

## Digital Beamforming In Wireless Communications

Advances in Computing, Communication, Automation and Biomedical Technology aims to bring together leading academic, scientists, researchers, industry representatives, postdoctoral fellows and research scholars around the world to share their knowledge and research expertise, to advances in the areas of Computing, Communication, Electrical, Civil, Mechanical and Biomedical Systems as well as to create a prospective collaboration and networking on various areas. It also provides a premier interdisciplinary platform for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered, and solutions adopted in the fields of innovation.

Lectori Salutem! This is another book – among the myriads – dealing with wireless communications. The reader might be aware: this topic is really among bestsellers in technology – bestsellers in technology itself and that in technical literature.

Communications is one of the leading techniques in information society and mobile/wireless communications is one among the (maybe not more than two with optics the second) leading techniques in communications. Development of wireless communications was and is really specular in the last decade of the 20th and first decade of the 21st century. Such topics as MIMO, wireless networking, security in the technological field, new business models in the service providing field, various

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applications in the users' side, to mention a few only, were undergoing an unprecedented evolution. So it is not surprising that the number of conferences and the number of books in this field grows and grows, in a nearly unbounded way.

Intelligent networking provides value-added communications capabilities such as cost reduction, improved service delivery, increased variety, and quality of services Provides an all-encompassing self-contained treatment of adaptive modulation, adaptive antennas, and adaptive networking Provides an overview of the various CMA-based 3G wireless standards--UTRA, IMT 2000, and cdma 2000 Presents the principles of beamforming and the various techniques used for its implementation Quantifies the UTRA network capacity under various channel conditions

This book presents an alternative and simplified approaches for the robust adaptive detection and beamforming in wireless communications. It adopts several systems models including DS/CDMA, OFDM/MIMO with antenna array, and general antenna arrays beamforming model. It presents and analyzes recently developed detection and beamforming algorithms with an emphasis on robustness. In addition, simplified and efficient robust adaptive detection and beamforming techniques are presented and compared with exiting techniques. Practical examples based on the above systems models are provided to exemplify the developed detectors and beamforming algorithms. Moreover, the developed techniques are implemented using MATLAB—and the relevant MATLAB scripts are provided to help the readers to develop and analyze

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the presented algorithms. Simplified Robust Adaptive Detection and Beamforming for Wireless Communications starts by introducing readers to adaptive signal processing and robust adaptive detection. It then goes on to cover Wireless Systems Models. The robust adaptive detectors and beamformers are implemented using the well-known algorithms including LMS, RLS, IQRD-RLS, RSD, BSCMA, CG, and SD. The robust detection and beamforming are derived based on the existing detectors/beamformers including MOE, PLIC, LCCMA, LCMV, MVDR, BSCMA, and MBER. The adopted cost functions include MSE, BER, CM, MV, and SINR/SNR.

At present, the expansion of tetherless communications is a technological trend surpassed perhaps only by the explosive growth of the Internet. Wireless systems are being deployed today mainly for telephony, satisfying the industrialized nations' appetite for talk-on-the-go, and providing much-needed communications infrastructure in developing countries. The desire for wireless access to the Internet is starting to add fuel to the growth of tetherless communications. Indeed, the synergy of wireless and Internet technologies will lead to a host of exciting new applications, some of which are not yet envisioned. Future-generation wireless systems will achieve capacities much higher than the systems of today by incorporating myriad improvements. These innovations include transmission in higher-frequency bands, "smart antennas", multi-user detection, new forward error-correction techniques, and advanced network resource-

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allocation techniques. The term “smart antenna” usually refers to the deployment of multiple antennas at the base-station site, coupled with special processing of the multiple received signals. Smart antennas can adaptively reject co-channel interference and mitigate multipath fading, and have been identified by many as a promising means to extend base-station coverage, increase system capacity and enhance quality of service.

**MULTIFUNCTIONAL ANTENNAS AND ARRAYS FOR WIRELESS COMMUNICATION SYSTEMS** Offers an up-to-date discussion of multifunctional antennas and arrays for wireless communication systems Multifunctional Antennas and Arrays for Wireless Communication Systems is a comprehensive reference on state-of-the-art reconfigurable antennas and 4G/5G communication antennas. The book gives a unique perspective while giving a comprehensive overview of the following topics: Frequency reconfigurable antennas Pattern reconfigurable antennas Polarization reconfigurable antennas Reconfigurable antennas using Liquid Metal, Piezoelectric, and RF MEMS MIMO and 4G/5G wireless communication antennas Metamaterials and metasurfaces in reconfigurable antennas Multifunctional antennas for user equipments (UEs) Defense related antennas and applications Flat panel phased array antennas The book is a valuable resource for the practicing engineer as well as for those within the research field. As wireless communications continuously evolves, more and more functionally will be required, and thus multifunctional antennas and RF systems will be necessary.

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These multifunctional antennas will require a degree of reconfigurability, and this book discusses various methods which enable this. The main topics of frequency, pattern, and polarization reconfigurability is first discussed. Methods utilizing unique materials and devices, both real and artificial are discussed. The book also delves into 4G/5G antennas as it relates to MIMO, and millimeter-wave phased arrays. Finally, there is a section on defense related multifunctional RF antenna systems.

Part I: RF System Integration. 1. RF System Integration; C. Toumazou. 2. RF System Board Level Integration for Mobile Phones; G.J. Aspin. 3. Integration of RF Systems on a Chip; P.J. Mole. 4. Towards the Full Integration of Wireless Front-End Circuits; M. Steyaert. 5. GSM Transceiver Front-End Circuits in 0.25  $\mu\text{m}$  CMOS; Q. Huang, et al. Part II: RF Front-End Circuits. 6. RF Front-End Circuits; Q. Huang. 7. Phase-Noise-to-Carrier Ratio in LC Oscillators; Q. Huang. 8. Design Study of a 900 MHz/1.8 GHz CMOS Transceiver for Dual-Band Applications; B. Razavi. 9. Integrated Wireless Transc.

Wireless Communication Systems: Advanced Techniques for Signal Reception offers a unified framework for understanding today's newest techniques for signal processing in communication systems - and using them to design receivers for emerging wireless systems. Two leading researchers cover a full range of physical-layer issues, including multipath, dispersion, interference, dynamism, and multiple-antenna systems. Topics include blind, group-blind, space-time, and turbo multiuser detection; narrowband

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interference suppression; Monte Carlo Bayesian signal processing; fast fading channels; advanced signal processing in coded OFDM systems, and more.

This compilation of the works and insights of various key scientists and engineers in this area addresses the current and future trends of scenarios for employing adaptive antenna arrays in communication systems. Ideal as a quick reference for engineers, researchers, advanced undergraduate and postgraduate students.

The Definitive, Comprehensive Guide to Cutting-Edge Millimeter Wave Wireless Design “This is a great book on mmWave systems that covers many aspects of the technology targeted for beginners all the way to the advanced users. The authors are some of the most credible scholars I know of who are well respected by the industry. I highly recommend studying this book in detail.” —Ali Sadri, Ph.D., Sr. Director, Intel Corporation, MCG mmWave Standards and Advanced Technologies Millimeter wave (mmWave) is today's breakthrough frontier for emerging wireless mobile cellular networks, wireless local area networks, personal area networks, and vehicular communications. In the near future, mmWave products, systems, theories, and devices will come together to deliver mobile data rates thousands of times faster than today's existing cellular and WiFi networks. In Millimeter Wave Wireless Communications, four of the field's pioneers draw on their immense experience as researchers, entrepreneurs, inventors, and consultants, empowering engineers at all levels to succeed with mmWave. They deliver exceptionally clear and useful guidance for newcomers, as well as the first complete desk reference for design experts. The authors explain mmWave signal propagation, mmWave circuit design, antenna designs, communication theory, and current standards (including IEEE 802.15.3c, Wireless HD, and ECMA/WiMedia). They cover comprehensive mmWave wireless

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design issues, for 60 GHz and other mmWave bands, from channel to antenna to receiver, introducing emerging design techniques that will be invaluable for research engineers in both industry and academia. Topics include Fundamentals: communication theory, channel propagation, circuits, antennas, architectures, capabilities, and applications Digital communication: baseband signal/channel models, modulation, equalization, error control coding, multiple input multiple output (MIMO) principles, and hardware architectures Radio wave propagation characteristics: indoor and outdoor applications Antennas/antenna arrays, including on-chip and in-package antennas, fabrication, and packaging Analog circuit design: mmWave transistors, fabrication, and transceiver design approaches Baseband circuit design: multi-gigabit-per-second, high-fidelity DAC and ADC converters Physical layer: algorithmic choices, design considerations, and impairment solutions; and how to overcome clipping, quantization, and nonlinearity Higher-layer design: beam adaptation protocols, relaying, multimedia transmission, and multiband considerations 60 GHz standardization: IEEE 802.15.3c for WPAN, Wireless HD, ECMA-387, IEEE 802.11ad, Wireless Gigabit Alliance (WiGig)

The desired objective of this book is to investigate diversity and mutual coupling effects on MIMO antenna designs for WLAN/WiMAX/LTE applications, controlled with diversity and ground modification techniques including equivalent circuit diagrams. Diversity techniques in MIMO antennas leading to the performance improvement ratings are demonstrated and deliberated. The book contributes towards the development of 2:1 VSWR MIMO antennas with diversity techniques for indoor/outdoor applications for high data rate, QOS, and SNR. The improved MIMO antenna structures are investigated and presented in this book including part

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of massive MIMO to provide the important aspects of emerging technology. Aimed at researchers, professionals and graduate students in electrical engineering, electromagnetics, communications and signal processing including antenna theory and design, smart antennas, communication systems, this book: Investigates real time MIMO antenna designs for WLAN/WiMAX/LTE applications. Covers effects of ECC, MEG, TARC, and equivalent circuit. Addresses the coupling and diversity aspects of antenna design problem for MIMO systems. Focus on the MIMO antenna designs for the real time applications. Exclusive chapter on 5G Massive MIMO along with case studies throughout the book.

The book provides insights of International Conference in Communication, Devices and Networking (ICCDN 2017) organized by the Department of Electronics and Communication Engineering, Sikkim Manipal Institute of Technology, Sikkim, India during 3 – 4 June, 2017. The book discusses latest research papers presented by researchers, engineers, academicians and industry professionals. It also assists both novice and experienced scientists and developers, to explore newer scopes, collect new ideas and establish new cooperation between research groups and exchange ideas, information, techniques and applications in the field of electronics, communication, devices and networking.

Massive MIMO Networks is the first book on the subject to cover the spatial channel correlation and consider rigorous signal processing design essential for the complete understanding by the students, practicing engineers and researchers working on modern day communication systems.

Reviews advances in the design and deployment of antenna arrays for the next generation of cellular technology, offering new solutions for the telecommunications industry Advanced



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Antenna Arrays for 5G and Beyond addresses the challenges in designing and deploying antennas which deliver 5G performance, can be collocated with 4G antennas, and are immune to interference caused by future 6G antennas mounted on airborne and spaceborne platforms. This timely and authoritative volume presents innovative solutions for developing integrated communications networks of high-gain, individually-scannable, multi-beam antennas that are reconfigurable and conform to all platforms. The text begins with an up-to-date discussion of the engineering issues facing future wireless communications systems, followed by detailed review of different beamforming networks for multi-beam antennas. Subsequent chapters address problems of 4G/5G antenna collocation, discuss differentially-fed antenna arrays, explore conformal transmit arrays for airborne platforms, and more. Based primarily on the authors' extensive work in the field, including original research never before published, this important new volume: Reviews multi-beam feed networks for 5G, array decoupling and de-scattering methods, and advances in 2D Butler matrix configurations Offers cost-effective solutions for deploying multi-beam massive antenna arrays and improving antenna pattern distortion Provides a systematic study on differentially fed antenna arrays that are resistant to interference caused by future multifunctional/multi-generation systems Features previously unpublished material on reconfigurable leaky wave antennas Includes novel algorithms for synthesizing and optimizing thinned massive arrays, conformal arrays, frequency invariant arrays, and other future arrays Advanced Antenna Arrays for 5G and Beyond is an invaluable resource for antenna engineers and researchers, as well as graduate and senior undergraduate students in the field.

Vast, complex technologies, countless relevant topics, seemingly limitless documentation of

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standards and recommendations... In a field as dynamic as wireless technology, how is one to keep up when the very task of deciding which publications to read and which resources belong on your shelf can be daunting? *Wireless Technology: Protocols, Standards, and Techniques* has sorted it out for you. From basic principles to the state of the art, it furnishes clear, concise descriptions of second and third generation wireless technologies. The bestselling author of the *Foundations of Mobile Radio Engineering* has gathered together the most up-to-date networking standards, techniques, and protocols and incorporated clear, concise treatments of the necessary background material to form the most current and complete wireless reference available. However bumpy the road may seem, the migration to a wireless world is inevitable. Whether you are a communications engineer, network analyst or designer, electrical engineer, or computer engineer, keeping up in this rapidly evolving field is imperative. This book will help you stay at the forefront of your field and contribute to making the wireless world a reality. This textbook takes a unified view of the fundamentals of wireless communication and explains cutting-edge concepts in a simple and intuitive way. An abundant supply of exercises make it ideal for graduate courses in electrical and computer engineering and it will also be of great interest to practising engineers.

In the last decades the restless evolution of information and communication technologies (ICT) brought to a deep transformation of our habits. The growth of the Internet and the advances in hardware and software implementations modified our way to communicate and to share information. In this book, an overview of the major issues faced today by researchers in the field of radio communications is given through 35

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high quality chapters written by specialists working in universities and research centers all over the world. Various aspects will be deeply discussed: channel modeling, beamforming, multiple antennas, cooperative networks, opportunistic scheduling, advanced admission control, handover management, systems performance assessment, routing issues in mobility conditions, localization, web security. Advanced techniques for the radio resource management will be discussed both in single and multiple radio technologies; either in infrastructure, mesh or ad hoc networks.

The most up-to-date, comprehensive treatment of classical and modern antennas and their related technologies Modern Antenna Handbook represents the most current and complete thinking in the field of antennas. The handbook is edited by one of the most recognizable, prominent, and prolific authors, educators, and researchers on antennas and electromagnetics. Each chapter is authored by one or more leading international experts and includes cover-age of current and future antenna-related technology. The information is of a practical nature and is intended to be useful for researchers as well as practicing engineers. From the fundamental parameters of antennas to antennas for mobile wireless communications and medical applications, Modern Antenna Handbook covers everything professional engineers, consultants, researchers, and students need to know about the recent developments and the future direction of this fast-paced field. In addition to antenna topics, the handbook also covers modern technologies such as metamaterials, microelectromechanical systems (MEMS), frequency selective surfaces

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(FSS), and radar cross sections (RCS) and their applications to antennas, while five chapters are devoted to advanced numerical/computational methods targeted primarily for the analysis and design of antennas.

Radio Propagation and Adaptive Antennas for Wireless Communication Networks, 2nd Edition, presents a comprehensive overview of wireless communication system design, including the latest updates to considerations of over-the-terrain, atmospheric, and ionospheric communication channels. New features include the latest experimentally-verified stochastic approach, based on several multi-parametric models; all-new chapters on wireless network fundamentals, advanced technologies, and current and modern multiple access networks; and helpful problem sets at the conclusion of each chapter to enhance clarity. The volume's emphasis remains on a thorough examination of the role of obstructions on the corresponding propagation phenomena that influence the transmission of radio signals through line-of-sight (LOS) and non-line-of-sight (NLOS) propagation conditions along the radio path between the transmitter and the receiver antennas—and how adaptive antennas, used at the link terminals, can be used to minimize the deleterious effects of such obstructions. With its focus on 3G, 4G, MIMO, and the latest wireless technologies, Radio Propagation and Adaptive Antennas for Wireless Communication Networks represents an invaluable resource to topics critical to the design of contemporary wireless communication systems. Explores novel wireless networks beyond 3G, and advanced 4G technologies, such as MIMO, via

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propagation phenomena and the fundamentals of adapted antenna usage. Explains how adaptive antennas can improve GoS and QoS for any wireless channel, with specific examples and applications in land, aircraft and satellite communications. Introduces new stochastic approach based on several multi-parametric models describing various terrestrial scenarios, which have been experimentally verified in different environmental conditions New chapters on fundamentals of wireless networks, cellular and non-cellular, multiple access networks, new applications of adaptive antennas for positioning, and localization of subscribers Includes the addition of problem sets at the end of chapters describing fundamental aspects of wireless communication and antennas.

Physical limitations on wireless communication channels impose huge challenges to reliable communication. Bandwidth limitations, propagation loss, noise and interference make the wireless channel a narrow pipe that does not readily accommodate rapid flow of data. Thus, researches aim to design systems that are suitable to operate in such channels, in order to have high performance quality of service. Also, the mobility of the communication systems requires further investigations to reduce the complexity and the power consumption of the receiver. This book aims to provide highlights of the current research in the field of wireless communications. The subjects discussed are very valuable to communication researchers rather than researchers in the wireless related areas. The book chapters cover a wide range of wireless communication topics.

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Fixed broadband networks can provide far higher data rates and capacity than the currently envisioned 3G and 4G mobile cellular systems. Achieving higher data rates is due to the unique technical properties of fixed systems, in particular, the use of high gain and adaptive antennas, wide frequency bands, dynamic data rate and channel resource allocation, and advanced multiple access techniques. Fixed Broadband Wireless System Design is a comprehensive presentation of the engineering principles, advanced engineering techniques, and practical design methods for planning and deploying fixed wireless systems, including: Point-to-point LOS and NLOS network design Point-to-point microwave link design including active and passive repeaters Consecutive point and mesh network planning Advanced empirical and physical propagation modeling including ray-tracing Detailed microwave fading models for multipath and rain NLOS (indoor and outdoor) propagation and fading models Propagation environment models including terrain, morphology, buildings, and atmospheric effects Novel mixed application packet traffic modeling for dimensioning network capacity Narrow beam, wide beam, and adaptive (smart) antennas MIMO systems and space-time coding Channel planning including fixed and dynamic channel assignment and dynamic packet assignment IEEE 802.11b and 802.11a (WLAN) system design Free space optic (FSO) link design At present, there are no titles available that provide such a concise presentation of the wide variety of systems, frequency bands, multiple access techniques, and other factors that distinguish fixed

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wireless systems from mobile wireless systems. Fixed Broadband Wireless System Design is essential reading for design, system and RF engineers involved in the design and deployment of fixed broadband wireless systems, fixed wireless equipment vendors, and academics and postgraduate students in the field.

This is an extensively revised and updated new edition of the best-selling Mobile Antenna Systems Handbook. Comprehensive, authoritative and practical, it provides the information you need to understand the relationship between the elements involved in antenna systems design for mobile communications. You get sound advice in choosing the appropriate antenna for any given requirement - including antennas for ITS, access to the latest modeling formulas for macro, micro and pico cell propagation, and guidance on the latest RF safety standards and measurement techniques.

Digital Beamforming in Wireless Communications Artech House Publishers  
Provides information on smart antenna technologies featuring contributions with in-depth descriptions of terminologies, concepts, methods, and applications related to smart antennas in various wireless systems.

This book provides an excellent reference for all professionals working in the area of array signal processing and its applications in wireless communications. Wideband beamforming has advanced with the increasing bandwidth in wireless communications and the development of ultra wideband (UWB) technology. In this book, the authors address the fundamentals and most recent developments in the field of wideband

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beamforming. The book provides a thorough coverage of the subject including major sub-areas such as sub-band adaptive beamforming, frequency invariant beamforming, blind wideband beamforming, beamforming without temporal processing, and beamforming for multi-path signals. Key Features: Unique book focusing on wideband beamforming Discusses a hot topic coinciding with the increasing bandwidth in wireless communications and the development of UWB technology Addresses the general concept of beamforming including fixed beamformers and adaptive beamformers Covers advanced topics including sub-band adaptive beamforming, frequency invariant beamforming, blind wideband beamforming, beamforming without temporal processing, and beamforming for multi-path signals Includes various design examples and corresponding complexity analyses This book provides a reference for engineers and researchers in wireless communications and signal processing fields. Postgraduate students studying signal processing will also find this book of interest.

Explosive growth of wireless communications is demanding increased system capacity for mobile communications satellites - and the expert authors of this first-of-a-kind book explore a promising, cost-effective solution: digital beamforming (DBF) technology. Wireless communications and sensing systems are nowadays ubiquitous: cell phones and automotive radars typifying two of the most familiar examples. This book introduces the field by addressing its fundamental principles, proceeding from its very beginnings up to today's emerging technologies related to the fifth-generation wireless systems



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(5G), Multi-Input Multiple Output (MIMO) connectivity, and Aerospace/Electronic Warfare Radar. The tone is tutorial. Problems are included at the end of each chapter to facilitate the understanding and assimilation of the material to electrical engineering undergraduate/graduate students and beginning and non-specialist professionals. Free temporary access to Keysight's SystemVue system simulation is provided to further enhance reader learning through hands-on tutorial exercises. Chapter 1 introduces wireless communications and sensing and in particular how curiosity-driven scientific research led to the foundation of the field. Chapter 2 presents a brief introduction to the building blocks that make up wireless systems. Chapter 3 focuses on developing an understanding of the performance parameters that characterize a wireless system. Chapter 4 deals with circuit topologies for modulation and detection. In Chapter 5 we cover the fundamental transmitter and receiver systems architectures that enable the transmission of information at precise frequencies and their reception from among a rather large multitude of other signals present in space. Chapter 6 introduces 5G, its motivation, and its development and adoption challenges for providing unprecedented levels of highest speed wireless connectivity. Chapter 7 takes on the topic of MIMO, its justification and its various architectures. Chapter 8 addresses the topic of aerospace/electronic warfare radar and finally Chapter 9 presents three Tutorials utilizing the SystemVue simulation tool.

Offers practitioners, researchers, and academicians with fundamental principles of

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cooperative communication. This book provides readers diverse findings and exposes underlying issues in the analysis, design, and optimization of wireless systems. The aim of this book is to present the modern design and analysis principles of millimeter-wave communication system for wireless devices and to give postgraduates and system professionals the design insights and challenges when integrating millimeter wave personal communication system. Millimeter wave communication system are going to play key roles in modern gigabit wireless communication area as millimeter-wave industrial standards from IEEE, European Computer Manufacturing Association (ECMA) and Wireless High Definition (Wireless HD) Group, are on their way to the market. The book will review up-to-date research results and utilize numerous design and analysis for the whole system covering from Millimeter wave frontend to digital signal processing in order to address major topics in a high speed wireless system. This book emphasizes the importance and the requirements of high-gain antennas, low power transceiver, adaptive equalizer/modulation, channeling coding and adaptive multi-user detection for gigabit wireless communications. In addition, the book will include the updated research literature and patents in the topics of transceivers, antennas, MIMO, channel capacity, coding, equalizer, Modem and multi-user detection. Finally the application of these antennas will be discussed in light of different forthcoming wireless standards at V-band and E-band. Beyond 2020, wireless communication systems will have to support more than 1,000

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times the traffic volume of today's systems. This extremely high traffic load is a major issue faced by 5G designers and researchers. This challenge will be met by a combination of parallel techniques that will use more spectrum more flexibly, realize higher spectral efficiency, and densify cells. Novel techniques and paradigms must be developed to meet these goals. The book addresses diverse key-point issues of next-generation wireless communications systems and identifies promising solutions. The book's core is concentrated to techniques and methods belonging to what is generally called radio access network.

During 12-15 of September 1999, 10th International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC'99) was held in Osaka Japan, and it was really a successful symposium that accommodated more than 600 participants from more than 30 countries and regions. PIMRC is really well organized annual symposium for wireless multimedia communication systems, in which, various up-to-date topics are discussed in the invited talk, panel discussions and tutorial sessions. One of the unique features of the PIMRC is that PIMRC is continuing to publish, from Kluwer Academic Publishers since 1997, a book that collects the hottest topics discussed in PIMRC. In PIMRC'97, Invited talks were summarized in "Wireless Communications –TDMA versus CDMA – (ISBN 0-7923- 8005-3)," and it was published just before PIMRC'97. This book was also distributed to all the PIMRC'97 participants as a part of proceedings for the conference. In PIMRC'98, extended version of the invited papers were summarized in

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Wireless Multimedia Network Technologies (ISBN 0-7923-8633- 7) and published in September 1999, which is almost the same timing for the PIMRC'99. In the case of PIMRC'99, to produce more informative book, we have - lected topics that attracted many PIMRC'99 participants during the conf- ence, and invited prospective authors not only from the invited speakers but also from tutorial speakers, panel organizers, panelists, and some other exc- lent PIMRC'99 participants.

Enabling Technologies for Next Generation Wireless Communications provides up-to-date information on emerging trends in wireless systems, their enabling technologies and their evolving application paradigms. This book includes the latest trends and developments toward next generation wireless communications. It highlights the requirements of next generation wireless systems, limitations of existing technologies in delivering those requirements and the need to develop radical new technologies. It focuses on bringing together information on various technological developments that are enablers vital to fulfilling the requirements of future wireless communication systems and their applications. Topics discussed include spectrum issues, network planning, signal processing, transmitter, receiver, antenna technologies, channel coding, security and application of machine learning and deep learning for wireless communication systems. The book also provides information on enabling business models for future wireless systems. This book is useful as a resource for researchers and practitioners worldwide, including industry practitioners, technologists, policy

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decision-makers, academicians, and graduate students.

The process of Integrated Circuits (IC) started its era of VLSI (Very Large Scale Integration) in 1970's when thousands of transistors were integrated into one single chip. Nowadays we are able to integrate more than a billion transistors on a single chip. However, the term "VLSI" is still being used, though there was some effort to coin a new term ULSI (Ultra-Large Scale Integration) for fine distinctions many years ago. VLSI technology has brought tremendous benefits to our everyday life since its occurrence. VLSI circuits are used everywhere, real applications include microprocessors in a personal computer or workstation, chips in a graphic card, digital camera or camcorder, chips in a cell phone or a portable computing device, and embedded processors in an automobile, et al. VLSI covers many phases of design and fabrication of integrated circuits. For a commercial chip design, it involves system definition, VLSI architecture design and optimization, RTL (register transfer language) coding, (pre- and post-synthesis) simulation and verification, synthesis, place and route, timing analyses and timing closure, and multi-step semiconductor device fabrication including wafer processing, die preparation, IC packaging and testing, et al. As the process technology scales down, hundreds or even thousands of millions of transistors are integrated into one single chip. Hence, more and more complicated systems can be integrated into a single chip, the so-called System-on-chip (SoC), which brings to VLSI engineers ever increasingly challenges to master techniques in various phases of VLSI

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design. For modern SoC design, practical applications are usually speed hungry. For instance, Ethernet standard has evolved from 10Mbps to 10Gbps. Now the specification for 100Mbps Ethernet is on the way. On the other hand, with the popularity of wireless and portable computing devices, low power consumption has become extremely critical. To meet these contradicting requirements, VLSI designers have to perform optimizations at all levels of design. This book is intended to cover a wide range of VLSI design topics. The book can be roughly partitioned into four parts. Part I is mainly focused on algorithmic level and architectural level VLSI design and optimization for image and video signal processing systems. Part II addresses VLSI design optimizations for cryptography and error correction coding. Part III discusses general SoC design techniques as well as other application-specific VLSI design optimizations. The last part will cover generic nano-scale circuit-level design techniques.

This is a comprehensive reference for readers wanting to learn about the entire range of relevant aspects in wireless communications.

Wireless technologies and applications are becoming one of the fastest growing and most promising areas in recent years. To accommodate data transmission by multiple stations sharing the scarce wireless bandwidth, a medium access control (MAC) protocol plays a crucial role in scheduling packet transmission fairly and efficiently. The emerging wireless networks, such as ad-hoc networks, sensor networks or mesh

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networks, are mostly multi-hop based and in distributed manner, which brings a lot of problems and challenges in designing fine-tuned MAC protocols tailored for modern wireless network. In this book, the authors give complete and in-depth overviews to the classic medium access control algorithms and the related protocols, as well as their applications in various wireless data networks especially the most successful Wireless Local Area Networks (WLAN). The book consists of three major parts. Part I of this book, including Chapters 1-7, is emphasising on the fundamentals of medium access control algorithms and protocols. Chapter 1 provides an introduction to the wireless networks, such as overview of wireless networks, problems and challenges of the wireless networks, and the classifications of MAC protocols as well as the performance metrics. Chapter 2 introduces important collision resolution algorithms applied in medium access controls, for example, the splitting algorithm and the backoff algorithm. Chapter 3 reviews the hybrid access control algorithms that combine both contention and allocation schemes. A series of important collision avoidance schemes are introduced in Chapters 4-7 respectively, with a specific design goal covered in each chapter. Chapter 4 focuses on the multi-channel MAC protocols for collision avoidance; Chapter 5 introduces the concepts of power control and power management in medium access control and how they can be applied in MAC protocol design; Chapter 6 presents how to provide Quality-of-Service (QoS) to multimedia wireless networks, in either centralised or distributed manner; and Chapter 7 explains how the smart

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antennas can be applied in the medium access control to provide high channel throughput and low packet collision.

Bridging the gap between the video compression and communication communities, this unique volume provides an all-encompassing treatment of wireless video communications, compression, channel coding, and wireless transmission as a joint subject. WIRELESS VIDEO COMMUNICATIONS begins with relatively simple compression and information theoretical principles, continues through state-of-the-art and future concepts, and concludes with implementation-ready system solutions. This book's deductive presentation and broad scope make it essential for anyone interested in wireless communications. It systematically converts the lessons of Shannon's information theory into design principles applicable to practical wireless systems. It provides in a comprehensive manner "implementation-ready" overall system design and performance studies, giving cognizance to the contradictory design requirements of video quality, bit rate, delay, complexity error resilience, and other related system design aspects. Topics covered include information theoretical foundations block-based and convolutional channel coding very-low-bit-rate video codecs and multimode videophone transceivers high-resolution video coding using both proprietary and standard schemes CDMA/OFDM systems, third-generation and beyond adaptive video systems. WIRELESS VIDEO COMMUNICATIONS is a valuable reference for postgraduate researchers, system engineers, industrialists, managers and visual



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communications practitioners.

A comprehensive overview of the 5G landscape covering technology options, most likely use cases and potential system architectures.

This book introduces the basic theory and key technologies of MIMO multi-antenna system, the characteristics and applications of spatial multi-dimensional cooperative transmission in the Ground-based, Air-based and Space-based communication systems as well as several advanced technologies for spatial multidimensional cooperative transmission from theoretical and practical perspectives. The Chinese edition of this book won the 4th Chinese Government Award for Publishing, and the authors are well known in the field of Spatial Information Network.

A wireless communication system employs a radio frequency (RF) wave to transmit information bearing signals. In modern digital communication systems, sophisticated modulation techniques are developed to modulate information onto an RF carrier waveform, so as to transmit more information. This new book presents signal processing techniques for reducing impairments of analog and RF circuits in wireless communications systems. Engineers, researchers, and students will find full coverage of the topic, including vector modulators, power amplifiers, vector demodulators, group delay distortion in analog/RF filters, digital beamforming networks, and dual polarization systems. Several applications are discussed, including both single carrier and multi-carrier scenarios.

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