Hybrid Energy Harvester Based On Piezoelectric And

This edited volume Supercapacitors: Theoretical and Practical Solutions is a collection of reviewed and relevant research chapters, offering a comprehensive overview of recent developments in the field of electronic devices and materials. The book comprises single chapters authored by various researchers and is edited by a group of experts. Each chapter is complete in itself but united under a common research study topic. This publication aims at providing a thorough overview of the latest research efforts by international authors on electronic devices and materials and opens new possible research paths for further novel developments.

This book presents basic and advanced concepts for energy harvesting and energy efficiency, as well as related technologies, methods, and their applications. The book provides up-to-date knowledge and discusses the state-of-the-art equipment and methods used for energy harvesting and energy efficiency, combining theory and practical applications. Containing over 200 illustrations and problems and solutions, the book begins with overview chapters on the status quo in this field. Subsequent chapters introduce readers to advanced concepts and methods. In turn, the final part of the book is dedicated to technical strategies, efficient methods and applications in the field of energy efficiency, which also makes it of interest to technicians in industry. The book tackles problems commonly encountered using basic methods of energy harvesting and energy efficiency, and proposes advanced methods to resolve these issues. All the methods proposed have been validated through simulation and experimental results. These “hot topics” will continue to be of interest to scientists and engineers in future decades and will provide challenges to researchers around the globe as issues of climate change and changing energy policies become more pressing. Here, readers will find all the basic and advanced concepts they need. As such, it offers a valuable, comprehensive guide for all students and practicing engineers who wishing to learn about and work in these fields.

The recent advent of micro-electro-mechanical systems has increased the demand for localized energy harvesting. The autonomous gadgets, structural health monitoring sensors, wireless sensors, and pacemakers are all paving their ways in our lives. These electronic devices demand innovative ways of powering them effectively and efficiently. Various ambient excitations can be used from the environment like base or aeroelastic. For converting this wasted mechanical energy, several transduction mechanisms are employed, like piezoelectric, electromagnetic, and electrostatic. This dissertation is a step forward in meeting the localized energy demand for operating low-power electronic devices by using a hybrid formation of piezoelectric material and electromagnet-coil arrangement for harnessing aeroelastic oscillations. Therefore in the first part of this dissertation, this hybrid configuration is utilized to discuss energy harvesting by a cantilever beam and prismatic-shaped cylinder subjected to wind flow from transverse direction, by using a special class of aeroelastic oscillations known as galloping. After establishing the importance of accurate modeling of aeroeolastic galloping force, we proceed on to discuss about hybrid energy harvesting. The inclined square section cylinders are investigated to harvest aeroelastic energy offered by galloping oscillations using accurate modeling proposed in the first part, again by using a hybrid configuration. The last part of harvesting energy by galloping oscillation using a hybrid transduction mechanism deals with using the same cantilever based hybrid galloping harvester, but this time by inclusion of a non-rigid support exhibiting non-zero slope. The impact of such support on piezoelectric and electromagnetic energy harvesting is investigated in detail. The second part of this dissertation deals with using the same hybrid configuration for harnessing aeroelastic energy by using another, rather well-known class, named vortex-induced vibrations. The different tools of nonlinear dynamics and vibrations, such as Galerkin discretization, Normal form of Hopf bifurcation, and shooting method are used to dissect the hybrid energy harvesters in length throughout the Dissertation. It is concluded at the end that hybrid energy harvesters come with their own added shunt damping effects because of an additional transducer to a single functioning transducer, whether an added piezoelectric layer or an electromagnet-inductive coil. At the same time, careful selection of the electrical load resistances of respective piezoelectric and electromagnetic circuitries would interplay with each other, can help bring the overall coupled damping of hybrid formation to acceptable reduced levels. This careful selection can help replace a sole classical electromagnetic or piezoelectric harvester with a hybrid one which can power multiple electronic lower power gadgets.

This book introduces an innovative and high-efficiency technology for mechanical energy harvesting. The book covers the history and development of triboelectric nanogenerators, basic structures, working principles, performance characterization, and potential applications. It is divided into three parts: Part A illustrates the fundamental working modes of triboelectric nanogenerators with their prototype structures and theoretical analysis; Part B and Part C introduce two categories of applications, namely self-powered systems and self-powered active sensors. The book will be an ideal guide to scientists and engineers beginning to study triboelectric nanogenerators or wishing to deepen their knowledge of the field. Readers will be able to place the technical details about this technology in context, and acquire the necessary skills to reproduce the experimental setups for fabrication and measurement.

This book offers a comprehensive review of the state-of-the-art in innovative Beyond-CMOS nanodevices for developing novel functionalities, logic and memories dedicated to researchers, engineers and students. It particularly focuses on the interest of nanostructures and nanodevices (nanowires, small slope switches, 2D layers, nanostructured materials, etc.) for advanced More than Moore (RF-nanosensors-energy harvesters, on-chip electronic cooling, etc.) and Beyond-CMOS logic and memories applications.

Engineered Polymeric Fibrous Materials explains cutting edge techniques for the engineering of fibrous materials from physical, mechanical, and chemical points of view. Both conventional and nanofibers are described in this uniquely comprehensive book, for a wide range of applications including biomedical, automotive, aerospace, agriculture, energy, and environmental. This book refers to recent advances made in both academia and industry, in topics such as fiber-reinforced composites, fibrous thermal insulators, drug delivery and tissue engineering, and smart textiles and energy, and explains how fibrous structures are engineered to offer new solutions to important problems. The first two chapters provide basic introductory information to allow a wider range of readers to engage with the book. Addresses hot emerging topics including smart materials, wearable energy harvesters, and solar fuel production Includes valuable technical advice that is useful to industries including aerospace, biomedical, and energy Covers the full lifecycle of the material, from processing and treatment through to end usage

This book offers the first comprehensive view on integrated circuit and system design for the Internet of Things (IoT), and in particular for the tiny nodes at its edge. The authors provide a fresh perspective on how the IoT will evolve based on recent and foreseeable trends in the semiconductor industry, highlighting the key challenges, as well as the opportunities for circuit and system innovation to address them. This book describes what the IoT really means from the design point of view, and how the constraints imposed by applications translate into integrated circuit requirements and design guidelines. Chapter contributions equally come from industry and academia. After providing a system perspective on IoT nodes, this book focuses on state-of-the-art design techniques for IoT applications, encompassing the fundamental sub-systems encountered in Systems on Chip for IoT: ultra-low power digital architectures and circuits low- and zero-leakage memories (including emerging technologies) circuits for hardware security and authentication System on Chip design methodologies on-chip power management and energy harvesting ultra-low power analog interfaces and analog-digital conversion short-range radios miniaturized battery technologies packaging and assembly of IoT integrated systems (on silicon and non-silicon substrates). As a common thread, all chapters conclude with a prospective view on the

foreseeable evolution of the related technologies for IoT. The concepts developed throughout the book are exemplified by two IoT node system demonstrations from industry. The unique balance between breadth and depth of this book: enables expert readers quickly to develop an understanding of the specific challenges and state-of-the-art solutions for IoT, as well as their evolution in the foreseeable future provides non-experts with a comprehensive introduction to integrated circuit design for IoT, and serves as an excellent starting point for further learning, thanks to the broad coverage of topics and selected references makes it very well suited for practicing engineers and scientists working in the hardware and chip design for IoT, and as textbook for senior undergraduate, graduate and postgraduate students (familiar with analog and digital circuits).

Shock & Vibration, Aircraft/Aerospace, Energy Harvesting, Volume 9: Proceedings of the 33rd IMAC, A Conference and Exposition on Structural Dynamics, 2015, the ninth volume of ten from the Conference brings together contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of Shock & Vibration, Aircraft/Aerospace , Energy Harvesting, including papers on: Energy Harvesting Adaptive Support Shock Calibration Operating Data Applications

Piezoelectric Aeroelastic Energy Harvesting explains the design and implementation of piezoelectric energy harvesting devices based on fluid-structure interaction. There is currently an increase in demand for low power electronic instruments in a range of settings, and recent advances have driven their energy consumption downwards. As a result, the possibility to extract energy from an operational environment is of growing significance to industry and academic research globally. This book solves problems related to the integration of smart structures with the aeroelastic system, addresses the importance of the aerodynamic model on accurate prediction of the performance of the energy harvester, describes the overall effect of the piezoelectric patch on the dynamics of the system, and explains different mechanisms for harvesting energy via fluid-structure interaction. This wealth of innovative technical information is supported by introductory chapters on piezoelectric materials, energy harvesting and circuits, and fluid structure interaction, opening this interdisciplinary topic up for readers with a range of backgrounds. Provides new designs of piezoelectric energy harvesters for fluid-structure interaction Explains how to correctly model aerodynamics for effective aeroelastic energy harvesting Numerical examples allow the reader to practice the design, modeling and implementation of piezoelectric energy harvesting devices

A thorough treatment of the principles, applications and system integration of energy harvesting technology.

The scope of the conference will be on Electronics Circuits and Systems

This book consists of selected and peer-reviewed papers presented at the 13th International Conference on Vibration Problems (ICOVP 2017). The topics covered in this book are broadly related to the fields of structural health monitoring, vibration control and rotor dynamics. In the structural health monitoring section studies on nonlinear dynamic analysis, damage identification, viscoelastic model of concrete, and seismic damage assessment are thoroughly discussed with analytical and numerical techniques. The vibration control part includes topics such as multi-storeyed stacked tuned mass dampers, vibration isolation with elastomeric mounts, and nonlinear active vibration absorber. This book will be useful for beginners, researchers and professionals interested in the field of vibration control, structural health monitoring and rotor dynamics.

Organic Ferroelectric Materials and Applications aims to bring an up-to date account of the field with discussion of recent findings. This book presents an interdisciplinary resource for scientists from both academia and industry on the science and applications of molecular organic piezo- and ferroelectric materials. The book addresses the fundamental science of ferroelectric polymers, molecular crystals, supramolecular networks, and other key and emerging organic materials systems. It touches on important processing and characterization methods and provides an overview of current and emerging applications of organic piezoelectrics and ferroelectrics for electronics, sensors, energy harvesting, and biomedical technologies. Organic Ferroelectric Materials and Applications will be of special interest to those in academia or industry working in materials science, engineering, chemistry, and physics. Provides an overview of key physical properties of the emerging piezoelectric and ferroelectric molecular and supramolecular systems Discusses best practices of processing, patterning, and characterization methods and techniques Addresses current and emerging applications for electronics, materials development, sensors, energy harvesting, and biomedical technologies

Seeking renewable and clean energies is essential for releasing the heavy reliance on mineral-based energy and remedying the threat of global warming to our environment. In the last decade, explosive growth in research and development efforts devoted to microelectromechanical systems (MEMS) technology and nanowires-related nanotechnology have paved a great foundation for new mechanisms of harvesting mechanical energy at the micro/nano-meter scale. MEMS-based inertial sensors have been the enabler for numerous applications associated with smart phones, tablets, and mobile electronics. This is a valuable reference for all those faced with the challenging problems created by the ever-increasing interest in MEMS and nanotechnology-based energy harvesters and their applications. This book presents fundamental physics, theoretical design, and method of modeling for four mainstream energy harvesting mechanisms -- piezoelectric, electromagnetic, electrostatic, and triboelectric. Readers are provided with a comprehensive technical review and historical view of each mechanism. The authors also present current challenges in energy harvesting technology, technical reviews, design requirements, case studies, along with unique and representative examples of energy harvester applications.

This volume surveys recent research on autonomous sensor networks from the perspective of enabling technologies that support medical, environmental and military applications. State of the art, as well as emerging concepts in wireless sensor networks, body area networks and ambient assisted living introduce the reader to the field, while subsequent chapters deal in depth with established and related technologies, which render their implementation possible. These range from smart textiles and printed electronic devices to implanted devices and specialized packaging, including the most relevant technological features. The last four chapters are devoted to customization, implementation difficulties and outlook for these technologies in specific applications.

Wind Turbines and Aerodynamics Energy Harvesters not only presents the most research-focused resource on aerodynamic energy harvesters, but also provides a detailed review on aeroacoustics characteristics. The book considers all developing aspects of 3D printed miniature and large-size Savonious wind harvesters, while also introducing and discussing bladeless and aeroelastic harvesters. Following with a review of Off-shore wind turbine aerodynamics modeling and measurements, the book continues the discussion by comparing the numerical codes for floating offshore wind turbines. Each chapter contains a detailed analysis and numerical and experimental case studies that consider recent research design, developments, and their application in practice. Written by an experienced, international team in this cross-disciplinary field, the book is an invaluable reference for wind power engineers, technicians and manufacturers, as well as researchers examining one of the most promising and efficient sources of renewable energy. Offers numerical models and case studies by experienced authors in this field Contains an overview and analysis of the latest research Explores 3D printing technology and the production of wind harvesters for real applications Includes, and uses, ANSYS FLUENT case files

This book contains chapters that discuss numerous methods and techniques in energy harvesting. Both theoretical and experimental results are presented from investigations that were carried out in the various chapters. Well-grounding methods and techniques presented in the new areas provide a good head start not only to those with interest in energy harvesting but also to experienced researchers who

may want to look at energy harvesting from different angles. The concepts of energy harvesting are well articulated in the introduction of each chapter. It is my sincere hope that the readers of this book will find it a useful fountain of knowledge in energy harvesting.

Energy Harvesting Technologies provides a cohesive overview of the fundamentals and current developments in the field of energy harvesting. In a well-organized structure, this volume discusses basic principles for the design and fabrication of bulk and MEMS based vibration energy systems, theory and design rules required for fabrication of efficient electronics, in addition to recent findings in thermoelectric energy harvesting systems. Combining leading research from both academia and industry onto a single platform, Energy Harvesting Technologies serves as an important reference for researchers and engineers involved with power sources, sensor networks and smart materials.

The book starts with the fundamentals of triboelectric nanogenerators (TENGs), and continues through to fabrication technologies to achieve flexible and stretchable. Then self-powered flexible microsystems are introduced and application examples are presented, including TENG-based active sensors, TENG-powered actuators, artificial intelligence and integrated systems.

Energy Harvesting Autonomous Sensor Systems: Design, Analysis, and Practical Implementation provides a wide range of coverage of various energy harvesting techniques to enable the development of a truly self-autonomous and sustainable energy harvesting wireless sensor network (EH-WSN). It supplies a practical overview of the entire EH-WSN system from energy source all the way to energy usage by wireless sensor nodes/network. After an in-depth review of existing energy harvesting research thus far, the book focuses on: Outlines two wind energy harvesting (WEH) approaches, one using a wind turbine generator and one a piezoelectric wind energy harvester Covers thermal energy harvesting (TEH) from ambient heat sources with low temperature differences Presents two types of piezoelectric-based vibration energy harvesting systems to harvest impact or impulse forces from a human pressing a button or switch action Examines hybrid energy harvesting approaches that augment the reliability of the wireless sensor node’s operation Discusses a hybrid wind and solar energy harvesting scheme to simultaneously use both energy sources and therefore extend the lifetime of the wireless sensor node Explores a hybrid of indoor ambient light and TEH scheme that uses only one power management circuit to condition the combined output power harvested from both energy sources Although the author focuses on small-scale energy harvesting, the systems discussed can be upsized to large-scale renewable energy harvesting systems. The book goes beyond theory to explore practical applications that not only solve real-life energy issues but pave the way for future work in this area.

Wireless Power Transfer (WPT) is considered to be an innovative game changing technology. The same radio wave and electromagnetic field theory and technology for wireless communication and remote sensing is applied for WPT. In conventional wireless communication systems, information is "carried" on a radio wave and is then transmitted over a distance. In WPT however, the energy of the radio wave itself is transmitted over a distance. Wireless communication technology has proven to be extremely useful, however in future it should be even more useful to apply both wireless communication and wireless power technologies together. There are various WPT technologies, e.g. inductive near field WPT, resonance coupling WPT, WPT via radio waves, and laser power transfer. Recent Wireless Power Transfer Technologies via Radio Waves focusses on recent technologies and applications of the WPT via radio waves in far field. The book also covers the history, and future, of WPT via radio waves, as well as safety, EMC and coexistence of radio waves for WPT. Technical topics discussed in the book include: Radio Wave GenerationRadio Wave Amplification with Solid States Circuit and Microwave TubesAntenna and Beam Forming TechnologiesRadio Wave Conversion/Rectification to ElectricityBattery-less Sensor Applications toward Internet of Things (IoT)Solar Power Satellite ApplicationSafety, EMC, Coexistence of Radio Waves for the WPT WPT is an old technology based on the basic theory of radio waves, however WPT is also a state-of-the-art technology for the latest applications in IoT, sensor networks, wireless chargers for mobile phones, and solar power satellite. The theory behind these technologies, as well as applications, are explained in this book.

Also called energy scavenging, energy harvesting captures, stores, and uses "clean" energy sources by employing interfaces, storage devices, and other units. Unlike conventional electric power generation systems, renewable energy harvesting does not use fossil fuels and the generation units can be decentralized, thereby significantly reducing transmission and distribution losses. But advanced technical methods must be developed to increase the efficiency of devices in harvesting energy from environmentally friendly, "green" resources and converting them into electrical energy. Recognizing this need, Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems describes various energy harvesting technologies, different topologies, and many types of power electronic interfaces for stand-alone utilization or grid connection of energy harvesting applications. Along with providing all the necessary concepts and theoretical background, the authors develop simulation models throughout the text to build a practical understanding of system analysis and modeling. With a focus on solar energy, the first chapter discusses the I?V characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, sun tracking systems, maximum power point tracking systems, shading effects, and power electronic interfaces for grid-connected and stand-alone PV systems. It also presents sizing criteria for applications and modern solar energy applications, including residential, vehicular, naval, and space applications. The next chapter reviews different types of wind turbines and electrical machines as well as various power electronic interfaces. After explaining the energy generation technologies, optimal operation principles, and possible utilization techniques of ocean tidal energy harvesting, the book explores near- and offshore approaches for harvesting the kinetic and potential energy of ocean waves. It also describes the required absorber, turbine, and generator types, along with the power electronic interfaces for grid connection and commercialized ocean wave energy conversion applications. The final chapter deals with closed, open, and hybrid-cycle ocean thermal energy conversion systems.

This new edition of our 2016 book provides insight into designing intelligent materials and structures for special application in engineering. Literature is updated throughout and a new chapter on optics fibers has been added. The book discusses simulation and experimental determination of physical material properties, such as piezoelectric effects, shape memory, electro-rheology, and distributed control for vibrations minimization.

This unique resource provides a detailed understanding of the options for harvesting energy from localized, renewable sources to supply power to autonomous wireless systems. You are introduced to a variety of types of autonomous system and wireless networks and discover the capabilities of existing battery-based solutions, RF solutions, and fuel cells. The book focuses on the most promising harvesting techniques, including solar, kinetic, and thermal energy. You also learn the implications of the energy harvesting techniques on the design of the power management electronics in a system. This in-depth reference discusses each energy harvesting approach in detail, comparing and

contrasting its potential in the field.

As sources of energy are becoming more scarce and expensive, energy harvesting is receiving more global interest and is currently a growing field. Energy harvesting is the process of converting ambient energy, such as vibration, to electrical energy that can power a multitude of applications. Vibration energy is the by-product of everyday life; it is generated from any perceivable activity. While typically viewed as noise, there is a strong potential for harvesting this energy and deploying it to useful applications. The focus of this thesis will be using vibration as the ambient source of energy. Hybrid energy harvesters employ more than one of the harvesting technologies. In this thesis, two hybrid harvesters that utilize piezoelectric, magnetostrictive, and electromagnetic technologies are designed, modelled, and tested. Both of these harvesters have beams that are spiral in shape. The use of the spiral geometry allows the system to have a lower natural frequency as opposed to the traditional cantilever beam, while still maintaining a high volume of active material. The first harvester that is discussed is the P-MSM harvester. It utilizes piezoelectric and magnetostrictive material. Both materials are configured in a spiral beam geometry and allowed to resonate independently. The resonance frequency of these two materials is designed to create wideband energy harvesting. This allows the harvester to be operating efficiently even if the ambient vibration shifts a small amount. The second harvester that is discussed is the P-MAG harvester. It utilizes piezoelectric and electromagnetic technologies. It also incorporates a spiral geometry for the piezoelectric layers and includes a magnet attached at the centre. The magnet is placed in the centre of the spiral to reduce the natural frequency of the system and to also actively contribute to the harvesting. This harvester has two sources operating at the same resonant frequency, which allows it to have a larger power output than if the sources were separated. Finally, finite element analysis was used to model both harvesters. ANSYS was used for the piezoelectric material and COMSOL was used for the electromagnetic material. The results are compared to the experimental and are in good agreement.

The transformation of vibrations into electric energy through the use of piezoelectric devices is an exciting and rapidly developing area of research with a widening range of applications constantly materialising. With Piezoelectric Energy Harvesting, world-leading researchers provide a timely and comprehensive coverage of the electromechanical modelling and applications of piezoelectric energy harvesters. They present principal modelling approaches, synthesizing fundamental material related to mechanical, aerospace, civil, electrical and materials engineering disciplines for vibration-based energy harvesting using piezoelectric transduction. Piezoelectric Energy Harvesting provides the first comprehensive treatment of distributed-parameter electromechanical modelling for piezoelectric energy harvesting with extensive case studies including experimental validations, and is the first book to address modelling of various forms of excitation in piezoelectric energy harvesting, ranging from airflow excitation to moving loads, thus ensuring its relevance to engineers in fields as disparate as aerospace engineering and civil engineering. Coverage includes: Analytical and approximate analytical distributed-parameter electromechanical models with illustrative theoretical case studies as well as extensive experimental validations Several problems of piezoelectric energy harvesting ranging from simple harmonic excitation to random vibrations Details of introducing and modelling piezoelectric coupling for various problems Modelling and exploiting nonlinear dynamics for performance enhancement, supported with experimental verifications Applications ranging from moving load excitation of slender bridges to airflow excitation of aeroelastic sections A review of standard nonlinear energy harvesting circuits with modelling aspects.

Hybrid Energy Systems: Strategy for Industrial Decarbonization demonstrates how hybrid energy and processes can decarbonize energy industry needs for power and heating and cooling. It describes the role of hybrid energy and processes in nine major industry sectors and discusses how hybrid energy can offer sustainable solutions in each. Introduces the basics and examples of hybrid energy systems Examines hybrid energy and processes in coal, oil and gas, nuclear, building, vehicle, manufacturing and industrial processes, computing and portable electronic, district heating and cooling, and water sectors Shows that hybrid processes can improve efficiency and that hybrid energy can effectively insert renewable fuels in the energy industry Serves as a companion text to the author’s book Hybrid Power: Generation, Storage, and Grids Written for advanced students, researchers, and industry professionals involved in energy-related processes and plants, this book offers latest research and practical strategies for application of the innovative field of hybrid energy.

With its inclusion of the fundamentals, systems and applications, this reference provides readers with the basics of micro energy conversion along with expert knowledge on system electronics and real-life microdevices. The authors address different aspects of energy harvesting at the micro scale with a focus on miniaturized and microfabricated devices. Along the way they provide an overview of the field by compiling knowledge on the design, materials development, device realization and aspects of system integration, covering emerging technologies, as well as applications in power management, energy storage, medicine and low-power system electronics. In addition, they survey the energy harvesting principles based on chemical, thermal, mechanical, as well as hybrid and nanotechnology approaches. In unparalleled detail this volume presents the complete picture -- and a peek into the future -- of micro-powered microsystems.

This book is a printed edition of the Special Issue "Piezoelectric MEMS" that was published in Micromachines

Wireless sensors and sensor networks (WSNs) are nowadays becoming increasingly important due to their decisive advantages. Different trends towards the Internet of Things (IoT), Industry 4.0 and 5G Networks address massive sensing and admit to have wireless sensors delivering measurement data directly to the Web in a reliable and easy manner. These sensors can only be supported, if sufficient energy efficiency and flexible solutions are developed for energy-aware wireless sensor nodes. In the last years, different possibilities for energy harvesting have been investigated showing a high level of maturity. This book gives therefore an overview on fundamentals and techniques for energy harvesting and energy transfer from different points of view.

Different techniques and methods for energy transfer, management and energy saving on network level are reported together with selected interesting applications. The book is interesting for researchers, developers and students in the field of sensors, wireless sensors, WSNs, IoT and manifold application fields using related technologies. The book is organized in four major parts. The first part of the book introduces essential fundamentals and methods, while the second part focusses on vibration converters and hybridization. The third part is dedicated to wireless energy transfer, including both RF and inductive energy transfer. Finally, the fourth part of the book treats energy saving and management strategies. The main contents are: Essential fundamentals and methods of wireless sensors Energy harvesting from vibration Hybrid vibration energy converters Electromagnetic transducers Piezoelectric transducers Magneto-electric transducers Non-linear broadband converters Energy transfer via magnetic fields RF energy transfer Energy saving techniques Energy management strategies Energy management on network level Applications in agriculture Applications in structural health monitoring Application in power grids Prof. Dr. Olfa Kanoun is professor for measurement and sensor technology at Chemnitz university of technology. She is specialist in the field of sensors and sensor systems design.

Energy harvesting refers to the process by which energy is extracted from vast sources and stored for use by low-energy devices. The subjects discussed in this book that address the various aspects which fall under this field are energy conversion and storage, designing energy efficient systems, developing advanced technologies for enhancing extraction of renewable energy, etc. As this field is emerging at a rapid pace, the contents of this book will help the readers understand the modern concepts and applications of the subject. It will prove to be an invaluable resource for academicians and professionals alike.

This timely new resource explores the available energy sources within commercial and residential buildings and the available technologies for energy harvesting. Energy harvesting within built environments is presented using strong research and commercial examples. This book includes clear and concise case studies on solar cell powered sensor nodes for emotion monitoring systems in ambient assistive living environments and inductive/RF power transfers. Thermoelectric energy harvesting and power management circuit design, airflow and vibration energy harvesting is also explored. The book concludes with a look at the future of energy harvesting in buildings.

Frequency Analysis of Vibration Energy Harvesting Systems aims to present unique frequency response methods for analyzing and improving vibration energy harvesting systems. Vibration energy is usually converted into heat energy, which is transferred to and wasted in the environment. If this vibration energy can be converted into useful electric energy, both the performance and energy efficiency of machines, vehicles, and structures will be improved, and new opportunities will open up for powering electronic devices. To make use of ambient vibration energy, an effective analysis and design method is established and developed in this book. The book covers a wide range of frequency response analysis methods and includes details of a variety of real-life applications. MATLAB programming is introduced in the first two chapters and used in selected methods throughout the book. Using the methods studied, readers will learn how to analyze and optimize the efficiency of vibration energy systems. This book will be ideal for postgraduate students and researchers in mechanical and energy engineering. Covers a variety of frequency response analysis methods, including Fourier and Laplace transform, transfer function, integration and state space for piezoelectric and electromagnetic vibration energy harvesting analysis Provides coverage of new and traditional methods of analyzing and optimizing the power and efficiency of vibration energy harvesting systems, with MATLAB exercises provided throughout Demonstrates a wide range of real-life applications, such as ocean wave energy conversion, vehicle suspension vibration energy harvesting, and more

This book provides a thorough guide to the use of numerical methods in energy systems and applications. It presents methods for analysing engineering applications for energy systems, discussing finite difference, finite element, and other advanced numerical methods. Solutions to technical problems relating the application of these methods to energy systems are also thoroughly explored. Readers will discover diverse perspectives of the contributing authors and extensive discussions of issues including: • a wide variety of numerical methods concepts and related energy systems applications;• systems equations and optimization, partial differential equations, and finite difference method;• methods for solving nonlinear equations, special methods, and their mathematical implementation in multi-energy sources;• numerical investigations of electrochemical fields and devices; and• issues related to numerical approaches and optimal integration of energy consumption. This is a highly informative and carefully presented book, providing scientific and academic insight for readers with an interest in numerical methods and energy systems.