

Nanoelectronic Device Applications Handbook

An increasing number of technologies are being used to detect minute quantities of biomolecules and cells. However, it can be difficult to determine which technologies show the most promise for high-sensitivity and low-limit detection in different applications. Microfluidics and Nanotechnology: Biosensing to the Single Molecule Limit details proven approaches for the detection of single cells and even single molecules—approaches employed by the world’s foremost microfluidics and nanotechnology laboratories. While similar books concentrate only on microfluidics or nanotechnology, this book focuses on the combination of soft materials (elastomers and other polymers) with hard materials (semiconductors, metals, and glass) to form integrated detection systems for biological and chemical targets. It explores physical and chemical—as well as contact and noncontact—detection methods, using case studies to demonstrate system capabilities. Presenting a snapshot of the current state of the art, the text: Explains the theory behind different detection techniques, from mechanical resonators for detecting cell density to fiber-optic methods for detecting DNA hybridization, and beyond Examines microfluidic advances, including droplet microfluidics, digital microfluidics for manipulating droplets on the microscale, and more Highlights an array of technologies to allow for a comparison of the fundamental advantages and challenges of each, as well as an appreciation of the power of leveraging scalability and integration to achieve sensitivity at low cost Microfluidics and Nanotechnology: Biosensing to the Single Molecule Limit not only serves as a quick reference for the latest achievements in biochemical detection at the single-cell and single-molecule levels, but also provides researchers with inspiration for further innovation and expansion of the field. Labs on Chip: Principles, Design and Technology provides a complete reference for the complex field of labs on chip in biotechnology. Merging three main areas— fluid dynamics, monolithic micro- and nanotechnology, and out-of-equilibrium biochemistry—this text integrates coverage of technology issues with strong theoretical explanations of design techniques. Analyzing each subject from basic principles to relevant applications, this book: Describes the biochemical elements required to work on labs on chip Discusses fabrication, microfluidic, and electronic and optical detection techniques Addresses planar technologies, polymer microfabrication, and process scalability to huge volumes Presents a global view of current lab-on-chip research and development Devotes an entire chapter to labs on chip for genetics Summarizing in one source the different technical competencies required, Labs on Chip: Principles, Design and Technology offers valuable guidance for the lab-on-chip design decision-making process, while exploring essential elements of labs on chip useful both to the professional who wants to approach a new field and to the specialist who wants to gain a broader perspective.

Electronic Conduction: Classical and Quantum Theory to Nanoelectronic Devices provides a concise, complete introduction to the fundamental principles of electronic conduction in microelectronic and nanoelectronic devices, with an emphasis on integrating the quantum aspects of conduction. The chapter coverage begins by presenting the classical theory of conduction, including introductory chapters on quantum mechanics and the solid state, then moving to a complete presentation of essential theory for understanding modern electronic devices. The author’s unique approach is applicable to microscale and nanoscale device simulation, which is particularly timely given the explosion in the nanoelectronics field. Features Self-contained Gives a complete account of classical and quantum aspects of conduction in nanometer scale devices Emphasises core principles, the book can be useful to electrical engineers and material scientists, and no prior course in semiconductors is necessary Highlights the bridge to modern electronics, first presenting the physics, and then the engineering complications related to quantum behaviour Includes many clear, illustrative diagrams and chapter problem sets Gives an account of post-Silicon devices such as the GaAs MOSFET, the CNT-FET and the vacuum transistor Showcases why quantum mechanics is necessary with modern devices due to their size and corresponding electron transport properties Discusses all the issues that will enable readers to conduct their own research

The book has two intentions. First, it assembles the latest research in the field of medical imaging technology in one place. Detailed descriptions of current state-of-the-art medical imaging systems (comprised of x-ray CT, MRI, ultrasound, and nuclear medicine) and data processing techniques are discussed. Information is provided that will give interested engineers and scientists a solid foundation from which to build with additional resources. Secondly, it exposes the reader to myriad applications that medical imaging technology has enabled.

Integrating aspects of engineering, application physics, and medical science, Solid-State Radiation Detectors: Technology and Applications offers a comprehensive review of new and emerging solid-state materials-based technologies for radiation detection. Each chapter is structured to address the current advantages and challenges of each material and technology presented, as well as to discuss novel research and applications. Featuring contributions from leading experts in industry and academia, this authoritative text: Covers modern semiconductors used for radiation monitoring Examines CdZnTe and CdTe technology for imaging applications including three-dimensional capability detectors Highlights interconnect technology for current pixel detectors Describes hybrid pixel detectors and their characterizations Tackles the integrated analog signal processing read-out front ends for particle detectors Considers new organic materials with direct bandgap for direct energy detection Summarizes recent developments involving lanthanum halide and cerium bromide scintillators Analyzes the potential of recent progress in the field of crystallogenesis, quantum dots, and photonics crystals toward a new concept of x- and gamma-ray detectors based on metamaterials Explores position-sensitivity photomultipliers and silicon photomultipliers for scintillation crystals Solid-State Radiation Detectors: Technology and Applications provides a valuable reference for engineers and scientists looking to enhance the performance of radiation detector technology for medical imaging and other applications.

Terahertz radiation – also known as submillimeter radiation, terahertz waves, tremendously high frequency (THF), T-rays, T-waves, T-light, T-lux or THz – consists of electromagnetic waves within the ITU-designated band of frequencies from 0.3 to 3 terahertz. Wavelengths of radiation in the terahertz band correspondingly range from 1 mm to 0.1 mm. Because terahertz radiation begins at a wavelength of one millimeter and proceeds into shorter wavelengths, it is sometimes known as the submillimeter band, and its radiation as submillimeter waves, especially in astronomy. The book presents information about Terahertz science, Terahertz photodetectors and Terahertz Lasers. A special emphasis is given to room temperature operation of long wavelength photodetectors based on novel quantum dots. Moreover, a complete analysis of systems based on Quantum Cascade structures to detect far infrared wavelengths is provided. Finally, the book presents Terahertz laser principles considering multi-color lasers in this range of wavelengths. It is written as a background for graduate students in the Optics field.

Composed of contributions from top experts, Microelectronics to Nanoelectronics: Materials, Devices and Manufacturability offers a detailed overview of important recent scientific and technological developments in the rapidly evolving nanoelectronics arena. Under the editorial guidance and technical expertise of noted materials scientist Anupama B. Kaul of California Institute of Technology’s Jet Propulsion Lab, this book captures the ascent of microelectronics into the nanoscale realm. It addresses a wide variety of important scientific and technological issues in nanoelectronics research and development. The book also showcases some key application areas of micro-electro-mechanical-systems (MEMS) that have reached the commercial realm. Capitalizing on Dr. Kaul’s considerable technical experience with micro- and nanotechnologies and her extensive research in prestigious academic and industrial labs, the book offers a fresh perspective on application-driven research in micro- and nanoelectronics, including MEMS. Chapters explore how rapid developments in this area are transitioning from the lab to the market, where new and exciting materials, devices, and manufacturing technologies are revolutionizing the electronics industry. Although many micro- and nanotechnologies still face major scientific and technological challenges and remain within the realm of academic research labs, rapid advances in this area have led to the recent emergence of new applications and markets. This handbook encapsulates that exciting recent progress by providing high-quality content contributed by international experts from academia, leading industrial institutions—such as Hewlett-Packard—and government laboratories including the U.S. Department of Energy’s Sandia National Laboratory. Offering something for everyone, from students to scientists to entrepreneurs, this book showcases the broad spectrum of cutting-edge technologies that show significant promise for electronics and related applications in which nanotechnology plays a key role.

This introductory, yet in-depth, book explains the physical principles of electronic imaging and sensing and provides the reader with the information necessary to understand the design, operation, and practical applications of contemporary electronic imaging and sensing systems. The text has strong practical focus and contains examples of biomedical applications of optical electronic imaging and sensing. Each chapter draws upon the authors’ extensive research, teaching, and industrial experience and provides a useful resource for undergraduate and graduate students, as well as a convenient reference for scientists and engineers working in the field of electronic imaging and sensing.

[Energy Efficient Computing & Electronics Technologies and Applications Devices to Systems](#)

[Smart Sensors for Industrial Applications](#)

[Technology and Applications](#)

[Advances in Imaging and Sensing](#)

[Physical Design for 3D Integrated Circuits](#)

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[Principles, Design and Technology](#)

[Microelectronics to Nanoelectronics](#)

[Handbook of Terahertz Technology](#)

[Microfluidics and Nanotechnology](#)

The aim of this book is to educate the reader on radiation detectors, from sensor to read-out electronics to application. Relatively new detector materials, such as CdZTe and Cr compensated GaAs, are introduced, along with emerging applications of radiation detectors. This X-ray technology has practical applications in medical, industrial, and security applications. It identifies materials based on their molecular composition, not densities as the traditional transmission equipment does. With chapters written by an international selection of authors from both academia and industry, the book covers a wide range of topics on radiation detectors, which will satisfy the needs of both beginners and experts in the field.

Recently the world celebrated the 60th anniversary of the invention of the first transistor. The first integrated circuit (IC) was built a decade later, with the first microprocessor designed in the early 1970s. Today, ICs are a part of nearly every aspect of our daily lives. They help us live longer and more comfortably, and do more, faster. All this is possible because of the relentless search for new materials, circuit designs, and ideas happening on a daily basis at industrial and academic institutions around the globe. Showcasing the latest advances in very-large-scale integrated (VLSI) circuits, VLSI: Circuits for Emerging Applications provides a balanced view of industrial and academic developments beyond silicon and complementary metal-oxide-semiconductor (CMOS) technology. From quantum-dot cellular automata (QCA) to chips for cochlear implants, this must-have resource: Investigates the trend of combining multiple cores in a single chip to boost performance of the overall system Describes a novel approach to enable physically unclonable functions (PUFs) using intrinsic features of a VLSI chip Examines the VLSI implementations of major symmetric and asymmetric key cryptographic algorithms, hash functions, and digital signatures Discusses nonvolatile memories such as resistive random-access memory (Re-RAM), magneto-resistive RAM (MRAM), and floating-body RAM (FB-RAM) Explores organic transistors, soft errors, photonics, nanoelectromechanical (NEM) relays, reversible computation, bioinformatics, asynchronous logic, and more VLSI: Circuits for Emerging Applications presents cutting-edge research, design architectures, materials, and uses for VLSI circuits, offering valuable insight into the current state of the art of micro- and nanoelectronics.

This book covers the state of the art in the theoretical framework, computational modeling, and the fabrication and characterization of nanoelectronics devices. It addresses material properties, device physics, circuit analysis, system design, and a range of applications. A discussion on the nanoscale fabrication, characterization and metrology is also included. The book offers a valuable resource for researchers, graduate students, and senior undergraduate students in engineering and natural sciences, who are interested in exploring nanoelectronics from materials, devices, systems, and applications perspectives.

Mixed-Signal Circuits offers a thoroughly modern treatment of integrated circuit design in the context of mixed-signal applications. Featuring chapters authored by leading experts from industry and academia, this book: Discusses signal integrity and large-scale simulation, verification, and testing Demonstrates advanced design techniques that enable digital circuits and sensitive analog circuits to coexist without any compromise Describes the process technology needed to address the performance challenges associated with developing complex mixed-signal circuits Deals with modeling topics, such as reliability, variability, and crosstalk, that define pre-silicon design methodology and trends, and are the focus of companies involved in wireless applications Develops methods to move analog into the digital domain quickly, minimizing and eliminating common trade-offs between performance, power consumption, simulation time, verification, size, and cost Details approaches for very low-power performances, high-speed interfaces, phase-locked loops (PLLs), voltage-controlled oscillators (VCOs), analog-to-digital converters (ADCs), and biomedical filters Delineates the respective parts of a full system-on-chip (SoC), from the digital parts to the baseband blocks, radio frequency (RF) circuitries, electrostatic-discharge (ESD) structures, and built-in self-test (BIST) architectures Mixed-Signal Circuits explores exciting opportunities in wireless communications and beyond. The book is a must for anyone involved in mixed-signal circuit design for future technologies.

A significant portion of biomedical applications necessitates the establishment of an interface between the cells of the patient and the components of the device. In many cases, such as in implants and engineered tissues, the interaction of the cells with the biomaterial is one of the main determinants of the success of the system. Cell and Material Interface: Advances in Tissue Engineering, Biosensor, Implant, and Imaging Technologies explores this interaction and its control at length scales ranging from the nano to the macro. Featuring contributions from leading molecular biologists, chemists, and material scientists, this authoritative reference: Presents practical examples of cell and material interface-based applications Reflects the interdisciplinary nature of bioengineering, covering topics such as biosensing, immunology, and controlled delivery Explains the role of the cell and material interface in the context of cardiac and skin tissue engineering, nanoparticles, natural polymers, and more Cell and Material Interface: Advances in Tissue Engineering, Biosensor, Implant, and Imaging Technologies addresses concepts essential to biomaterial production methods and cell and material interactions. The book provides a solid starting point for elucidating and exploiting the different aspects of cellular interactions with materials for biomedical engineering.

Nanoelectronics are a diverse set of materials and devices that are so small that quantum mechanics need to be applied to their function. The possibilities these devices present outweigh the difficulties associated with their development, as biosensors and similar devices have the potential to vastly improve our technological reach. The Handbook of Research on Nanoelectronic Sensor Modeling and Applications begins with an introduction of the fundamental concepts of nanoelectronic sensors, then proceeds to outline in great detail the concepts of nanoscale device modeling and nanoquantum fundamentals. Recent advances in the field such as graphene technology are discussed at length in this comprehensive handbook, ideal for electrical engineers, advanced engineering students, researchers, and academics.

Optical Imaging Devices: New Technologies and Applications delivers a comprehensive introduction to optical imaging and sensing, from devices to system-level applications. Drawing upon the extensive academic and industrial experience of its prestigious editors and renowned chapter authors, this authoritative text: Explains the physical principles of optical imaging and sensing Covers topics such as silicon-based imaging characteristics, nanophotonic phased arrays, thin-film sensors, label-free DNA sensors, and in vivo flow cytometry Presents the contributions of leading researchers, real-world examples from biomedicine, recommendations for further reading, and all measurements in SI units Optical Imaging Devices: New Technologies and Applications provides an essential understanding of the design, operation, and practical applications of optical imaging and sensing systems, making it a handy reference for students and practitioners alike.

Addresses a Growing Need for High-Power and High-Frequency Transistors Gallium Nitride (GaN): Physics, Devices, and Technology offers a balanced perspective on the state of the art in gallium nitride technology. A semiconductor commonly used in bright light-emitting diodes, GaN can serve as a great alternative to existing devices used in microelectronics. It has a wide band gap and high electron mobility that gives it special properties for applications in optoelectronic, high-power, and high-frequency devices, and because of its high off-state breakdown strength combined with excellent on-state channel conductivity, GaN is an ideal candidate for switching power transistors. Explores Recent Progress in High-Frequency GaN Technology Written by a panel of academic and industry experts from around the globe, this book reviews the advantages of GaN-based material systems suitable for high-frequency, high-power applications. It provides an overview of the semiconductor environment, outlines the fundamental device physics of GaN, and describes GaN materials and device structures that are needed for the next stage of microelectronics and optoelectronics. The book details the development of radio frequency (RF) semiconductor devices and circuits, considers the current challenges that the industry now faces, and examines future trends. In addition, the authors: Propose a design in which multiple LED stacks can be connected in a series using interband tunnel junction (IJ) interconnects Examine GaN technology while in its early stages of high-volume deployment in commercial and military products Consider the potential use of both sunlight and hydrogen as promising and prominent energy sources for this technology Introduce two unique methods, PEC oxidation and vapor cooling condensation methods, for the deposition of high-quality oxide layers A single-source reference for students and professionals, Gallium Nitride (GaN): Physics, Devices, and Technology provides an overall assessment of the semiconductor environment, discusses the potential use of GaN-based technology for RF semiconductor devices, and highlights the current and emerging applications of GaN.

[Devices, Circuits and Systems](#)

[Labs on Chip](#)

[Magnetic Sensors and Devices](#)

[Handbook of Nanophysics](#)

[Wireless Medical Systems and Algorithms](#)

[Semiconductor Radiation Detectors](#)

[VLSI](#)

[Metallic Spintronic Devices](#)

[Design and Applications](#)

[Nanopatterning and Nanoscale Devices for Biological Applications](#)

[Micro- and Nanoelectronics](#)

[Electronic Conduction](#)

[Classical and Quantum Theory to Nanoelectronic Devices](#)

Soft errors are a multifaceted issue at the crossroads of applied physics and engineering sciences. Soft errors are by nature multiscale and multiphysics problems that combine not only nuclear and semiconductor physics, material sciences, circuit design, and chip architecture and operation, but also cosmic-ray physics, natural radioactivity issues, particle detection, and related instrumentation. Soft Errors: From Particles to Circuits addresses the problem of soft errors in digital integrated circuits subjected to the terrestrial natural radiation environment—one of the most important primary limits for modern digital electronic reliability. Covering the fundamentals of soft errors as well as engineering considerations and technological aspects, this robust text: Discusses the basics of the natural radiation environment, particle interactions with matter, and soft-error mechanisms Details instrumentation developments in the fields of environment characterization, particle detection, and real-time and accelerated tests Describes the latest computational developments, modeling, and simulation strategies for the soft error-rate estimation in digital circuits Explores trends for future technological nodes and emerging devices Soft Errors: From Particles to Circuits presents the state of the art of this complex subject, providing comprehensive knowledge of the complete chain of the physics of soft errors. The book makes an ideal text for introductory graduate-level courses, offers academic researchers a specialized overview, and serves as a practical guide for semiconductor industry engineers or application engineers.

Wireless Medical Systems and Algorithms: Design and Applications provides a state-of-the-art overview of the key steps in the development of wireless medical systems, from biochips to brain-computer interfaces and beyond. The book also examines some of the most advanced algorithms and data processing in the field. Addressing the latest challenges and solutions related to the medical needs, electronic design, advanced materials chemistry, wireless body sensor networks, and technologies suitable for wireless medical devices, the text: Investigates the technological and manufacturing issues associated with the development of wireless medical devices Introduces the techniques and strategies that can optimize the performances of algorithms for medical applications and provide robust results in terms of data reliability Includes a variety of practical examples and case studies relevant to engineers, medical doctors, chemists, and biologists Wireless Medical Systems and Algorithms: Design and Applications not only highlights new technologies for the continuous surveillance of patient health conditions, but also shows how disciplines such as chemistry, biology, engineering, and medicine are merging to produce a new class of smart devices capable of managing and monitoring a wide range of cognitive and physical disabilities.

Nanoscale techniques and devices have had an explosive influence on research in life sciences and bioengineering. Reflecting this influence, Nanopatterning and Nanoscale Devices for Biological Applications provides valuable insight into the latest developments in nanoscale technologies for the study of biological systems. Written and edited by experts in the field, this first-of-its-kind collection of topics: Covers device fabrication methods targeting the substrate on the nanoscale through surface modification Explores the generation of nanostructured biointerfaces and bioelectronics elements Examines microfluidically generated droplets as reactors enabling nanoscale sample preparation and analysis Gives an overview of key biosensors and integrated devices with nanoscale functionalities Discusses the biological applications of nanoscale devices, including a review of nanotechnology in tissue engineering Readers gain a deep understanding of the cutting-edge applications of nanotechnologies in biological engineering, and learn how to apply the relevant scientific concepts to their own research. Nanopatterning and Nanoscale Devices for Biological Applications is the definitive reference for researchers in engineering, biology, and biomedicine, and for anyone exploring the newest trends in this innovative field.

Efficient mobile systems that allow for vital sign monitoring and disease diagnosis at the point of care can help combat issues such as rising healthcare costs, treatment delays in remote and resource-poor areas, and the global shortage of skilled medical personnel. Covering everything from sensors, systems, and software to integration, usability, and regulatory challenges, Mobile Point-of-Care Monitors and Diagnostic Device Design offers valuable insight into state-of-the-art technologies, research, and methods for designing personal diagnostic and ambulatory healthcare devices. Presenting the combined expertise of contributors from various fields, this multidisciplinary text: Gives an overview of the latest mobile health and point-of-care technologies Discusses portable diagnostics devices and sensors, including mobile-phone-based health systems Explores lab-on-chip systems as well as energy-efficient solutions for mobile point-of-care monitors Addresses computer vision and signal processing for real-time diagnostics Considers interface design for lay healthcare providers and home users Mobile Point-of-Care Monitors and Diagnostic Device Design provides important background information about the design process of mobile health and point-of-care devices, using practical examples to illustrate key aspects related to instrumentation, information processing, and implementation.

Textbook presenting the fundamentals of nanoscience and nanotechnology with a view to nanoelectronics. Covers the underlying physics; nanostructures, including nanoobjects; methods for growth, fabrication and characterization of nanomaterials; and nanodevices. Provides a unifying framework for the basic ideas needed to understand the recent developments in the field. Includes numerous illustrations, homework problems and a number of interactive Java applets. For advanced undergraduate and graduate students in electrical and electronic engineering, nanoscience, materials, bioengineering and chemical engineering. Instructor solutions and Java applets available from www.cambridge.org/9780521881722.

Both the demographics and lack of resources in the health and well-being industry are increasingly forcing us to find alternative solutions for individualized health and social care. In an effort to address this issue, smart technologies present enormous potential in solving this challenge. This book strives to enhance communication and collaboration between technology and health and social care sectors. The reader will receive an extensive overview of the possibilities of various technologies in care sectors (including ICT, electronics, automation, and sensor technology) written by experts from various countries. It will prove extremely useful for engineers developing well-being related systems, software, or other devices that can be used by professionals working with people with specialist needs, well-being and health service providers, educators teaching related courses, and upper level undergraduate students and graduate student studying related topics. The technology focus of the book is widespread and addresses elderly care and hospitals, in addition to solutions for various user groups, devices, and technologies. Beyond serving as a resource for nurses and people working in care sector, the book is also meant to give guidelines for engineers developing person-centered systems by exploring the integration of these technologies into service systems.

Nanomaterials are being incorporated into products all around us, having an incredible impact on durability, strength, functionality, and other material properties. There are a vast number of nanomaterials presently available, and new formulations and chemistries are being announced daily. Nanomaterials: A Guide to Fabrication and Applications provides product developers, researchers, and materials scientists with a handy resource for understanding the range of options and materials currently available. Covering a variety of nanomaterials and their applications, this practical reference: Discusses the scale of nanomaterials and nanomachines, focusing on integrated circuits (ICs) and microelectromechanical systems (MEMS) Offers insight into different nanomaterials' interactions with chemical reactions, biological processes, and the environment Examines the mechanical properties of nanomaterials and potential treatments to enhance the nanomaterials' performance Details recent accomplishments in the use of nanomaterials to create new forms of electronic devices Explores the optical properties of certain nanomaterials and the nanomaterials' use in optimizing lasers and optical absorbers Describes an energy storage application as well as how nanomaterials from waste products may be used to improve capacitors Featuring contributions from experts around the globe, Nanomaterials: A Guide to Fabrication and Applications serves as a springboard for the discovery of new applications of nanomaterials.

These three volumes are intended to shape the field of nanoscience and technology and will serve as an essential point of reference for cutting-edge research in the field.

[Medical Imaging](#)

[Introduction to Smart eHealth and eCare Technologies](#)

[Semiconductor Devices in Harsh Conditions](#)

[Mobile Point-of-Care Monitors and Diagnostic Device Design](#)

[New Technologies and Applications](#)

[Physics, Devices, and Technology](#)

[Biosensing to the Single Molecule Limit](#)

[Volume 3: Applications](#)

[Nanoelectronics Fundamentals](#)

[Gallium Nitride \(GaN\)](#)

[Materials, Devices & Manufacturability](#)

[Graphene, Carbon Nanotubes, and Nanostructures](#)

[Optical Imaging Devices](#)

The book addresses the need to investigate new approaches to lower energy requirement in multiple application areas and serves as a guide into emerging circuit technologies. It explores revolutionary device concepts, sensors, and associated circuits and architectures that will greatly extend the practical engineering limits of energy-efficient computation. The book responds to the need to develop disruptive new system architectures, circuit microarchitectures, and attendant device and interconnect technology aimed at achieving the highest level of computational energy efficiency for general purpose computing systems. Features Discusses unique technologies and material only available in specialized journal and conferences Covers emerging applications areas, such as ultra low power communications, emerging bio-electronics, and operation in extreme environments Explores broad circuit operation, ex. analog, RF, memory, and digital circuits Contains practical applications in the engineering field, as well as graduate studies Written by international experts from both academia and industry

There has been an increasing interest in multi-disciplinary research on multisensor attitude estimation technology driven by its versatility and diverse areas of application, such as sensor networks, robotics, navigation, video, biomedicine, etc. Attitude estimation consists of the determination of rigid bodies' orientation in 3D space. This research area is a multilevel, multifaceted process handling the automatic association, correlation, estimation, and combination of data and information from several sources. Data fusion for attitude estimation is motivated by several issues and problems, such as data imperfection, data multi-modality, data dimensionality, processing framework, etc. While many of these problems have been identified and heavily investigated, no single data fusion algorithm is capable of addressing all the aforementioned challenges. The variety of methods in the literature focus on a subset of these issues to solve, which would be determined based on the application in hand. Historically, the problem of attitude estimation has been introduced by Grace Wahba in 1965 within the estimate of satellite attitude and aerospace applications. This book intends to provide the reader with both a generic and comprehensive view of contemporary data fusion methodologies for attitude estimation, as well as the most recent researches and novel advances on multisensor attitude estimation task. It explores the design of algorithms and architectures, benefits, and challenging aspects, as well as a broad array of disciplines, including: navigation, robotics, biomedicine, motion analysis, etc. A number of issues that make data fusion for attitude estimation a challenging task, and which will be discussed through the different chapters of the book, are related to: 1) The nature of sensors and information sources (accelerometer, gyroscope, magnetometer, GPS, inclinometer, etc.); 2) The computational ability at the sensors; 3) The theoretical developments and convergence proofs; 4) The system architecture, computational resources, fusion level.

This book presents in-depth coverage of magnetic sensors in industrial applications. It is divided into three sections: devices and technology for magnetic sensing, industrial applications (automotive, navigation), and emerging applications. Topics include transmission speed sensor ICs, dynamic differential Hall ICs, chopped Hall switches, programmable linear output Hall sensors, low power Hall ICs, self-calibrating differential Hall ICs for wheel speed sensing, dynamic differential Hall ICs, uni- and bipolar Hall IC switches, chopped mono cell Hall ICs, and electromagnetic levitation.

Electrostatic discharge (ESD) is one of the most prevalent threats to electronic components. In an ESD event, a finite amount of charge is transferred from one object (i.e., human body) to another (i.e., microchip). This process can result in a very high current passing through the microchip within a very short period of time. Thus, more than 35 percent of single-event chip damages can be attributed to ESD events, and designing ESD structures to protect integrated circuits against the ESD stresses is a high priority in the semiconductor industry. Electrostatic Discharge Protection: Advances and Applications delivers timely coverage of component- and system-level ESD protection for semiconductor devices and integrated circuits. Bringing together contributions from internationally respected researchers and engineers with expertise in ESD design, optimization, modeling, simulation, and characterization, this book bridges the gap between theory and practice to offer valuable insight into the state of the art of ESD protection. Amply illustrated with tables, figures, and case studies, the text: Instills a deeper understanding of ESD events and ESD protection design principles Examines vital processes including Si CMOS, Si BCD, Si SOI, and GaN technologies Addresses important aspects pertinent to the modeling and simulation of ESD protection solutions Electrostatic Discharge Protection: Advances and Applications provides a single source for cutting-edge information vital to the research and development of effective, robust ESD protection solutions for semiconductor devices and integrated circuits.

This book introduces the reader to a number of challenges for the operation of electronic devices in various harsh environmental conditions. While some chapters focus on measuring and understanding the effects of these environments on electronic components, many also propose design solutions, whether in choice of material, innovative structures, or strategies for amelioration and repair. Many applications need electronics designed to operate in harsh environments. Readers will find, in this collection of topics, tools and ideas useful in their own pursuits and of interest to their intellectual curiosity. With a focus on radiation, operating conditions, sensor systems, package, and system design, the book is divided into three parts. The first part deals with sensing devices designed for operating in the presence of radiation, commercials of the shelf (COTS) products for space computing, and influences of single event upset. The second covers system and package design for harsh operating conditions. The third presents devices for biomedical applications under moisture and temperature loads in the frame of sensor systems and operating conditions.

Nanoelectronic Device Applications Handbook gives a comprehensive snapshot of the state of the art in nanodevices for nanoelectronics applications. Combining breadth and depth, the book includes 68 chapters on topics that range from nano-scaled complementary metal-oxide-semiconductor (CMOS) devices through recent developments in nano capacitors and AlGaAs/GaAs devices. The contributors are world-renowned experts from academia and industry from around the globe. The handbook explores current research into potentially disruptive technologies for a post-CMOS world. These include: Nanoscale advances in current MOSFET/CMOS technology Nano capacitors for applications such as electronics packaging and humidity sensors Single electron transistors and other electron tunneling devices Quantum cellular automata and nanomagnetic logic Memristors as switching devices and for memory Graphene preparation, properties, and devices Carbon nanotubes (CNTs), both single CNT and random network Other CNT applications such as terahertz, sensors, interconnects, and capacitors Nano system architectures for reliability Nanowire device fabrication and applications Nanowire transistors Nanodevices for spintronics The book closes with a call for a new generation of simulation tools to handle nanoscale mechanisms in realistic nanodevice geometries. This timely handbook offers a wealth of insights into the application of nanoelectronics. It is an invaluable reference and source of ideas for anyone working in the rapidly expanding field of nanoelectronics.

Nanoelectronics: Devices, Circuits and Systems explores current and emerging trends in the field of nanoelectronics, from both a devices-to-circuits and circuits-to-systems perspective. It covers a wide spectrum and detailed discussion on the field of nanoelectronic devices, circuits and systems. This book presents an in-depth analysis and description of electron transport phenomenon at nanoscale dimensions. Both qualitative and analytical approaches are taken to explore the devices, circuit functionalities and their system applications at deep submicron and nanoscale levels. Recent devices, including FinFET, Tunnel FET, and emerging materials, including graphene, and its applications are discussed. In addition, a chapter on advanced VLSI interconnects gives clear insight to the importance of these nano-transmission lines in determining the overall IC performance. The importance of integration of optics with electronics is elucidated in the optoelectronics and photonic integrated circuit sections of this book. This book provides valuable resource materials for scientists and electrical engineers who want to learn more about nanoscale electronic materials and how they are used. Shows how electronic transport works at the nanoscale level Demonstrates how nanotechnology can help engineers create more effective circuits and systems Assesses the most commonly used nanoelectronic devices, explaining which is best for different situations

Presenting the cutting-edge results of new device developments and circuit implementations, High-Speed Devices and Circuits with THz Applications covers the recent advancements of nano devices for terahertz (THz) applications and the latest high-speed data rate connectivity technologies from system design to integrated circuit (IC) design, providing relevant standard activities and technical specifications. Featuring the contributions of leading experts from industry and academia, this pivotal work: Discusses THz sensing and imaging devices based on nano devices and materials Describes silicon on insulator (SOI) multigate nanowire field-effect transistors (FETs) Explains the theory underpinning nanoscale nanowire metal-oxide-semiconductor field-effect transistors (MOSFETs), simulation methods, and their results Explores the physics of the silicon-germanium (SiGe) heterojunction bipolar transistor (HBT), as well as commercially available SiGe HBT devices and their applications Details aspects of THz IC design using standard silicon (Si) complementary metal-oxide-semiconductor (CMOS) devices, including experimental setups for measurements, detection methods, and more An essential text for the future of high-frequency engineering, High-Speed Devices and Circuits with THz Applications offers valuable insight into emerging technologies and product possibilities that are attractive in terms of mass production and compatibility with current manufacturing facilities.

[Multisensor Attitude Estimation](#)

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Physical Design for 3D Integrated Circuits reveals how to effectively and optimally design 3D integrated circuits (ICs). It also analyzes the design tools for 3D circuits while exploiting the benefits of 3D technology. The book begins by offering an overview of physical design challenges with respect to conventional 2D circuits, and then each chapter delivers an in-depth look at a specific physical design topic. This comprehensive reference: Contains extensive coverage of the physical design of 2.5D/3D ICs and monolithic 3D ICs Supplies state-of-the-art solutions for challenges unique to 3D circuit design Features contributions from renowned experts in their respective fields Physical Design for 3D Integrated Circuits provides a single, convenient source of cutting-edge information for those pursuing 2.5D/3D technology.

In our abundant computing infrastructure, performance improvements across most all application spaces are now severely limited by the energy dissipation involved in processing, storing, and moving data. The exponential increase in the volume of data to be handled by our computational infrastructure is driven in large part by unstructured data from countless sources. This book explores revolutionary device concepts, associated circuits, and architectures that will greatly extend the practical engineering limits of energy-efficient computation from device to circuit to system level. With chapters written by international experts in their corresponding field, the text investigates new approaches to lower energy requirements in computing. Features

• Has a comprehensive coverage of various technologies

• Written by international experts in their corresponding field

• Covers revolutionary concepts at the device, circuit, and system levels

Many bottom-up and top-down techniques for nanomaterial and nanostructure generation have enabled the development of applications in nanoelectronics and nanophotonics. Handbook of Nanophysics: Nanoelectronics and Nanophotonics explores important recent applications of nanophysics in the areas of electronics and photonics. Each peer-reviewed chapter contains a broad-based introduction and enhances understanding of the state-of-the-art scientific content through fundamental equations and illustrations, some in color. This volume discusses how different nanomaterials, such as quantum dots and nanotubes, are used in quantum computing, capacitors, and transistors. Leading international experts review the potential of the novel patterning techniques in molecular electronics as well as nanolithography approaches for producing semiconductor circuits.

They also describe optical properties of nanostructures, nanowires, nanorods, and clusters, including cathodoluminescence, photoluminescence, and polarization-sensitivity. In addition, the book covers nanophotonic devices and nanolasers. Nanophysics brings together multiple disciplines to determine the structural, electronic, optical, and thermal behavior of nanomaterials; electrical and thermal conductivity; the forces between nanoscale objects; and the transition between classical and quantum behavior. Facilitating communication across many disciplines, this landmark publication encourages scientists with disparate interests to collaborate on interdisciplinary projects and incorporate the theory and methodology of other areas into their work.

Metallic Spintronic Devices provides a balanced view of the present state of the art of metallic spintronic devices, addressing both mainstream and emerging applications from magnetic tunneling junction sensors and spin torque oscillators to spin torque memory and logic. Featuring contributions from well-known and respected industrial and academic experts, this cutting-edge work not only presents the latest research and developments but also: Describes spintronic applications in current and future magnetic recording devices Discusses spin-transfer torque magnetoresistive random-access memory (STT-MRAM) device architectures and modeling Explores prospects of STT-MRAM scaling, such as detailed multilevel cell structure analysis Investigates spintronic device write and read optimization in light of spintronic memristive effects Considers spintronic research directions based on yttrium iron garnet thin films, including spin pumping, magnetic proximity, spin hall, and spin Seebeck effects Proposes unique solutions for low-power spintronic device applications where memory is closely integrated with logic *Metallic Spintronic Devices* aims to equip anyone who is serious about metallic spintronic devices with up-to-date design, modeling, and processing knowledge. It can be used either by an expert in the field or a graduate student in course curriculum.

Sensor technologies are a rapidly growing area of interest in science and product design, embracing developments in electronics, photonics, mechanics, chemistry, and biology. Their presence is widespread in everyday life, where they are used to sense sound, movement, and optical or magnetic signals. The demand for portable and lightweight sensors is relentless in several industries, from consumer electronics to biomedical engineering to the military. Smart Sensors for Industrial Applications brings together the latest research in smart sensors technology and exposes the reader to myriad applications that this technology has enabled. Organized into five parts, the book explores: Photonics and optoelectronics sensors, including developments in optical fibers, Brillouin detection, and Doppler effect analysis. Chapters also look at key applications such as oxygen detection, directional discrimination, and optical sensing. Infrared and thermal sensors, such as Bragg gratings, thin films, and microbolometers. Contributors also cover temperature measurements in industrial conditions, including sensing inside explosions. Magnetic and inductive sensors, including magnetometers, inductive coupling, and ferro-fluidics. The book also discusses magnetic field and inductive current measurements in various industrial conditions, such as on airplanes. Sound and ultrasound sensors, including underwater acoustic modem, vibrational spectroscopy, and photoacoustics. Piezoresistive, wireless, and electrical sensors, with applications in health monitoring, agrofood, and other industries. Featuring contributions by experts from around the world, this book offers a comprehensive review of the groundbreaking technologies and the latest applications and trends in the field of smart sensors.

Micro- and Nanoelectronics: Emerging Device Challenges and Solutions presents a comprehensive overview of the current state of the art of micro- and nanoelectronics, covering the field from fundamental science and material properties to novel ways of making nanodevices. Containing contributions from experts in both industry and academia, this cutting-edge text: Discusses emerging silicon devices for CMOS technologies, fully depleted device architectures, characteristics, and scaling Explains the specifics of silicon compound devices (SiGe, SiC) and their unique properties Explores various options for post-CMOS nanoelectronics, such as spintronic devices and nanoionic switches Describes the latest developments in carbon nanotubes, iii-v devices structures, and more *Micro- and Nanoelectronics: Emerging Device Challenges and Solutions* provides an excellent representation of a complex engineering field, examining emerging materials and device architecture alternatives with the potential to shape the future of nanotechnology.

Graphene, Carbon Nanotubes, and Nanostructures: Techniques and Applications offers a comprehensive review of groundbreaking research in nanofabrication technology and explores myriad applications that this technology has enabled. The book examines the historical evolution and emerging trends of nanofabrication and supplies an analytical understanding of some of the most important underlying nanofabrication technologies, with an emphasis on graphene, carbon nanotubes (CNTs), and nanowires. Featuring contributions by experts from academia and industry around the world, this book presents cutting-edge nanofabrication research in a wide range of areas. Topics include: CNT electrostatics and signal propagation models Electronic structure calculations of a graphene–hexagonal boron nitride interface to aid the understanding of experimental devices based on these heterostructures How a laser field would modify the electronic structure and transport response of graphene, to generate bandgaps The fabrication of transparent CNT electrodes for organic light-emitting diodes Direct graphene growth on dielectric substrates, and potential applications in electronic and spintronic devices CNTs as a promising candidate for next-generation interconnect conductors CMOS–CNT integration approaches, including the promising localized heating CNT synthesis method CNTs in electrochemical and optical biosensors The synthesis of diamondoids by pulsed laser ablation plasmas generated in supercritical fluids, and possible applications The use of DNA nanostructures in lithography CMOS-compatible silicon nanowire biosensors The use of titanium oxide-B nanowires to detect explosive vapors The properties of protective layers on silver nanoparticles for ink-jet printing Nanostructured thin-film production using microreactors A one-stop reference for professionals, researchers, and graduate students working in nanofabrication, this book will also be useful for investors who want an overview of the current nanofabrication landscape.

Three-dimensional (3D) integration of microsystems and subsystems has become essential to the future of semiconductor technology development. 3D integration requires a greater understanding of several interconnected systems stacked over each other. While this vertical growth profoundly increases the system functionality, it also exponentially increases the design complexity. Design of 3D Integrated Circuits and Systems tackles all aspects of 3D integration, including 3D circuit and system design, new processes and simulation techniques, alternative communication schemes for 3D circuits and systems, application of novel materials for 3D systems, and the thermal challenges to restrict power dissipation and improve performance of 3D systems. Containing contributions from experts in industry as well as academia, this authoritative text: Illustrates different 3D integration approaches, such as die-to-die, die-to-wafer, and wafer-to-wafer Discusses the use of interposer technology and the role of Through-Silicon Vias (TSVs) Presents the latest improvements in three major fields of thermal management for multiprocessor systems-on-chip (MPSoCs) Explores ThruChip Interface (TCI), NAND flash memory stacking, and emerging applications Describes large-scale integration testing and state-of-the-art low-power testing solutions Complete with experimental results of chip-level 3D integration schemes tested at IBM and case studies on advanced complementary metal–oxide–semiconductor (CMOS) integration for 3D integrated circuits (ICs), *Design of 3D Integrated Circuits and Systems* is a practical reference that not only covers a wealth of design issues encountered in 3D integration but also demonstrates their impact on the efficiency of 3D systems.

[Nanomaterials](#)

[Solid-State Radiation Detectors](#)

[Introduction to Nanoelectronics](#)

[Low Power Circuits for Emerging Applications in Communications, Computing, and Sensing](#)

[Techniques and Applications](#)

[Nanoelectronic Device Applications Handbook](#)

[Nanoelectronics and Nanophotonics](#)

[Fundamental Concepts and Applications](#)

[Handbook of Research on Nanoelectronic Sensor Modeling and Applications](#)

[A Guide to Fabrication and Applications](#)

[Design of 3D Integrated Circuits and Systems](#)