systems, entirely passive systems and designs that rely on a mix of those two (hybrid systems). Active control systems invariably require line power to achieve vibration mitigation. Passive designs require no power,

and are usually less expensive than active designs, but are incapable of achieving the protection that an active system can provide. Spencer and Sain asserted that ‘‘Control strategies based on semi-active devices appear to combine the best features of both passive and active control systems and to offer the greatest likelihood for near-term acceptance of control technology as a viable means of protecting civil engineering structural systems. . .’’ [145]. Semi-active control systems provide a much needed technology between fully active structural control systems and passive designs. The term semi-active describes a system that consists of a variable actuator that requires very little power to operate. Both the semi-active (SA) hydraulic system and fully active (FA) hydraulic 2490 A. Ebrahimpour, R.L. Sack / Computers and Structures 83 (2005) 2488–2494 system designs include actuators, valuing, etc. But the power required for the SA system is that necessary to modulate the valve position only. That power is typically many orders of magnitude less than that required to achieve a similar FA design. The utility of a SA design is realized when it is used to dissipate energy. Mitigating the motion of a structure during an earthquake, or attenuating the response of a beam due to dynamic loading are examples of applications where the motion of the structure can be harnessed to make a SA design functional. For these applications, analysis has shown that, if the hydraulic pump is removed from a FA hydraulic design, and the plumbing is altered, then the (now SA) system can provide attenuation that is equivalent to what would have been expected had the FA design been implemented. SA friction dampers, mounted as braces on a structure are examples of a SA control system. Hydraulic semi-active vibration dampers (SAHD), provide a combination of both damping and stiffness. Sack and Patten [146] conducted tests using a single-lane bridge 12.3 m in length that they subjected to vehicle loadings. They significantly reduced peak deflection by as much as 15% using feedback linearization to produce a suboptimal controller design. They also demonstrated the effectiveness of semi-active control on a full-scale experiment on an in-service bridge on interstate highway I-35 in Oklahoma. This application was the first full-scale implementation of semi-active control in the United States on a civil structure, and the results showed deflection reduction of more than 70% when compared to the vibration deflection of the bridge operated without dampers attached [147,148]. Setareh [149] and Koo et al. [150,151] proposed the use of a new class of semi-active tuned mass dampers, called ground-hook tuned mass dampers (GHTMD). Ground-hook control was initially introduced for vehicle application. Unlike the ‘‘skyhook’’ control that is designed to control the vibration of the sprung mass for the comfort of a rider, the ‘‘ground-hook’’ is intended to reduce the vibration of the unsprang mass (i.e., the tire and axle assembly). The ground-hook control

is used for the stability of the vehicle. Because the structure’s mass is similar to the unsprang mass of a vehicle, the ground-hook control is applicable in the control of structures attached to a TMD. Setareh obtained optimum design parameters for GHTMD in a floor structure, based on minimization of the acceleration response of the floor, mass ratios (damper to structure), and floor damping ratios. Koo et al. [151] suggested four control strategies for use in GHTMDs: two velocity-based and two displacement-based. In each case, two types of semi-active damping were considered: continuous and on-off. The study concluded that the on-off displacement-based control performs best in minimizing the structural vibrations.

2.6 HYBRID CONTROL

In a hybrid control system may be use an active or semi-active control system to supplement and improve the efficiency of the passive control system or, conversely use a passive control system to reduce energy requirements in an active or semi-active control system. For example, it can be noted to a building equipped using by distributed a series of viscoelastic dampers and active mass damper on the top floor it. It should be noted that the main difference between active control and hybrid in most cases, the amount of external energy required by the system. So we can say that hybrid control systems actually reduce some of the limitations of each of the main control systems and as a result, these systems have a higher performance level. In addition, even if the power supply fails, the of passive components and hybrid control continues to fulfill its duty to protect the structures. [153,155]

3. SLIDING MODE CONTROL AND NONLINEAR METHODS

the most frequently used accost for vibration control is Sliding Mode Control or (SMC). An adaptive method is proposed and experimentally used by Li et al [8]. Another method has been developed by Hu which is an observer based method [9].

A dynasties of nonlinear vibration controller have been applied for nonlinear vibratory systems. The reference [10] is a useful source for this topic. Nonlinear vibration control has been used alongside energy harvesting in [11]. Hybrid time-domain and spatial filtering nonlinear damping strategy for efficient broadband vibration control is developed and discussed in [12]. For nonlinear vibrations, a series of works are developed and implemented [13-15].

collections of nonlinearities are caused by the nonlinear geometry of the system, for those, Method of Multiple Scales are used [16-20]. Cantilever beams are typically vibrated nonlinearly when the magnitude are high. Some useful references of these techniques are found at [21-26].

4. POSITIVE POSITION FEEDBACK (PPF)

Positive situation Feedback (PPF) is indubitably the most famous technique for vibration control in resonant frequencies. PPF control has been extensively used in space structures vibration control. In fact, PPF was first introduced for this application and was designed to use piezoelectric actuators/sensors [27, 28]. Vibration control of space structures has been a challenging problem since the beginning of space travel. There are several studies on active vibration control of space structures where collocated control methods are widely used. Recently, PPF control has overshadowed other collocated methods enhanced by some other approaches such as adaptive control [29-33]. PPF has been modified in order to have a higher level of suppression [34-36]. Direct velocity feedback and acceleration feedback have also been used by several researchers for the vibration control of space structures [37-45]. Specifically, acceleration feedback control has been used for the control of the self-mobile space manipulator [46].

as well, active noise and vibration control of pliable structures by means of smart materials, mainly piezoelectric patches, is of interest of many scholars. Application of piezoelectric actuators and shape memory alloys in vibration control is increasing in many research areas from micro-scale actuators in atomic force microscopes to active vibration control of aircraft bodies [47-50]. Direct Velocity Feedback (DVL) and PPF have been experimentally used to control the vibration of a micro-actuator for hard disk drives [51]. Vibrations in an aircraft or aerospace structure may appear due to various issues, and there are different methods to control the vibrations. Active vibration control also has been used for space structures, such as the Solar Array Flight Experiment (SAFE) structure during its deployment [52]. Two of the most recent approaches that are based on PPF are presented in [53, 54].

5. VIBRATION CONTROL IN MEMS SYSTEMS

The vibration control of Micro-Electro-Mechanical structures is an interesting and challenging study area that is widespread applicable in micro-mass measurement, micro-sensors, and micro-mirror control. One of the important MEMS devices is micro-gyroscope. Micro-gyroscopes provide a low cost inertial measurement of rotation rate by sensing the Coriolis force, the study of their control is essential [55-57]. An integral part of most MEMS devices is a micro-cantilever. They are the sensing device in micro-biosensors, micro-mass sensors, and in the Atomic Force Microscope. Piezoelectric materials are extensively used in novel studies and industries, especially aerospace, and in wide and various applications in both macro- and micro-technologies. Because of their small size and light weight, they have been extensively used in aircraft and aerospace structures for active vibration control alongside collocated control methods. They have been used by research institutes such as McDonnell Douglas Aerospace in Huntington Beach, California [58-59]. Acceleration feedback control is not as popular as velocity or position feedback but is still used for many aircraft vibration control applications [60]. Scanning Probe Microscopes (SPM) was at first designed to catch three dimensional images of Nano-scale surfaces; however, today it has many other applications including bio-sensing for cell property measurement, Nano-manipulation, and friction measurement. Modeling and calculation of the forces between the SPM tip and the sample is one important part of the measurements. There are two forces that should be measured: The Van der Waals force and the contact force. Contact force identification using the subharmonic resonance of contact mode AFM was studied considering the nonlinear contact force between the tip and a hard sample [61]. In another study, the dynamics of the AFM were investigated in the presence of a nonlinear contact and Van der Waals force; however, the micro-cantilever beam was considered to act linearly [62]. However, most of the studies considered forces to act linearly [63]. Nonlinear behavior of non-contact tapping-mode AFM was studied in the presence of the Van der Waals force to study the stability of the system [64]. The dynamic-coupling effect associated with using an iterative control and positive velocity and position feedback control of piezoelectric tube scanners has been studied [65]. An iterative control approach has also been used for high-speed force-distance measurements using AFM [66].

6. OTHER NOVEL CONTROL TECHNIQUES

In the last part of this paper, some other novel methods for vibration control are summarize. In a chain of studies, vibration control using network based methods are applied. Two of these studies include PPF-based control and an integral resonant method [67-68]. A novel active pneumatic vibration isolator through floor vibration observer has been used for robust control in [69]. In another study in [70], a self-sensing and actuating method is used. A two-degree-of-freedom active vibration control of a prototyped smart rotor has been investigated [71]. Flatness-based active vibration control for piezoelectric actuators is studied in [72]. For more unconventional techniques that are designed for a variety of systems, see [73-77].

7. CONCLUSION

Our goal in this paper, Provide a comparison review in the field of vibration control procedures and techniques. In recent years, research has moved mostly from active control to semi-active and hybrid vibration control of structures. Semiactive and hybrid control systems provide more practical approaches for actual implementation of the smart structure technology. with exclusive focus on recently published methods of control algorithms. These techniques were divided into categories of integral based methods, nonlinear techniques, PPF-based methods, vibration control in MEMS systems and some other unconventional methods. Each of the mentioned techniques are specifically designed for a special vibration control case. The controller designed must first understand his problem very well, and then start selecting the controller from available methods. However, it is highly recommended that the technique is modified for the requirements of that specific vibration control problem.

REFERENCES

[1]. Szabat, Krzysztof, and Teresa Orlowska-Kowalska. "Vibration suppression in a two-mass drive system using PI speed controller and additional feedbacks—Comparative study." *Industrial Electronics, IEEE Transactions on* 54.2 (2007): 1193-1206.

[2]. Hu, Qinglei. "Robust integral variable structure controller and pulse-width pulse-frequency modulated input shaper design for flexible spacecraft with mismatched uncertainty/disturbance." *ISA transactions* 46.4 (2007): 505-518.

[3]. Shin, SangJoon. *Integral twist actuation of helicolpter rotor blades for vibration reduction*. Diss. Massachusetts Institute of Technology, 2001.

[4]. Khot, S. M., Nitesh P. Yelve, Rajat Tomar, Sameer Desai, and S. Vittal. "Active vibration control of cantilever beam by using PID based output feedback controller." *Journal of Vibration and Control* 18, no. 3 (2012): 366-372.

[5]. Karagülle, H., L. Malgaca, and H. F. Öktem. "Analysis of active vibration control in smart structures by ANSYS." Smart Materials and Structures 13.4 (2004): 661.

[6]. Palazzolo, A. B., Jagannathan, S., Kascak, A. F., Montague, G. T., & Kiraly, L. J. "Hybrid active vibration control of rotorbearing systems using piezoelectric actuators." *Journal of Vibration and Acoustics*115.1 (1993): 111-119.

[7]. Jnifene, Amor, and William Andrews. "Experimental study on active vibration control of a single-link flexible manipulator using tools of fuzzy logic and neural networks." *Instrumentation and Measurement, IEEE Transactions on*54.3 (2005): 1200-1208.

[8]. Li, Hongyi, Jinyong Yu, Chris Hilton, and Honghai Liu. "Adaptive sliding-mode control for nonlinear active suspension vehicle systems using T–S fuzzy approach." *Industrial Electronics, IEEE Transactions on* 60, no. 8 (2013): 3328-3338.

[9]. Hu, Junfeng, and Dachang Zhu. "Vibration control of smart structure using sliding mode control with observer." *Journal of Computers* 7.2 (2012): 411-418.

[10]. Wagg, David, and S. A. Neild. *Nonlinear vibration with control*. Springer, 2014.

[11]. Ahmadabadi, Z. Nili, and S. E. Khadem. "Nonlinear vibration control and energy harvesting of a beam using a nonlinear energy sink and a piezoelectric device." *Journal of Sound and Vibration* 333.19 (2014): 4444-4457.

[12]. Yan, Linjuan, Mickaël Lallart, and Daniel Guyomar. "Hybrid time-domain and spatial filtering nonlinear damping strategy for efficient broadband vibration control." *Journal of Intelligent Material Systems and Structures* (2015): 1045389X14568817.

[13]. Kim, Dookie, Md Kamrul Hassan, Seongkyu Chang, and Yasser Bigdeli. "Nonlinear Vibration Control of 3D Irregular Structures Subjected to Seismic Loads." *Handbook of Research on Advanced Computational Techniques for Simulation-Based Engineering* (2015): 103.

[14]. Lang, Z. Q., P. F. Guo, and I. Takewaki. "Output frequency response function based design of additional nonlinear viscous dampers for vibration control of multi-degree-of-freedom systems." *Journal of Sound and Vibration* 332.19 (2013): 4461-4481.

[15]. Wang, Wei, and Yuling Song. "Nonlinear vibration semi-active control of automotive steering using magneto-rheological damper." *Meccanica* 47.8 (2012): 2027-2039.

[16]. El-Ganaini, W. A., N. A. Saeed, and M. Eissa. "Positive position feedback (PPF) controller for suppression of nonlinear system vibration." *Nonlinear Dynamics* 72.3 (2013): 517-537.

[17]. Rafiee, Mohammad, Jie Yang, and Sritawat Kitipornchai. "Large amplitude vibration of carbon nanotube reinforced functionally graded composite beams with piezoelectric layers." *Composite Structures* 96 (2013): 716-725.

[18]. Sayed, M., and M. Kamel. "1: 2 and 1: 3 internal resonances active absorber for non-linear vibrating system." *Applied Mathematical Modelling* 36.1 (2012): 310-332.

[19]. Yang, J., Y. P. Xiong, and J. T. Xing. "Dynamics and power flow behaviour of a nonlinear vibration isolation system with a negative stiffness mechanism."*Journal of sound and vibration* 332.1 (2013): 167-183.

[20]. Zulli, Daniele, and Angelo Luongo. "Nonlinear energy sink to control vibrations of an internally nonresonant elastic string." *Meccanica* 50.3 (2014): 781-794.

[21]. Omidi, Ehsan, and S. Nima Mahmoodi. "Sensitivity analysis of the Nonlinear Integral Positive Position Feedback and Integral Resonant controllers on vibration suppression of nonlinear oscillatory systems." *Communications in Nonlinear Science and Numerical Simulation* 22.1 (2015): 149-166.

[22]. Omidi, Ehsan, and S. Nima Mahmoodi. "Nonlinear vibration suppression of flexible structures using nonlinear modified positive position feedback approach." *Nonlinear Dynamics* 79.2 (2015): 835-849.

[24]. Pratiher, Barun. "Vibration control of a transversely excited cantilever beam with tip mass." *Archive of Applied Mechanics* 82.1 (2012): 31-42.

[25]. Hosseini, Seyedeh Marzieh, et al. "Analytical solution for nonlinear forced response of a viscoelastic piezoelectric cantilever beam resting on a nonlinear elastic foundation to an external harmonic excitation." *Composites Part B: Engineering* 67 (2014): 464-471.

[26]. Omidi, E., and Mahmoodi., N., "Nonlinear Vibration Control of Flexible Structures Using Nonlinear Modified Positive Position Feedback Approach." *ASME 2014 Dynamic Systems and Control Conference*. American Society of Mechanical Engineers, 2014.

[27]. Goh, C. J., and Caughey, T. K., 1985, "On the Stability Problem Caused by Finite Actuator Dynamics in the Collocated Control of Large Space Structures," International Journal of Control, 41(3) pp. 787-802.

[28]. Fanson, J. L., and Caughey, T. K., 1990, "Positive Position Feedback Control for Large Space Structures," AIAA Journal, 28(4) pp. 717-24.

[29]. Song, G., Schmidt, S. P., and Agrawal, B. N., 2002, "Experimental Robustness Study of Positive Position Feedback Control for Active Vibration Suppression," Journal of Guidance, Control, and Dynamics, 25(1) pp. 179-82.

[30]. Hu, Q., Xie, L., and Gao, H., 2006, "A combined positive position feedback and variable structure approach for flexible spacecraft under input nonlinearity," 2006 9th International Conference on Control, Automation, Robotics and Vision, Anonymous IEEE, Piscataway, NJ, USA, pp. 6 pp.

[31]. Park, G., Myung-Hyun Kim, and Inman, D. J., 2001, "Integration of Smart Materials into Dynamics and Control of Inflatable Space Structures," Journal of Intelligent Material Systems and Structures, 12(6) pp. 423-33.

[32]. Tarazaga, P. A., Inman, D. J., and Wilkie, W. K., 2007, "Control of a Space Rigidizable Inflatable Boom using Macro-Fiber Composite Actuators," Journal of Vibration and Control, 13(7) pp. 935-50.

[33]. Baz, A., Poh, S., and Fedor, J., 1992, "Independent Modal Space Control with Positive Position Feedback," Journal of Dynamic Systems, Measurement and Control, Transactions of the ASME, 114(1) pp. 96-112.

[34]. Omidi, E., and Mahmoodi, N., "Multiple Mode Spatial Vibration Reduction in Flexible Beams Using H2-and H∞-Modified Positive Position Feedback." *Journal of Vibration and Acoustics* 137.1 (2015): 011016.

[35]. Omidi, E., and Mahmoodi, N., "Vibration control of collocated smart structures using H∞ modified positive position and velocity feedback." *Journal of Vibration and Control* (2014): 1077546314548471.

[36]. Omidi, E., and Mahmoodi., N., "Multimode Modified Positive Position Feedback to Control a Collocated Structure." *Journal of Dynamic Systems, Measurement, and Control* 137.5 (2015): 051003.

[37]. Bayon, d. N., and Hanagud, S. V., 1998, "Comparison of H2 optimized design and cross-over point design for acceleration feedback control," Part 1 (of 4), April 20, 1998 - April 23, Anonymous AIAA, Long Beach, CA, USA, 4, pp. 3250-3258.

[38]. Yurkovich, S., Garcia-Benitez, E., and Watkins, J., 1991, "Feedback linearization with acceleration feedback for a two-link flexible manipulator," 91CH2939-7), American Autom. Control Council, Evanston, IL, USA, pp. 1360-5.

[39]. McClamroch, N. H., 1984, "Sampled Data Control of Flexible Structures using Constant Gain Velocity Feedback," Journal of Guidance, Control, and Dynamics, 7(6) pp. 747-50.

[40]. Bar-Kana, I., Fischl, R., and Kalata, P., 1991, "Direct Position Plus Velocity Feedback Control of Large Flexible Space Structures," IEEE Transactions on Automatic Control, 36(10) pp. 1186-8.

[41]. Balas, M. J., 1979, "Direct Velocity Feedback Control of Large Space Structures," Journal of Guidance and Control, 2(3) pp. 252-3.

[42]. Balas, M. J., 1982, "Discrete-Time Stability of Continuous-Time Controller Designs for Large Space Structures," Journal of Guidance, Control, and Dynamics, 5(5) pp. 541-3.

[43]. Li, J., and Xiong, S. -., 1998, "Experimental studies of vibration control of a space truss structure," Part 1 (of 2), February 2, 1998 - February 5, Anonymous SEM, Santa Barbara, CA, USA, 1, pp. 263-269.

[44]. Lim, S. S., and Ahmed, N. U., 1992, "Modeling and Control of Flexible Space Stations," Dynamics and Control, 2(1) pp. 5-33.

[45]. Sung-Ryong Hong, Seung-Bok Choi, and Moon-Shik Han, 2002, "Vibration Control of a Frame Structure using Electro-Rheological Fluid Mounts," International Journal of Mechanical Sciences, 44(10) pp. 2027-45.

[46]. Xu, Y., Brown, H. B., J., Friedman, M., 1994, "Control System of the Self-Mobile Space Manipulator," IEEE Transactions on Control Systems Technology, 2(3) pp. 207-19.

[47]. Humphris, A. D. L., Miles, M. J., and Hobbs, J. K., 2005, "A Mechanical Microscope: High-Speed Atomic Force Microscopy," Applied Physics Letters, 86(3) pp. 34106-1.

[48]. Elahinia, M. H., and Ahmadian, M., 2006, "Application of the Extended Kalman Filter to Control of a Shape Memory Alloy Arm," Smart Materials and Structures, 15(5) pp. 1370-84.

[49]. Elahinia, M. H., and Ahmadian, M., 2005, "An Enhanced SMA Phenomenological Model: I. the Shortcomings of the Existing Models," Smart Materials and Structures, 14(6) pp. 1297-1308.

[50]. Hu, Q., and Ma, G., 2006, "Spacecraft Vibration Suppression using Variable Structure Output Feedback Control and Smart Materials," Transactions of the ASME.Journal of Vibration and Acoustics, 128(2) pp. 221-30.

[51]. Yamada, H., Sasaki, M., and Nam, Y., 2008, "Active Vibration Control of a Micro-Actuator for Hard Disk Drives using Self-Sensing Actuator," Journal of Intelligent Material Systems and Structures, 19(1) pp. 113-23.

[52]. Krishnamurthy, K., and Chao, M., 1992, "Active Vibration Control during Deployment of Space Structures," Journal of Sound and Vibration, 152(2) pp. 205-18.

[53]. Omidi, E.; Mahmoodi, N., 2015, "Hybrid Positive Feedback Control for Active Vibration Attenuation of Flexible Structures," in *Mechatronics, IEEE/ASME Transactions on,* 20(4), pp.1790-1797.

[54]. Omidi, Ehsan, S. Nima Mahmoodi, and W. Steve Shepard. "Multi positive feedback control method for active vibration suppression in flexible structures." *Mechatronics* 33 (2016): 23-33.

[55] Leland, R. P., 2006, "Adaptive Control of a MEMS Gyroscope using Lyapunov Methods," IEEE Transactions on Control Systems Technology, 14(2) pp. 278-83.

[56] Oboe, R., Antonello, R., Lasalandra, E., 2005, "Control of a Z-Axis MEMS Vibrational Gyroscope," IEEE/ASME Transactions on Mechatronics, 10(4) pp. 364-70.

[57] Batur, C., Sreeramreddy, T., and Khasawneh, Q., 2006, "Sliding Mode Control of a Simulated MEMS Gyroscope," ISA Transactions, 45(1) pp. 99-108.

[58] Mitra, M., Gopalakrishnan, S., and Bhat, M. S., 2004, "Vibration Control in a Composite Box Beam with Piezoelectric Actuators," Smart Materials and Structures, 13(4) pp. 676-90.

[59] Wu, S. Y., Tran, B. N., Davis, F. Y., 1994, "Active beam vibration control using PZT actuators," Fifth International Symposium on Integrated Ferroelectrics, Anonymous UK, 4, pp. 281-91.

[60] Sim, E., and Lee, S. W., 1993, "Active Vibration Control of Flexible Structures with Acceleration Feedback," Journal of Guidance, Control, and Dynamics, 16(2) pp. 413-415.

[61] San Paulo, A., and Garcia, R., 2002, "Unifying Theory of Tapping-Mode Atomic-Force Microscopy," Physical Review B (Condensed Matter and Materials Physics), 66(4) pp. 041406-1.

[62] Kalinin, S. V., Rodriguez, B. J., Jesse, S., 2007, "Towards Local Electromechanical Probing of Cellular and Biomolecular Systems in a Liquid Environment," Nanotechnology, 18(42) pp. 10 pp.

[63] Nony, L., Boisgard, R., and Aime, J., 2001, "Stability Criterions of an Oscillating Tip-Cantilever System in Dynamic Force Microscopy," European Physical Journal B, 24(2) pp. 221-9.

[64] Holscher, H., 2006, "Quantitative Measurement of Tip-Sample Interactions in Amplitude Modulation Atomic Force Microscopy," Applied Physics Letters, 89(12) pp. 123109-1.

[65] Rabe, U., Amelio, S., Kester, E., 2000, "Quantitative Determination of Contact Stiffness using Atomic Force Acoustic Microscopy," Ultrasonics, 38(1) pp. 430-437.

[66]. Tien, S., Zou, Q., and Devasia, S., 2005, "Iterative Control of Dynamics-Coupling-Caused Errors in Piezoscanners during High-Speed AFM Operation," IEEE Transactions on Control Systems Technology, **13**(6) pp. 921-31.

[67]. Omidi, E., and Mahmoodi, N., 2015, "Consensus positive position feedback control for vibration attenuation of smart structures." *Smart Materials and Structures* 24.4: 045016.

[68]. Omidi, E., and Mahmoodi, N., 2016, "Vibration suppression of distributed parameter flexible structures by Integral Consensus Control." *Journal of Sound and Vibration* 364: 1-13.

[69]. Chen, P. C., & Shih, M. C. 2011. Robust control of a novel active pneumatic vibration isolator through floor vibration observer. Journal of Vibration and Control, 17(9), 1325-1336.

[70]. Ji, H. L., Qiu, J. H., Wu, Y. P., Cheng, J., & Ichchou, M. N. (2011). Novel approach of self-sensing actuation for active vibration control. Journal of Intelligent Material Systems and Structures, 1045389X10395642.

[71]. Van Wingerden, Jan-Willem, et al. "Two-degree-of-freedom active vibration control of a prototyped “smart” rotor." *Control Systems Technology, IEEE Transactions on* 19.2 (2011): 284-296.

[72]. Rodriguez-Fortun, J. M., Orus, J., Alfonso, J., Gimeno, F. B., & Castellanos, J. (2013). Flatness-based active vibration control for piezoelectric actuators. Mechatronics, IEEE/ASME Transactions on, 18(1), 221-229.

[73]. Yun, Yuan, and Yangmin Li. "A general dynamics and control model of a class of multi-DOF manipulators for active vibration control." *Mechanism and machine theory* 46.10 (2011): 1549-1574.

[74]. Kim, Hwa Soo, Young Man Cho, and Jun Hee Moon. "Active vibration control using a novel three-DOF precision micro-stage." *Smart Materials and Structures* 19.5 (2010): 055001.

[75]. Kim, Yeesock, Stefan Hurlebaus, and Reza Langari. "Model-Based Multi-input, Multi-output Supervisory Semi-active Nonlinear Fuzzy Controller."*Computer-Aided Civil and Infrastructure Engineering* 25.5 (2010): 387-393.

[76]. Xiao, Shunli, and Yangmin Li. "Modeling and high dynamic compensating the rate-dependent hysteresis of piezoelectric actuators via a novel modified inverse Preisach model." *Control Systems Technology, IEEE Transactions on* 21.5 (2013): 1549-1557.

[77] Koprinkova-Hriatova, P. ‘‘Backpropagation through time training of aneuro-fuzzy controller’’, International Journal of Neural Systems, 20(5), pp. 421–428 (2010).

[78] Chen, J.P., Webster, R.S., Hathaway, M.D., Herrick, G.P. and Skoch, G.J. ‘‘High performance computing of compressor rotating stall and stallcontrol’’, Integrated Computer-Aided Engineering, 16(2), pp. 75–89 (2009).

[79] Theodoridis, D.C., Boutalis, Y.S. and Christodoulou, M.A. ‘‘Indirectadaptive control of unknown multi variable nonlinear systems withparametric and dynamic uncertainties using a new neuro-fuzzy systemdescription’’, International Journal of Neural Systems, 20(2), pp. 129–148

[80] Housner, G.W., Bergman, L.A., Caughey, T.K., Chassiakos, A.G., Claus, R.O., Masri, S.F., Skelton, E., Soong, T.T., Spencer,

B.F. and Yao, J.T.P. ‘‘Structural control: past, present and future’’, Journal of Engineering Mechanics,123(9), pp. 897–974 (1997)

[81] Pakrashi, V., O’Connor, A. and Basu, B. ‘‘A study on the effects of damage models and wavelet bases for damage identification and calibration in beams’’, Computer-Aided Civil and Infrastructure Engineering, 22(8), pp. 555–569 (2007).

[82] Park, H.S., Lee, H.M., Adeli, H. and Lee, I. ‘‘A new approach for health monitoring of structures: terrestrial laser scanning’’, Computer-Aided Civil and Infrastructure Engineering, 22(1), pp. 19–30 (2007).

[83] Su, H.Z., Wu, Z.R. and Wen, Z.P. ‘‘Identification model for dam behavior based on wavelet network’’, Computer-Aided Civil and Infrastructure Engineering, 22(6), pp. 438–448 (2007).

[84] Xu, B., Chen, G. and Wu, Z. ‘‘Parametric identification for a truss structure using axial strain’’, Computer-Aided Civil and Infrastructure Engineering, 22(3), pp. 210–222 (2007).

[85] Jiang, X. and Adeli, H. ‘‘Dynamic wavelet neural network for nonlinear identification of highrise buildings’’, Computer-Aided Civil and Infrastructure Engineering, 20(5), pp. 316–330 (2005).

[86] Carden, E.P. and Brownjohn, J.M.W. ‘‘Fuzzy clustering of stability diagrams for vibration-based structural health monitoring’’, Computer- Aided Civil and Infrastructure Engineering, 23(5), pp. 360–372 (2008).

[87] He, X., Moaveni, B., Conte, J.P. and Elgamal, A. ‘‘Modal identification study of Vincent Thomas bridge using simulated wind-induced ambient vibration data’’, Computer-Aided Civil and Infrastructure Engineering,
23(5), pp. 373–388 (2008).

[88] Belli, K., Wadia-Fascetti, S. and Rappaport, C. ‘‘Model based evaluation of bridge decks using ground penetrating radar’’, Computer-Aided Civil and Infrastructure Engineering, 23(1), pp. 3–16 (2008).

[89] Li, S. and Wu, Z. ‘‘A non-baseline method for damage locating and quantifying in beam-like structure based on dynamic distributed strain measurements’’, Computer-Aided Civil and Infrastructure Engineering,23(5), pp. 404–413 (2008).

[90] Ni, Y.Q., Zhou, H.F., Chan, K.C. and Ko, J.M. ‘‘Modal flexibility analysis of cable-stayed Ting Kau bridge for damage identification’’, Computer-Aided Civil and Infrastructure Engineering, 23(3), pp. 223–236 (2008).

[91] Sohn, H., Kim, S.D. and Harries, K. ‘‘Reference-free damage classification based on cluster analysis’’, Computer-Aided Civil and Infrastructure Engineering, 23(5), pp. 324–338 (2008).

[92] Psimoulis, P.A. and Stiros, S.C. ‘‘Experimental assessment of the accuracy of GPS and RTS for the determination of the parameters of oscillation of major structures’’, Computer-Aided Civil and Infrastructure Engineering, 23(5), pp. 389–403 (2008).

[93] Moaveni, B., He, X. and Conte, J.P. ‘‘Damage identification of a composite beam based on changes of modal parameters’’, Computer-Aided Civil and Infrastructure Engineering, 23(5), pp. 339–359 (2008).

[94] Moaveni, B., Conte, J.P. and Hemez, F.M. ‘‘Uncertainty and sensitivity analysis of damage identification results obtained using finite element model updating’’, Computer-Aided Civil and Infrastructure Engineering,24(5), pp. 320–334 (2009).

[95] Soyoz, S. and Feng, M.Q. ‘‘Long-term monitoring and identification of bridge structural parameters’’, Computer-Aided Civil and Infrastructure Engineering, 24(2), pp. 82–92 (2009).

[96] Umesha, P.K., Ravichandran, R. and Sivasubramanian, K. ‘‘Crack detection and quantification in beams using wavelets’’, Computer-Aided Civil and Infrastructure Engineering, 24(8), pp. 593–607 (2009).

[97] Cruz, P.J.S. and Salgado, R. ‘‘Performance of vibration-based damage detection methods in bridges’’, Computer-Aided Civil and Infrastructure Engineering, 24(1), pp. 62–79 (2009).

[98] Chen, B. and Liu, W. ‘‘Mobile agent computing paradigm for building a flexible structural health monitoring sensor network’’, Computer-Aided Civil and Infrastructure Engineering, 25(7), pp. 504–516 (2010).

[99] Huang, C.S., Huang, S.L., Su, W.C. and Wu, C.L. ‘‘Identification of time-variant modal parameters using TVARX and low-order polynomial function’’, Computer-Aided Civil and Infrastructure Engineering, 24(7), pp. 470–491 (2009).

[100] Huang, R.Y., Mao, I.S. and Lee, H.K. ‘‘Exploring the deterioration factors of bridges: a rough set theory approach’’, Computer-Aided Civil and Infrastructure Engineering, 25(7), pp. 517–529 (2010).

[101] Fisco, N.R. and Adeli, H. ‘‘Smart structures: part II—hybrid control systems and control strategies’’, Scientia Iranica, Transaction A: Civil Engineering,18(3), pp. 285–295 (2011).

[102] Saleh, A. and Adeli, H. ‘‘Microtasking, macrotasking and auto tasking for structural optimization’’, Journal of Aerospace Engineering, ASCE, 7(2), pp. 156–174 (1994).

[103] Saleh, A. and Adeli, H. ‘‘Parallel algorithms for integrated structural and control optimization’’, Journal of Aerospace Engineering, ASCE, 7(3), pp. 297–314 (1994).

[104] Adeli, H. and Saleh, A. ‘‘Integrated structural/control optimization of large adaptive/smart structures’’, International Journal of Solids and Structures,35(28–29), pp. 3815–3830 (1998)

[105] Hsu, H.L. and Adeli, H. ‘‘A microtasking algorithm for optimization of structures’’, International Journal of Supercomputer Applications, 5(2), pp. 81–90 (1991).

[106] Adeli, H. and Kamal, O. ‘‘Concurrent analysis of large structures – I – algorithms’’, Computers and Structures, 42(3), pp. 413–424 (1992).

[107] Adeli, H. and Kamal, O. ''Concurrent analysis of large structures – II –applications'', Computers and Structures, 42(3), pp. 425–432 (1992).

[108] Adeli, H. and Hung, S.L. ''A concurrent adaptive conjugate gradient learning algorithm on MIMD machines'', Journal of Supercomputer Applications, MIT Press, 7(2), pp. 155–166 (1993).

[109] Hung, S.L. and Adeli, H. ''Parallel backpropagation learning algorithms on cray Y-MP8/864 supercomputers'', Neurocomputing, 5(6), pp. 287–302 (1993).

[110] Adeli, H. and Hsu, H.-L. ''Optimization of space trusses on a vector multiprocessor'', Journal of Aerospace Engineering, ASCE, 7(1), pp. 120–126 (1994).

[111] Soegiarso, R. and Adeli, H. ''Impact of vectorization on large-scale structural optimization'', Structural Optimization, 7(1), pp. 117–125 (1994).

[112] Saleh, A. and Adeli, H. ''Microtasking, macrotasking, and auto tasking for optimization of structures'', Journal of Aerospace Engineering, ASCE, 7(2), pp. 156–174 (1994).

[113] Adeli, H. and Cheng, N.-T. ''Concurrent genetic algorithms for optimization of large structures'', Journal of Aerospace Engineering, ASCE, 7(3), pp. 276–296 (1994).

[114] Hung, S.L. and Adeli, H. ''A parallel genetic/neural network learning algorithm for MIMD shared memory machines'', IEEE Transactions on Neural Networks, 5(60), pp. 900–909 (1994).

[115] Adeli, H. and Kumar, S. ''Distributed genetic algorithms for structural optimization'', Journal of Aerospace Engineering, 8(3), pp. 156–163 (1995).

[116] Adeli, H. and Kumar, S. ''Distributed finite element analysis on a network of workstations—algorithms'', Journal of Structural Engineering, ASCE, 121(10), pp. 1448–1455 (1995).

[117] Kumar, S. and Adeli, H. ''Distributed finite element analysis on a network of workstations—implementation and applications'', Journal of Structural Engineering, ASCE, 121(10), pp. 1456–1462 (1995).

[118] Adeli, H. and Kumar, S. ''Concurrent structural optimization on a massively parallel supercomputer'', Journal of Structural Engineering, ASCE, 121(11), pp. 1588–1597 (1995).

[119] Park, H.S. and Adeli, H. ''Distributed neural dynamics algorithms for optimization of large steel structures'', Journal of Structural Engineering, ASCE, 123(7), pp. 880–888 (1997).

[120] Adeli, H. ''High-performance computing for large-scale analysis, optimization and control'', Journal of Aerospace Engineering, ASCE, 13(1), pp. 1–10 (2000).

[121] Sarma, K.C. and Adeli, H. ''Bi-level parallel genetic algorithms for optimization of large steel structures'', Computer-Aided Civil and Infrastructure Engineering, 16(5), pp. 295–304 (2001).

[122] Adeli, H. and Kamal, O., Parallel Processing in Structural Engineering, Elsevier Applied Science, London (1993).

[123] Adeli, H. and Soegiarso, R., High-Performance Computing in Structural Engineering, CRC Press, Boca Raton, Florida (1999).

[124] Soegiarso, R. and Adeli, H. ''Parallel-vector algorithms for analysis of large structures'', Journal of Aerospace Engineering, ASCE, 8(1), pp. 54–67 (1995).

[125] Begg, D.W. and Lui, X. ''Algorithms for optimal design of smart structural systems'', Computer-Aided Civil and Infrastructure Engineering, 13(6), pp. 415–423 (1998).

[126] Adeli, H. and Saleh, A. ''Optimal control of adaptive/smart bridge structures'', Journal of Structural Engineering, ASCE, 123(2), pp. 218–226 (1997).

[127] Saleh, A. and Adeli, H. ''Parallel eigenvalue algorithms for large-scale control-optimization problems'', Journal of Aerospace Engineering, ASCE, 9(3), pp. 70–79 (1996).

[128] Saleh, A. and Adeli, H. ''Robust parallel algorithms for solution of the Riccati equation'', Journal of Aerospace Engineering, ASCE, 10(3), pp. 126–133 (1997).

[129] Hanagan, L.M. and Murray, T.M. ''Active control approach for reducing floor vibrations'', Journal of Structural Engineering, 123(11), pp. 1497–1505 (1997).

[130] Hanagan, L.M., Kulasekere, E.C., Walgama, K.S. and Premaratne, K. ''Optimal placement of actuators and sensors for floor vibration control'', Journal of Structural Engineering, 126(12), pp. 1380–1387 (2000).

[131] Agrawal, A.K., Yang, J.N., Schmitendorf, W.E. and Jabbari, F. ''Stability of actively controlled structures with actuator saturation'', Journal of Structural Engineering, 123(11), pp. 1497–1505 (1997).

[132] Djouadi, S., Motro, R., Pons, J.C. and Crosnier, B. ''Active control of tensegrity systems'', Journal of Aerospace Engineering, 11(2), pp. 37–44 (1998).

[133] Asano, K. and Nakagawa, H. ''Active saturation control of hysteresis structures'', Computer-Aided Civil and Infrastructure Engineering, 13(6), pp. 425–432 (1998).

[134] Chase, J.G., Breneman, S.E. and Smith, H.A. ''Robust $H\infty$ static output feedback control with actuator saturation'', Journal of Engineering Mechanics, 125(2), pp. 225–233 (1999).

[135] Saleh, A. and Adeli, H. ''Optimal control of adaptive/smart building structures'', Computer-Aided Civil and Infrastructure Engineering, 13(6), pp. 389–403 (1998).

[136] Saleh, A. and Adeli, H. ''Optimal control of adaptive building structures under blast loading'', Mechatronics, 8(8), pp. 821–844 (1998).

[137] Reiher H, Meister FJ. The effect of vibration on people. Forsch Gebeite Ingenieurwes 1931; 2:381–6 [in German] English Translation: Report No. F-TS-616-RE, Headquarters Air Material Command, Wright Field, Ohio, 1946.

[138] Lenzen KH. Vibration of steel joist-concrete slab floors. AISC Eng J 1966(3):133–6.

[139] Wiss JF, Parmelee RA. Human perception of transient vibrations. J Struct Div, ASCE 1974;100(4):773–87.

[140] Allen DE, Rainer JH. Vibration criteria for long-span floors. Can J Civ Eng 1976; 3:165–73.

[141] Murray TM. Acceptability criterion for occupant-induced floor vibrations. Sound Vib 1979:24–30.

[142] Allen DE, Rainer JH, Pernica G. Vibration criteria for assembly occupancies. Can J Civ Eng 1985; 12:617–23.

[143] International Standard Organization. Evaluation of human exposure to whole body vibration—Part 2: human

[144] Hanagan LM, Murray TM. Experimental implementation of active control to reduce annoying floor vibrations. AISC Eng J 1998;35(4):123–7.

[145] Spencer Jr BF, Sain MK. Controlling buildings: a new frontier in feedback. IEEE Control Syst 1997;17(6):19–35.

[146] Sack RL, Patten WN. Semiactive hydraulic structural control. In: Housner GW, Masri SF, editors. Proceedings International Workshop on Structural Control, Honolulu, Hawaii, August 1993. p. 417–31.

[147] Patten WN, Kuehn JL, Sun J, Song G, Sack RL. Impact vibration reduction via semiactive vibration absorbers (SAVA) for an interstate bridge. In: Proceedings, of 13th Annual International Bridge Conference, Pittsburgh, PA, June 3–5, 1996.

[148] Patten WN, Sack RL, He Q. Controlled semiactive hydraulic vibration absorber for bridges. J Struct Eng 1996;122(2):187–92.

[149] Setareh M. Floor vibration control using semi-active tuned mass damper. Can J Civ Eng 2002; 29:76–84.

[150] Koo J-H, Ahmadian M, Setareh M. Experimental evaluation of magneto-rheological dampers for semiactive tuned vibration absorbers. In: Proceedings, SPIE—The International Society for Optical Engineering: Smart Structures and Materials 2003, Damping and Isolation, San Diego, CA, USA, vol. 5052, 2003. p. 83– 91.

[151] Koo J-H, Ahmadian M, Setareh M, Murray TM. In search of suitable control methods for semi-active tuned vibration absorbers. J Vib Control 2004; 10:163–74.

[152] Hanagan LM, Murray TM, Premarante K. Controlling floor vibration with active and passive devices. Shock Vib Digest 2003;35(5)

[153] Casciati, F., Magonette, G., Marazzi, F., (2006). Technology of semi-active devices and applications in vibration mitigation. England, West Sussex: John Wiley & Sons, Ltd.

[154] Chu, S.Y., Soong, T.T., Rein horn, A.M., (2005). Active, hybrid, and semi-active structural control: a design and implementation hand book. England, West Sussex: John Wiley & Sons, Ltd.

[155] Spencer, B.F., Sain, Jr., Sain, M., (1997). "Controlling buildings: A new frontier in feedback." Special issue of the IEEE control systems magazine on emerging technology, Vol. 17, No. 6, pp. 19–35, December 1997.

[156] Symans, M., Constantinou, M., (1998). "Semi-active control systems for seismic protection of structures: a state-of-the-art review." Engineering structures, Journal of earthquake, wind and ocean engineering, Vol. 21, No. 6, pp. 469-487.