Energy Harvesting Autonomous Sensor Systems - Yen Kheng Tan 2017-12-19

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 sources to the 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.

Powering Autonomous Sensors - María Teresa Penella-López 2011-05-18

Autonomous sensors transmit data and power their electronics without using cables. They can be found in e.g. wireless sensor networks (WSNs) or remote acquisition systems. Although primary batteries provide a simple design for powering autonomous sensors, they present several limitations such as limited capacity and power density, and difficulty in predicting their condition and state of charge. An alternative is to extract energy from the environment (energy harvesting). However, the reduced dimensions of most autonomous sensors lead to a low level of available power from the energy transducer. Thus, efficient methods and circuits to manage and gather the energy are a must. An integral approach for powering autonomous sensors by considering both primary batteries and energy harvesters is presented. Two rather different forms of energy harvesting are also dealt with: optical (or solar) and radiofrequency (RF). Optical energy provides high energy density, especially outdoors, whereas RF remote powering is possibly the most feasible option for autonomous sensors embedded into the soil or within structures. Throughout different chapters, devices such as primary and secondary batteries, supercapacitors, and energy transducers are extensively reviewed. Then, circuits and methods found in the literature used to efficiently extract and gather the energy are presented. Finally, new proposals based on the authors' own research are analyzed and tested. Every chapter is written to be rather independent, with each incorporating the relevant literature references. Powering Autonomous Sensors is intended for a wide audience working on or interested in the powering of autonomous sensors. Researchers and engineers can find a broad introduction to basic topics in this interesting and emerging area as well as further insights on the topics of solar and RF harvesting and of circuits and methods to maximize the power extracted from energy transducers.


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.

Energy Harvesting for Low-power Autonomous Devices and Systems - Jahanpir Rastegar 2017

This book is an introductory text describing methods of harvesting electrical energy from mechanical potential and kinetic energy. The book focuses on the methods of transferring mechanical energy to energy conversion transducers of various types, including piezoelectric, electromagnetic, electrostatic, and magnetostriuctive transducers. Methods that have been developed for collecting, conditioning, and delivering the generated electrical energy to a load, as well as their potential use as self-powered sensors are described. The book should be of interest to those who want to know the potentials as well as shortcomings of energy harvesting technology. The book is particularly useful for energy harvesting system designers as it provides a systematic approach to the selection of the proper transduction mechanisms and methods of interfacing with a host system and electrical energy collection and conditioning options. An extensive bibliography is provided to direct the reader to appropriate references for detailed material not included in the book.

ICT - Energy Concepts for Energy Efficiency and Sustainability - Giorgos Fagas 2017-03-22

In a previous volume (ICT-Energy-Concepts Towards Zero-Power ICT, referenced below as Vol. 1), we addressed some of the fundamentals related to bridging the gap between the amount of energy required to operate portable/mobile ICT systems and the amount of energy available from ambient sources. The only viable solution appears to be to attack the gap from both sides, i.e. to reduce the amount of energy dissipated during computation and to improve the efficiency in energy-harvesting technologies. In this book, we build on those concepts and continue the discussion on energy efficiency and sustainability by addressing the minimisation of energy consumption at different levels across the ICT system stack, from hardware to software, as well as discussing energy consumption issues in high-performance computing (HPC), data centres and communication in sensor networks. This book was realised thanks to the contribution of the project ‘Coordinating Research Efforts of the ICT-Energy Community’ funded by the European Union under the Future and Emerging Technologies (FET) area of the Seventh Framework Programme for Research and Technological Development (grant agreement n. 611004).

Energy Harvesting Systems - Tom J. Kazmierski 2010-11-01

Kinetic energy harvesting converts movement or vibrations into electrical energy, enables battery free operation of wireless sensors and autonomous devices and facilitates their placement in locations where replacing a battery is not feasible or attractive. This book provides an introduction to operating principles and design methods of modern kinetic energy harvesting systems and explains the implications of harvested power on autonomous electronic systems design. It describes power conditioning circuits that maximize available energy and electronic systems design strategies that minimize power consumption and enable operation. The principles discussed in the book will be supported by real case studies such as battery-less monitoring sensors at water waste processing plants, embedded battery-less sensors in automotive electronics and sensor-networks built with ultra-low power wireless nodes suitable for battery-less applications.
Energy Harvesting for Wireless Sensor Networks—Olfa Kanoun 2018-11-19 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 sensor nodes. 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 focuses on vibration converters and hybrid systems. 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 Magnetostrictive transducers Non-linear 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 Autonomous Sensor Systems—Yen Kheng Tan 2017-12-19 Energy Harvesting Autonomous Sensor Systems: Design, Analysis, and Practical Implementation provides a comprehensive overview of various energy harvesting techniques to enable the development of a truly self-sustainable and autonomous 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 the latest technologies for energy harvesting and energy transfer to autonomous wireless sensor systems 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 energy level are related 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.

Autonomous Sensor Networks—Daniel Filippini 2012-11-27 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.

CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications—Carlos Manuel Ferreira Carvalho 2015-07-30 This book discusses in detail the CMOS implementation of energy harvesting. The authors describe an integrated, indoor light energy harvesting system based on a controller circuit that dynamically and automatically adjusts its operation to meet the actual light circumstances of the environment where the system is placed. The system is intended to power a sensor node, enabling an autonomous wireless sensor network (WSN). Although designed to cope with indoor light levels, the system is also able to work with higher levels, making it an all-round light energy harvesting system. The discussion includes experimental data obtained from an integrated manufactured prototype, which in conjunction with a photovoltaic (PV) cell, serves as a proof of concept of the desired energy harvesting system.

Micro Energy Harvesting—Daniil Briand 2015-06-22 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.

Innovative Energy Harvesting Technology for Wireless Bridge Monitoring Systems—Jason Michael Weaver 2011 Energy harvesting is a promising and evolving field of research capable of supplying power to systems in a broad range of applications. In particular, the ability to gather energy directly from the environment without human intervention makes energy harvesting an excellent option for powering autonomous sensors in remote or hazardous locations. This dissertation examines the possibility of using energy harvesting to extend the lifetime of sensor nodes placed in the substructures of highway bridges for structural health monitoring. Estimates for power requirements are established, using a wireless sensor node from National Instruments as an example system. Available power in a bridge environment is calculated for different energy sources, including solar radiation, wind, and vibration from traffic. Feasibility of using energy harvesting in such an application is addressed for both power availability and cost as compared with grid power or primary batteries. An in-depth functional analysis of existing energy-harvesting systems is also presented, with insights into where innovation would be most beneficial in future systems. Finally, the development of a suite of
complementary energy-harvesting devices is described. Because conditions on bridges may vary, multiple solutions involving different energy domains are considered, with the goal of being able to select the harvester most appropriate for the specific installation. Concept generation techniques such as mind-mapping and 6-3-5 (C-Sketch) are used to produce a wide variety of concepts, from which several promising concept variants are selected. The continued development for one concept, which harvests vibration using piezoelectric materials, is described. Analytical modeling is presented for static and dynamic loading, as well as predicted power generation. Two proof-of-concept prototypes are built and tested in laboratory conditions. Through the development of this prototype, it is shown that the example wireless sensor node can successfully be powered through energy harvesting, and insights are shared concerning the situations where this and other energy harvesters would be most appropriate.

### The Role of Energy Reservoirs in Distributed Computing

Martin A. Cowell 2017 The world already hosts more internet connected devices than people, and that number is only increasing. These devices seamlessly integrate with peoples lives to collect rich data and give immediate feedback about complex systems from business, health care, transportation, and security. As every aspect of global economies integrate distributed computing into their industrial systems and these systems benefit from rich datasets. Managing the power demands of these distributed computers will be paramount to ensuring sustained operational efficiency of these networks. This incision is elegantly addressed by including local energy harvesting and storage on a per-node basis. By replacing non-rechargeable batteries with energy harvesting, wireless sensor nodes will increase their lifetimes by an order of magnitude. This work investigates the coupling of high power energy storage with energy harvesting technologies to power wireless sensor nodes, with sections covering device manufacturing, system integration, and mathematical modeling. First we consider the energy storage mechanism of supercapacitors and batteries, and identify favorable characteristics in both reservoir types. We then discuss experimental methods used to manufacture high power supercapacitors in our labs. We go on to detail the design, fabrication, testing, and incorporation into our system of devices such as primary supercapacitors to aid in component architecture optimization. We then model the operation of these sensor nodes for the purpose of optimally sizing the energy harvesting and energy reservoir components. In consideration of deploying these sensor nodes in real-world environments, we model the operation of our energy harvesting and power management systems subject to spatially and temporally varying energy availability in order to understand the tradeoffs involved. Based on our observations, we see an opportunity for further research to implement machine learning algorithms to control the energy resources of distributed computing networks.

### Piezoelectric Energy Harvesting

Alper Erturk 2011-04-24 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 and synthesizing fundamental knowledge from physics, 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 the experimental validation of simulations, and in-depth analysis of 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.

### Energy Scavenging for Wireless Sensor Networks

Shad Roundy 2012-12-06 The vast reduction in size and power consumption of CMOS circuitry has led to a large research effort based around the vision of wireless sensor networks. In this book, the proposed network will be comprised of tens of thousands of small wireless nodes that operate in a multi-hop fashion, replacing long transmission distances with many low power, low cost wireless devices. The result will be the creation of an intelligent environment responding to its inhabitants and ambient conditions. Wireless devices currently being designed and built for use in such environments typically run on batteries. However, as the number of these devices increases in number and the devices decrease in size, the replacement of depleted batteries will not be practical. The cost of replacing batteries in a few devices that make up a small network about once per year is modest. However, the cost of replacing thousands of devices in a single building annually, some of which are in areas difficult to access, is simply not practical. Another approach would be to use a battery that is large enough to last the entire lifetime of the wireless sensor device. However, a battery large enough to last the lifetime of the device would dominate the overall system size and cost, and thus is not very attractive. Alternative methods of powering the devices that will make up the wireless networks are desperately needed.

### ENERGY HARVESTING SYSTEMS

Yen Kheng. Tan 2018

Powering Autonomous Sensors

María Teresa Penella-López 2011-05-27 Autonomous sensors transmit data and power their electronics without using cables. They can be found in e.g. wireless sensor networks (WSNs) or remote acquisition systems. Although primary batteries provide a simple design for powering autonomous sensors, they present several limitations such as limited capacity and power density, and difficulty in predicting their condition and state of charge. An alternative is to extract energy from the ambient (energy harvesting). However, the reduced dimensions of most autonomous sensors lead to a low level of available power from the energy transducer. Thus, efficient methods and circuits to manage and gather the energy are a must. An integral approach for powering autonomous sensors by considering both primary batteries and energy harvesters is presented. Two different forms of energy harvesting are also dealt with: optical (or solar) and radiofrequency (RF). Optical energy provides high energy density, especially outdoors, whereas RF remote powering is possibly the most feasible option for autonomous sensors embedded into the soil or within structures. Throughout different chapters, devices such as primary and secondary batteries, supercapacitors, and energy transducers are extensively reviewed. Then, circuits and methods found in the literature used to efficiently extract and gather the energy are presented. Finally, new proposals based on the authors’ own research are analyzed and tested. Every chapter is written to be rather independent, with each incorporating the relevant literature references. Powering Autonomous Sensors is intended for a wide audience, including students, researchers and engineers interested in the area of wireless sensor devices.

### Wireless Sensor Networks

Jun Zheng 2009-10-27 Learn the fundamental concepts, major challenges, and effective solutions in wireless sensor networking. This book provides a comprehensive and systematic introduction to the fundamental concepts, major challenges, and effective solutions in wireless sensor networking (WSN). Distinguished from other books, it focuses on the networking aspects of WSNs and covers the most important networking issues, including network architecture design, medium access control, routing and data dissemination, node clustering, node localization, query processing, data aggregation, transport and quality of service, time synchronization, network security, and sensor network standards. With contributions from internationally renowned researchers, Wireless Sensor Networks expertly strikes a balance between fundamental concepts and state-of-the-art technologies, providing readers with unprecedented insights into WSNs from a networking perspective. It is essential reading for a broad audience, including academic researchers, research engineers, and practitioners in industry. It is also suitable as a textbook or supplementary reading for electrical engineering, computer engineering, and computer science courses at the graduate level.

### Energy Harvesting

Tom J. Kazmierski 2010-11-10 Kinetic energy harvesting converts movement or vibrations into electrical energy, enables
battery free operation of wireless sensors and autonomous devices and facilitates their placement in locations where replacing a battery is not feasible or attractive. This book provides an introduction to operating principles and design methods of modern kinetic energy harvesting systems and explains the implications of harvested power on autonomous electronic systems design. It describes power conditioning circuits that maximize available energy and electronic systems design strategies that minimize power consumption and enable operation. The principles discussed in the book will be supported by real case studies from harvesting sensors at water waste processing plants, embedded battery-less sensors in automotive electronics and sensor-networks built with ultra-low power wireless nodes suitable for battery-less applications.

**Triboelectric Nanogenerators**

Zhong Lin Wang 2016-08-17 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.

**Design Considerations of Harvested-energy Management**

Mustafa Imran Ali 2012 Using energy harvesting for powering autonomous sensor systems can meet the goal of perpetual operation. However, the uncertainty in system supply coupled with the size constraints presents challenges in design of such systems. To address these challenges, this thesis is concerned with effective management of harvested-energy for matching supply and demand in order to operate perpetually with uniform performance. The thesis focuses on two fundamental design considerations in addressing these challenges: (i) managing variability of the energy harvesting source, and (ii) matching the demand with energy supply under the influence of non-ideal characteristics of the harvesting system. To address the problem of variability of energy source, the thesis focuses on effective prediction of harvested-energy. An effective approach toward increasing the accuracy of solar energy prediction algorithm is proposed and optimised values of prediction algorithm parameters are determined to minimise prediction error. The problem of achieving uniform performance under the supply variability is addressed by proposing a new prediction based energy management policy. The results of the proposed policy are compared with other recently reported policies and it is shown that the proposed policy yields up to 41% lower variance in performance and 30% lower dead time of the system, which is important to achieve the goal of perpetual operation. To address the problem of effective matching of supply and demand, the thesis considers the design of photovoltaic energy harvesting supply and storage subsystem in terms of its component's non-ideal characteristics. The influence of these characteristics on supply and demand is identified using modeling of losses and component interdependencies, and empirically validated using a reference system design. Using the proposed modeling, the performance of recently reported energy management policies is evaluated to show that these are ineffective in achieving the goal of perpetual operation, and optimisations are proposed to address this.

**Healthcare Sensor Networks**

Daniel Tze Huei Lai 2016-04-19 Healthcare sensor networks (HSNs) now offer the possibility to continuously monitor human activity and physiological signals in a mobile environment. Such sensor networks may be able to reduce the strain on the present healthcare workforce by providing new autonomous monitoring services ranging from simple user-reminder systems to more advanced monitoring systems. Different electromagnetic coupling architectures have been employed but no comprehensive comparison with respect to their output performance has been carried out up to now. Electromagnetic Vibration Energy Harvesting Devices targets the designer of electromagnetic vibration transducers who wishes to have a greater in-depth understanding for maximizing the output performance.

**Energy Harvesting Technologies**

Shashank Priya 2008-11-28 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 of piezoelectrics for 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.

**Renewable Energy**

Wenping Cao 2016-05-11 The development of renewable energy technologies (such as wind, solar, and biomass) has accelerated the establishment of a low-carbon society. This book provides a glimpse of some recent advancements in modelling, control, electrical generators and power converters, focusing on efficiency, reliability and environmental aspects of these technologies utilising these renewable sources of energy. It is aimed to provide some latest references for the readers who are interested in research work, energy policies, and social dimensions of renewable energy.

**Enabling the Internet of Things**

Massimo Alotto 2017-01-23 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 to integrate 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).

**SQUID Sensors**

H. Weinstock 2012-12-06 This book will be of value to anyone who wishes to consider the use of SQUID-based magnetic sensing for anyone of a number of practical applications. The focus here is to examine in detail how SQUID technology is used and how. The results of the measurements obtained can be interpreted to provide useful information in a variety of real-world applications. The concentration is on those areas that have received the most attention, namely biom—e.g., imaging and nondestructive evaluation, but, the topics chosen include as well, geophysics, underwater ordnance detection, accelerometry and a few somewhat more exotic applications. To provide a reasonable perspective. an attempt has been made to consider competing technologies for most applications, and in some cases to consider how SQUID-based technology may be integrated with other technologies to provide an optimum total-system configuration. It is also the intention of the editor, that this book will be of major value to those scientists and engineers who will be required to build both the essential components and complete cryogenic SQUID systems which will be utilized in the various applications presented. Thus, there is a comprehensive approach.
Wireless Power Transmission for Sustainable Electronics—Nuno Borges Carvalho 2020-03-04 Provides a collection of works produced by COST Action IC1301 with the goal of achieving significant advances in the field of wireless power transmission. This book constitutes together information from COST Action IC1301, a group of academic and industry experts seeking to align research efforts in the field of wireless power transmission (WPT). It begins with a discussion of backscattering as a solution for Internet of Things (IoT) devices and goes on to describe ambient backscattering sensors that use FM broadcasting for low-cost and low-power wireless applications. The book also explores localization of passive RFID tags and augmented tags using nonlinearities of RFID chips. It concludes with a review of methods of electromagnetic characterization of textile materials for the development of wearable antennas. Wireless Power Transmission for Sustainable Electronics: COST WP-E - IC1301 covers textile-supported wireless energy transfer, and reviews methods for the electromagnetic characterization of textile materials for the development of wearable antennas. It also looks at backscattering RFID sensor systems for remote health monitoring; simultaneous localization of (robots and objects) and mapping of autonomous vehicles. An overview of wireless power distribution for static and moving nodes of wireless sensor networks; and more. Presents techniques for smart beam-forming for “on demand” wireless power transmission (WPT). Discusses RF and microwave energy harvesting for space applications Describes miniaturized RFID transponders for object identification of sensing Wireless Power Transmission for Sustainable Electronics: COST WP-E - IC1301 is an essential resource for academic, and government research agencies developing new systems for sustainable materials for those fields.

Structural Health Monitoring (SHM) in Aerospace Structures—Pub-Gwo Yuan 2016-03-01 Structural Health Monitoring (SHM) in Aerospace Structures provides readers with the spectacular progress that has taken place over the last twenty years with respect to the area of Structural Health Monitoring (SHM). The widespread adoption of SHM could both significantly improve safety and reduce maintenance and repair expenses that are estimated to cost more than half of the aircraft fleet’s operating costs. The SHM field encompasses transdisciplinary areas, including smart materials, sensors and actuators, damage diagnosis and prognosis, signal and image processing algorithms, wireless intelligent sensing, data fusion, and energy harvesting. This book focuses on how SHM techniques are applied to aircraft structures with particular emphasis on composite materials, and is divided into four main parts: Part One provides an overview of SHM technologies for damage detection, diagnosis, and prognosis in aerospace structures. Part Two moves on to analyze smart materials for SHM in aerospace structures, such as piezoelectric materials, optical fibers, and flexoelectricity. In addition, this also includes two vibration-based energy harvesting techniques for powering wireless sensors based on piezoelectric electromechanical coupling and diamagnetic levitation. Part Three explores innovative SHM technologies for damage diagnosis in aerospace structures. Chapters within this section include sparse array imaging techniques and phase array techniques for damage detection. The final section of the volume details innovative SHM technologies for damage prognosis in aerospace structures. This book serves as a key reference for researchers working within this industry, academic, and government research agencies developing new systems for the SHM of aerospace structures and materials scientists. Provides key information on the potential of SHM in reducing maintenance and repair costs Analyzes current SHM technologies and sensing systems, highlighting the innovation in each area Encompasses chapters on smart materials such as electroactive polymers and optical fibers.

Structural Health Monitoring (SHM) in Aerospace Structures—Pub-Gwo Yuan 2016-03-01 Structural Health Monitoring (SHM) in Aerospace Structures provides readers with the spectacular progress that has taken place over the last twenty years with respect to the area of Structural Health Monitoring (SHM). The widespread adoption of SHM could both significantly improve safety and reduce maintenance and repair expenses that are estimated to cost more than half of the aircraft fleet’s operating costs. The SHM field encompasses transdisciplinary areas, including smart materials, sensors and actuators, damage diagnosis and prognosis, signal and image processing algorithms, wireless intelligent sensing, data fusion, and energy harvesting. This book focuses on how SHM techniques are applied to aircraft structures with particular emphasis on composite materials, and is divided into four main parts: Part One provides an overview of SHM technologies for damage detection, diagnosis, and prognosis in aerospace structures. Part Two moves on to analyze smart materials for SHM in aerospace structures, such as piezoelectric materials, optical fibers, and flexoelectricity. In addition, this also includes two vibration-based energy harvesting techniques for powering wireless sensors based on piezoelectric electromechanical coupling and diamagnetic levitation. Part Three explores innovative SHM technologies for damage diagnosis in aerospace structures. Chapters within this section include sparse array imaging techniques and phase array techniques for damage detection. The final section of the volume details innovative SHM technologies for damage prognosis in aerospace structures. This book serves as a key reference for researchers working within this industry, academic, and government research agencies developing new systems for the SHM of aerospace structures and materials scientists. Provides key information on the potential of SHM in reducing maintenance and repair costs Analyzes current SHM technologies and sensing systems, highlighting the innovation in each area Encompasses chapters on smart materials such as electroactive polymers and optical fibers.
Rechargeable Sensor Networks: Technology, Theory, and Application
Jiming Chen 2014-01-28

The harvesting of energy from ambient energy sources to power electronic devices has been recognized as a promising solution to the issue of powering the ever-growing number of mobile devices around us. Key technologies in the rapidly growing field of energy harvesting focus on developing solutions to capture an intermittent energy from the natural surrounding the mobile devices and convert it into usable electrical energy for the purpose of recharging said devices. Achieving a sustainable network lifetime via battery-aware designs brings forth a new frontier for energy optimization techniques. These techniques had, in their early stages, resulted in the development of low-power hardware designs. Today, they have evolved into power-aware designs and even battery-aware designs. This book covers recent results in the field of rechargeable sensor networks, including technologies and protocol designs to enable harvesting energy from alternative energy sources such as vibrations, temperature variations, wind, solar, and biochemical energy and passive human power. Contents: Wind Energy Harvesting for Recharging Wireless Sensor Nodes: Brief Review and a Case Study (Yen Kheng Tan, Bibin Zhu and Steve Beeby)Rechargeable Sensor Networks with Magnetic Resonant Coupling (Liguang Xie, Yi Shi, Y Thomas Hou, Wenjing Lou, Hanif D Sherali and Huaibei Zhou)Cross-Layer Resource Allocation in Energy-Harvesting Sensor Networks (Zhouchen Mao, C Emre Kocsal and Nesa B Shroff)Energy Harvesting Technique and Management for Wireless Sensor Networks (Jianhui Zhang and Xiangyang Li)Information Capacity of an AWGN Channel Powered by an Energy-Harvesting Source (R. Rajesh, P K Deekshith and Vinod Sharma)Energy Harvesting in Wireless Sensor Networks (Nathalie Milton and Riaan Wohlfuter)Topology Control for Wireless Sensor Networks and Ad Hoc Networks (Sahid Jardosh)An Evolutionary Game Approach for Rechargeable Sensor Networks (Majed Haddad, Eitan Altman, Dieter Fiems and Julien Gaillard)Marine Sediment Energy Harvesting for Sustainable Underwater Sensor Networks (Baikun Li, Lei Wang and Jun-Hong Cui)Wireless Rechargeable Sensor Networks in the Smart Grid (Melike Erol-Kantarci and Hussein T Moutah)Energy-Harvesting Methods for Medical Devices (Pedro Dinis Gaspar, Virginie Felizardo and Nuno M Garcia)Readership: Graduates, researchers, and professionals studying/dealing with networking, computer engineering, parallel computing, and electrical & electronic engineering. Keywords: Rechargeable Sensor; Energy Harvesting Technology; Renewable Sensor Networks Key Features: This book provides comprehensive coverage from hardware design, protocol design, to applications. This book provides very recent results. And this book has prominent contributors: With the increasing deterioration of global warming, energy harvesting technologies as a green source of energy are of great interest to the research community. For wireless networks especially wireless sensor networks, the introduction of energy harvesting technologies can address the challenge of energy constraint and obtain perpetual network operation. Although there are lots of existing publications on energy harvesting, most of them are journal and conference papers, which concentrate on specific research problems and do not provide a comprehensive overview and prerequisite preliminaries to understand the energy harvesting technologies. To the best of our knowledge, there are only a few books which are concerned with energy harvesting technologies. One main drawback of these books are that they all elaborate on the hardware design of energy harvesting devices but neglect the impact of hardware design on the performance of overall networks which is also of great significance in practice. For example, the energy management subsystem should be designed to fulfill all the tasks without running out of energy, which is dependent on the available energy of each node and all the tasks of the whole networks. Hence, the algorithm and protocol optimization are as important as hardware design. But this was not elaborated in existing publications and motivates this book.

Energy Harvesting and Energy Efficiency
Nicu Bizon 2017-03-09

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 knowledge 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 wish to learn about and work in these fields.

Piezoelectric Energy Harvesting
Mohammad Adnan Ilyas 2018-03-22

Environmental pollution has been one of the main challenges for sustainable development. Piezoelectric materials can be used as a means of transforming ambient vibrations into electrical energy to power devices. The focus is on an alternative approach to scavenge energy from the environment. This book presents harvesting methodologies to evaluate the potential effectiveness of different techniques and present an overview of the methods and challenges of harvesting energy using piezoelectric materials. Piezoelectric energy harvesters have many applications, including sensor nodes, wireless communication, microelectromechanical systems, hand held devices, and mobile devices. The book also presents a new approach within piezoelectric energy harvesting using the impact of raindrops. The energy-harvesting model presented is further analyzed for single-unit harvester and an array of multiple harvesters to maximize the efficiency of the device.

Sensor Technology: Concepts, Methodologies, Tools, and Applications
Management Association, Information Resources 2020-02-07

Collecting and processing data is a necessary aspect of living in a technologically advanced society. Whether it’s monitoring events, controlling different variables, or using decision-making applications, it is important to have a system that is both inexpensive and capable of coping with high amounts of data. As the application of these networks becomes more common, it becomes imperative to evaluate their effectiveness as well as other opportunities for possible implementation in the future. Sensor Technology: Concepts, Methodologies, Tools, and Applications is a vital reference source that brings together new ways to process and monitor data and to put it to work in everything from intelligent transportation systems to healthcare to multimedia applications. It also provides inclusive coverage on the processing and applications of wireless communication, sensor networks, and mobile computing. Highlighting a range of topics such as internet of things, signal processing hardware, and wireless sensor technologies, this multi-volume book is ideally designed for research and development engineers, IT specialists, developers, graduate students, academics, and researchers.