Structronic Systems Smart Structures Devices And Systems Series On Stability Vibration And Control Of Systems Series B Vol 4

In concept and execution, this book covers the field of EAP with careful attention to all its key aspects and full infrastructure, including the available materials, analytical models, processing techniques, and characterization methods. In this second edition the reader is brought current on promising advances in EAP that have occurred in electric EAP, electroactive polymer gels, ionomeric polymer-metal composites, carbon nanotube actuators, and more.

This book is concerned with electrostructural systems, particularly the interaction between the control of the structural and electrical (electronic) components. Structronics is a new emerging area with many potential applications in the design of high-performance structures, adaptive structures, high-precision systems, and micro-systems. As structures are increasingly being controlled by electronics, the problems of structural engineering can be separated less and less from those of electronic engineering and control engineering. This graduate-level book fills a gap in the literature by considering these problems while giving

an overview of the current state of analysis, modelling and control for structronic systems. It is a coherent compendium written by leading experts in this new research area and gives readers a sophisticated toolbox that will allow them to tackle the modelling and control of smart structures. The inclusion of an extensive, up-to-date bibliography and index makes this volume an invaluable standard for professional reference.Because of the large number of contributions to the present volume, it has been subdivided into two parts, of which this is Part I. This book will be of interest to engineers, materials scientists, physicists and applied mathematicians.The synergistic integration of active (smart) materials, structures, sensors, actuators, and control electronics has redefined the concept of structures from a conventional passive elastic system to an active (life-like) structronic (structure] electronic) system with inherent self-sensing, diagnosis, and control capabilities. Because of its multi-disciplinary nature, the development of structronic systems has attracted researchers and scientists from many disciplines, such as structures, materials, control, electronics, mathematics, manufacturing, electromechanics, and mechanics. In practical applications, this new structronic system can be used as a component of high-performance machines or structural systems, or be an integrated structure itself performing designated function(s).Most common active (smart) materials, such as

piezoelectrics, shape-memory alloys, electro- and magneto-strictive materials, and polyelectrolyte gels have been reviewed in Part I. Application examples are also provided and research issues reported on. While the first part focuses primarily on materials and structures, Part II emphasizes control applications and intelligent systems. With the information provided in this two-volume book, scientists and researchers can easily grasp the state of the art of smart materials and structronic systems, and are ready to pursue their own research and development endeavors.

This book gives an overview of the current state of uncertainty modeling in vibration, control, and fuzzy analysis of structural and mechanical systems. It is a coherent compendium written by leading experts and offers the reader a sampling of exciting research areas in several fast-growing branches in this field. Uncertainty modeling and analysis are becoming an integral part of system definition and modeling in many fields. The book consists of ten chapters that report the work of researchers, scientists and engineers on theoretical developments and diversified applications in engineering systems. They deal with modeling for vibration, control, and fuzzy analysis of structural and mechanical systems under uncertain conditions. The book designed for readers who are familiar with the fundamentals and wish to study a particular topic or use the book

as an authoritative reference. It gives readers a sophisticated toolbox for tackling modeling problems in mechanical and structural systems in real-world situations. The book is part of a series on Stability, Vibration and Control of Structures, and provides vital information in these areas.

Contains papers from three symposia at the November 1996 congress. Sections on structures and materials for aerospace vehicles, adaptive structures and material systems, and micro-electro-mechanical systems include section introductions, and present the latest research.

This is the first single volume monograph that systematically summarizes the recent progress in using non-Fourier heat conduction theories to deal with the multiphysical behaviour of smart materials and structures. The book contains six chapters and starts with a brief introduction to Fourier and non-Fourier heat conduction theories. Non-Fourier heat conduction theories include Cattaneo-Vernotte, dual-phase-lag (DPL), three-phase-lag (TPL), fractional phase-lag, and nonlocal phase-lag heat theories. Then, the fundamentals of thermal wave characteristics are introduced through reviewing the methods for solving non-Fourier heat conduction theories and by presenting transient heat transport in representative homogeneous and advanced heterogeneous materials. The book provides the fundamentals of smart materials and structures, including the

background, application, and governing equations. In particular, functionally-graded smart structures made of piezoelectric, piezomagnetic, and magnetoelectroelastic materials are introduced as they represent the recent development in the industry. A series of uncoupled thermal stress analyses on one-dimensional structures are also included. The volume ends with coupled thermal stress analyses of one-dimensional homogenous and heterogeneous smart piezoelectric structures considering different coupled thermopiezoelectric theories. Last but not least, fracture behavior of smart structures under thermal disturbance is investigated and the authors propose directions for future research on the topic of multiphysical analysis of smart materials.

Structural control offers opportunities to design new structures and to retrofit existing structures by the application of counter-forces, smart materials, frictional devices, etc., instead of just increasing the strength of the structure at greater cost.The Association for the Control of Structures (ACS) is promoting in Europe the development of this new technology in architectural design and infrastructure renewal and rehabilitation. The First European Conference on Structural Control was organized as one of the major initiatives toward this objective.

The 28 peer-reviewed papers, from two symposia at the congress, present current analytical, numerical, and experimental results in all aspects of passive,

active, hybrid, and semi-active methods applied to control structural vibrations and noise in engineering applications. The topics include an app
Iterative Learning Control (ILC) differs from most existing control methods in the sense that, it exploits every possibility to incorporate past control informa tion, such as tracking errors and control input signals, into the construction of the present control action. There are two phases in Iterative Learning Control: first the long term memory components are used to store past control infor mation, then the stored control information is fused in a certain manner so as to ensure that the system meets control specifications such as convergence, robustness, etc. It is worth pointing out that, those control specifications may not be easily satisfied by other control methods as they require more prior knowledge of the process in the stage of the controller design. ILC requires much less information of the system variations to yield the desired dynamic be haviors. Due to its simplicity and effectiveness, ILC has received considerable attention and applications in many areas for the past one and half decades. Most contributions have been focused on developing new ILC algorithms with property analysis. Since 1992, the research in ILC has progressed by leaps and bounds. On one hand, substantial work has been conducted and reported in the core area of developing and analyzing new ILC algorithms. On the other hand, researchers

have realized that integration of ILC with other control techniques may give rise to better controllers that exhibit desired performance which is impossible by any individual approach.

Annotation This is the first monograph devoted to the foundation of the theory of composite anisotropic thin-walled beams and to its applications in various problems involving the aeronautical/aerospace, helicopter, naval and mechanical structures. Throughout the theoretical part, an effort was made to provide the treatment of the subject by using the equations of the 3-D elasticity theory. Non-classical effects such as transverse shear, warping constraint, anisotropy of constituent materials yielding the coupling of twist-bending (lateral), bending (transversal)-extension have been included and their implications have been thoroughly analyzed. Thermal effects have been included and in order to be able to circumvent their deleterious effects, functionally graded materials have been considered in their construction. Implications of the application of the tailoring technique and of the active feedback control on free vibration, dynamic response, instability and aeroelasticity of such structures have been amply investigated. Special care was exercised throughout this work to address and validate the adopted solution methodologies and the obtained results against those available in the literature and obtained via numerical or experimental means.

The aim of the book is to give a clear picture of some new modern trends in composite mechanics and to give a presentation of the current state-of-the-art of the theory and application of composite laminates. The book addresses the basics as well as recent developments in the theory of laminates and their effective properties, the problem of testing and identification of properties, strength, damage, and failure of composite laminates, lightweight construction principles, optimization techniques, the generation of smart structures, and a number of special technical aspects (e.g. stress localization), their modelling and analysis. The intention of the book is to provide deeper understanding, to give mathematical and algorithmic techniques for analysis, simulation and optimization and to link various aspects of composite mechanics as necessary to exploit the full potential that is possible for composite structures.

Adaptive Structural Systems with Piezoelectric Transducer Circuitry provides a comprehensive discussion on the integration of piezoelectric transducers with electrical circuitry for the development and enhancement of adaptive structural systems. Covering a wide range of interdisciplinary research, this monograph presents a paradigm of taking full advantage of the two-way electro-mechanical coupling characteristics of piezoelectric transducers for structural control and identification in adaptive structural systems. Presenting descriptions of algorithm

development, theoretical analysis and experimental investigation, engineers and researchers alike will find this a valuable reference.

Shells, plates and beams have always appeared as fundamental components for civil, mechanical, aerospace and naval engineering. The increase in the use of these structures in different engineering practices justify the present international meeting where researches from every part of the globe can share and discuss the recent advancements regarding the use of standard structural components within advanced applications such as buckling, vibrations, repair, reinforcements, concrete, composite laminated materials and more recent metamaterials. In particular, the computational and experimental methods for shells, plates, beams and arches are the general topics of this conference. The importance of the present topics is justified also by the number of journal papers and technical notes that have been published extensively over the last seventy years in international scientific journals of different engineering fields. This Conference is suitable as a reference for engineers and scientists working in the professional field, in the industry and the academia and it gives the possibility to share recent advancements in different engineering practices to the outside world. This book aims to collect selected plenary and keynote lectures of this International Conference.

This book covers the fundamental properties, modeling, and demonstration of Electroactive polymers in robotic applications. It particularly details artificial muscles and sensors. In addition, the book discusses the properties and uses in robotics applications of ionic polymer–metal composite actuators and dielectric elastomers.

Two key words for mechanical engineering in the future are Micro and Intelligence. It is weIl known that the leadership in the intelligence technology is a marter of vital importance for the future status of industrial society, and thus national research projects for intelligent materials, structures and machines have started not only in advanced countries, but also in developing countries. Materials and structures which have self-sensing, diagnosis and actuating systems, are called intelligent or smart, and are of growing research interest in the world. In this situation, the IUT AM symposium on Dynamics 0/ Advanced Materials and Smart Structures was a timely one. Smart materials and structures are those equipped with sensors and actuators to achieve their designed performance in achanging environment. They have complex structural properties and mechanical responses. Many engineering problems, such as interface and edge phenomena, mechanical and electro-magnetic interaction/coupling and sensing, actuating and control techniques, arise in the development ofintelligent structures. Due to the

multi-disciplinary nature ofthese problems, all ofthe classical sciences and technologies, such as applied mathematics, material science, solid and fluid mechanics, control techniques and others must be assembled and used to solve them. IUTAM weIl understands the importance ofthis emerging technology. An IUTAM symposium on Smart Structures and Structronic Systems (Chaired by U. Composite structures are most efficient in performance and production cost when combined with smart materials making them adaptable to changing operational conditions. The specific production processes of composites offer the possibility to integrate more functions thus making the structure more valuable. Active functions can be realized by smart materials, e.g. morphing, active vibration control, active structure acoustic control or structure health monitoring. The foundation is a sound understanding of materials, design methods, design principles, production technologies and adaptronics. Along the complete process chain this disciplines together deliver advanced lightweight solutions for applications ranging from mechanical engineering to vehicles, airframe and finally space structures. This book provides the scientific foundations as well as inspiring new ideas for engineers working in the field of composite lightweight structures.

Non destructive testing aimed at monitoring, structural identification and di- nostics is of

strategic importance in many branches of civil and mechanical - gineering. This type of tests is widely practiced and directly affects topical issues regarding the design of new buildings and the repair and monitoring of existing ones. The load bearing capacity of a structure can now be evaluated using well established mechanical modelling methods aided by computing facilities of great capability. However, to ensure reliable results, models must be calibrated with - curate information on the characteristics of materials and structural components. To this end, non destructive techniques are a useful tool from several points of view. Particularly, by measuring structural response, they provide guidance on the validation of structural descriptions or of the mathematical models of material behaviour. Diagnostic engineering is a crucial area for the application of non destructive testing methods. Repeated tests over time can indicate the emergence of p- sible damage occurring during the structure's lifetime and provide quantitative estimates of the level of residual safety.

Lyapunov-Based Control of Robotic Systems describes nonlinear control design solutions for problems that arise from robots required to interact with and manipulate their environments. Since most practical scenarios require the design of nonlinear controllers to work around uncertainty and measurement-related issues, the authors use Lyapunov’s direct method as an effective tool to design and analyze controllers for robotic systems. After describing the evolution of real-time control design systems and the associated operating environments and hardware platforms, the book presents a

host of standard control design tools for robotic systems using a common Lyapunov-based framework. It then discusses several problems in visual servoing control, including the design of homography-based visual servo control methods and the classic structure from motion problem. The book also deals with the issues of path planning and control for manipulator arms and wheeled mobile robots. With a focus on the emerging research area of human machine interaction, the final chapter illustrates the design of control schemes based on passivity such that the machine is a net energy sink. Including much of the authors' own research work in controls and robotics, this book facilitates an understanding of the application of Lyapunov-based control design techniques to up-and-coming problems in robotics.

Proceedings of the IUTAM Symposium on Smart Structures and Structronic Systems, held in Magdeburg, Germany, 26-29 September 2000

This book offers an introduction to piezoelectric shells and distributed sensing, energy harvesting and control applications. It familiarizes readers with a generic approach of piezoelectric shells and fundamental electromechanics of distributed piezoelectric sensors, energy harvesters and actuators applied to shell structures. The book is divided into two major parts, the first of which focuses on piezoelectric shell continua, while the second examines distributing sensing, energy harvesting and control of elastic continua, e.g., shells and plates. The exploitation of new, advanced multifunctional smart structures and structronic systems has been one of the mainstream research and

development activities over the years. In the search for innovative structronics technologies, piezoelectric materials have proved to be very versatile in both sensor and actuator applications. Consequently, the piezoelectric technology has been applied to a broad range of practical applications, from small-scale nano- and micro-sensors/actuators to large-scale airplane and space structures and systems. The book provides practicing engineers and researchers with an introduction to advanced piezoelectric shell theories and distributed sensor/energy harvester/actuator technologies in the context of structural identification, energy harvesting and precision control. The book can also be used as a textbook for graduate students. This second edition contains substantial new materials, especially energy harvesting and experimental components, and has been updated and corrected for a new generation of readers.

The functionality of modern structural, mechanical and electrical or electronic systems depends on their ability to perform under uncertain conditions. Consideration of uncertainties and their effect on system behavior is an essential and integral part of defining systems. In eleven chapters, leading experts present an overview of the current state of uncertainty modeling, analysis and design of large systems in four major areas: finite and boundary element methods (common structural analysis techniques), fatigue, stability analysis, and fault-tolerant systems. The content of this book is unique; it describes exciting research developments and challenges in

emerging areas, and provide a sophisticated toolbox for tackling uncertainty modeling in real systems. Contents:Probabilistic Finite Element Analysis of Large Structural Systems (S Mahadevan)Reliability Evaluation of Structures Using Nonlinear SFEM (A Haldar & L-W Gao)Finite Element Method for Stochastic Structures Based on Inverse of Stiffness Matrix (I Elishakoff & Y-J Ren)The Weighted Integral Method and the Variability Response Function as Part of an SFEM Formulation (G Deodatis & L Graham)Response of a Vibrating Structure to Turbulent Wall Pressure: Fluid-Loaded Structure Modes Series and Boundary Element Method (P J T Filippi & D Mazzoni)Reliability-Based Structural Fatigue Damage Evaluation and Maintenance Using Non-Destructive Inspections (Z-W Zhao & A Haldar)Uncertainty Modeling in Structural Stability (B W Yeigh & M Shinozuka)Global Stability Analysis of Nonlinear Dynamical Systems (R Valèry Roy)Dynamic Random Snap-Buckling of Composite Shallow Shells (R Heuer et al.)Buckling Analysis and Design of Imperfection-Sensitive Structures (G V Palassopoulos)Basic Concepts of Fault-Tolerant Computing Design (C Aktouf et al.) Readership: Researchers in systems & knowledge engineering/artificial intelligence, civil, mechanical & electronic engineering, applied physics, applied mathematics, numerical and computing methods. keywords: “This book is a coherent compendium written by leading experts, and offers the reader a sampling of exciting research developments in these areas. It is designed for readers who are familiar with the fundamentals and wish to study a particular topic or use the book as an

authoritative reference." Mathematical Reviews

Research Progress in Nano and Intelligent Materials presents a broad selection of chapters on leading-edge research from top international researchers on various applications of nano and intelligent materials. The collection of topics in this book aims to reflect the diversity of recent advances in nano and intelligent materials with a broad perspective that will be useful for scientists as well as for graduate students and engineers. Chapters present a range of research, from new methods to novel applications of existing methods to foster the understanding of the material and/or structural behavior of new and advanced systems. Topics include: Updates on pan monofilament in nanoscale The development of flexible electrode using inkjet printing of silver nanoparticles Supreme EMI shielding using electroless plating of metallic nanoparticles on cotton fabric Inkjet deposited circuit components Reinforcing chitosan/poly(vinyl alcohol) nanofiber scaffolds using Single-walled carbon nanotube for neural tissue engineering Wireless wearable ECG monitoring system Conductive chitosan nanofiber Progress in production of nanofiber web

The coupling of models from different physical domains and the efficient and reliable simulation of multidisciplinary problems in engineering applications are important topics for various fields of engineering, in simulation technology and in

the development and analysis of numerical solvers. The volume presents advanced modelling and simulation techniques for the dynamical analysis of coupled engineering systems consisting of mechanical, electrical, hydraulic and biological components as well as control devices often based on computer hardware and software. The book starts with some basics in multibody dynamics and in port-based modelling and focuses on the modelling and simulation of heterogeneous systems with special emphasis on robust and efficient numerical solution techniques and on a variety of applied problems including case studies of co-simulation in industrial applications, methods and problems of model based controller design and real-time application.

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systems. It is a coherent compendium written by leading experts in this new research area and gives readers a sophisticated toolbox that will allow them to tackle the modelling and control of smart structures. The inclusion of an extensive, up-to-date bibliography and index makes this volume an invaluable standard for professional reference. Because of the large number of contributions to the present volume, it has been subdivided into two parts, of which this is Part I. This book will be of interest to engineers, materials scientists, physicists and applied mathematicians. The synergistic integration of active (smart) materials, structures, sensors, actuators, and control electronics has redefined the concept of structures from a conventional passive elastic system to an active (life-like) structronic (structure + electronic) system with inherent self-sensing, diagnosis, and control capabilities. Because of its multi-disciplinary nature, the development of structronic systems has attracted researchers and scientists from many disciplines, such as structures, materials, control, electronics, mathematics, manufacturing, electromechanics, and mechanics. In practical applications, this new structronic system can be used as a component of high-performance machines or structural systems, or be an integrated structure itself performing designated function(s). Most common active (smart) materials, such as piezoelectrics, shape-memory alloys, electro- and magneto-strictive materials,

and polyelectrolyte gels have been reviewed in Part I. Application examples are also provided and research issues reported on. While the first part focuses primarily on materials and structures, Part II emphasizes control applications and intelligent systems. With the information provided in this two-volume book, scientists and researchers can easily grasp the state of the art of smart materials and structronic systems, and are ready to pursue their own research and development endeavors. Contents:Part I: Materials and StructuresThe Piezoelectric Vibration Absorber Systems (J Holkamp & T Starchville, Jr.)Self-Sensing Control Applied to Smart Material Systems (E Garcia & L D Jones)An Introduction to Active Constrained Layer Damping Treatments (S Shen)Static and Dynamic Behavior of Adaptive Wings Carrying Externally Mounted Stores (L Librescu & O Song)Adaptive Design and Active Composite Material Systems (J Tani & J-H Qiu)Microelectromechanics and Functionality of Segmented Cylindrical Transducers (H-S Tzou et al.)Thermomechanical Modeling of Shape Memory Alloys and Composites (D Lagoudas et al.)Active-Passive Hybrid Structural Vibration Controls Via Piezoelectrical Networks (K-W Wang & S Kahn)On-Line Structural Damage Detection (H Shen)On Material Degradation and Failure of Piezoelectric Ceramics (H Sosa)Part II: Systems and ControlNear-Minimum-Time Slewing and Vibration Control of Smart Structures(Y Kim et

al.)Active Polyelectrolyte Gels as Electrically Controllable Artificial Muscles and Intelligent Network Structures(M Shahinpoor)Active Dynamic Absorbers — Theory and Application(S Tewani et al.)Active Vibration Sink for Flexible Structures(C-S Chou)Distributed Modal-Space Control and Estimation with Electroelastic Applications(H Öz)Markov Parameters in System Identification: Old and New Concepts(M Q Phan et al.)Effect of System Non-Linearities on the Modified Model Reference Adaptive Control Scheme(H M Sardar & M Ahmadian)Extending Teach-Repeat to Nonholonomic Robots(S B Skaar & J-D Yoder)Dynamic Analysis and Active Vibration Control of Chain Drive Systems(C-A Tan et al.)Basic Concepts of Fault-Tolerant Computing Design(C Aktouf et al.) Readership: Applied mathematicians, applied physicists and mechanical engineers. Keywords:Structronic Systems;Smart Structures;Devices;Systems;Materials;ControlReviews: "… Professors Guran and Tzou coined the word Structronics in the early 1990s as a new discipline describing the synergetic integration of active materials, structures, sensors, actuators, and control electronics. The present two-volume set is the first comprehensive book ever published on this newly emerging area of engineering. I believe anyone who would like to know what modern science and technology can offer for the design of better structures can learn a great deal from this book.

Students and educators can use it as supplemental reading in an intermediate or advanced course on Structronics, or to gain a broader knowledge of systems thinking, model materials, and structural systems. Practicing engineers wishing to consolidate their knowledge in smart technology will also find this book an invaluable reference." Dr Bernd Schaefer Director Institute of Robotics and Mechatronics, Wessling, Germany

This book is a collection of papers on the subject of nonlinear dynamics and its applications written by experts in this field. It offers the reader a sampling of exciting research areas in this fast-growing field. The topics covered include chaos, tools to analyze motions, fractal boundaries, dynamics of the Fitzhugh-Nagumo equation, structural control, separation of contaminations from signal of interest, parametric excitation, stochastic bifurcation, mode localization in repetitive structures, Toda lattice, transition from soliton to chaotic motion, nonlinear normal modes, noise perturbations of nonlinear dynamical systems, and phase locking of coupled limit cycle oscillators. Mathematical methods include Lie transforms, Monte Carlo simulations, stochastic calculus, perturbation methods and proper orthogonal decomposition. Applications include gyrodynamics, tether connected satellites, shell buckling, nonlinear circuits, volume oscillations of a large lake, systems with stick-slip friction, imperfect or

disordered structures, overturning of rigid blocks, central pattern generators, flow induced oscillations, shape control and vibration suppression of elastic structures.All of these diverse contributions have a common thread: the world of nonlinear behavior. Although linear dynamics is an invaluable tool, there are many problems where nonlinear effects are essential. Some examples include bifurcation of solutions, stability of motion, the effects of large displacements, and subharmonic resonance. This book shows how nonlinear dynamics is currently being utilized and investigated. It will be of interest to engineers, applied mathematicians and physicists.