

Efficient Cooperative Spectrum In Cognitive Radio

Cooperative Spectrum Sensing and Resource Allocation Strategies in Cognitive Radio Networks Performance of Cooperative Spectrum Sensing in Cognitive Radio Networks Cooperative Spectrum Sensing for Cognitive Radio Networks Cooperative Cognitive Spectrum Sensing Based on Optimized Time-Frequency Signal Analysis Artificial Intelligent Techniques for Wireless Communication and Networking Cooperative Cognitive Radio Networks Advancement in Sensing Technology Spectrum Sharing in Cognitive Radio Networks Sensing Techniques for Next Generation Cognitive Radio Networks Modeling and Design of Secure Internet of Things Cooperative Cognitive Radio Networks Cognitive Radio Techniques Cognitive Radio, Mobile Communications and Wireless Networks Cognitive Radio Networks Spectrum Sharing Cognitive Radio Networks Optimization with Spectrum Sensing Algorithms On Spectrum Sensing, Resource Allocation, and Medium Access Control in Cognitive Radio Networks Spectrum Sensing for Cognitive Radio Spectrum Sensing for Cognitive Radio Distributed Cooperative Control Cognitive Radio Sensor Networks: Applications, Architectures, and Challenges Spectrum Sensing Based on Capon Power Spectral Density Estimation Cognitive Radio-Oriented Wireless Networks Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems Handbook of Cognitive Radio 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) Proceedings of the 2nd International Conference on Communication, Devices and Computing Dynamic Spectrum Management Cognitive Radio Networks Complex, Intelligent, and Software Intensive Systems Cognitive Radio Communication and Networking Intelligent Spectrum Handovers in Cognitive Radio Networks Spectrum Sharing for Wireless Communications Measure and Integral Cognitive Radio Networks Cognitive Radios Dynamic Spectrum Access and Management in Cognitive Radio Networks 2019 IEEE Globecom Workshops (GC Wkshps) Adversary Detection For Cognitive Radio Networks Techno-Societal 2020

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Cognitive Radio Communication and Networking Mar 29 2020 The author presents a unified treatment of this highly interdisciplinary topic to help define the notion of cognitive radio. The book begins with addressing issues such as the fundamental system concept and basic mathematical tools such as spectrum sensing and machine learning, before moving on to more advanced concepts and discussions about the future of cognitive radio. From the fundamentals in spectrum sensing to the applications of cognitive algorithms to radio communications, and discussion of radio platforms and testbeds to show the applicability of the theory to practice, the author aims to provide an introduction to a fast moving topic for students and researchers seeking to develop a thorough understanding of cognitive radio networks. Examines basic mathematical tools before moving on to more advanced concepts and discussions about the future of cognitive radio Describe the fundamentals of cognitive radio, providing a step by step treatment of the topics to enable progressive learning Includes questions, exercises and suggestions for extra reading at the end of each chapter Topics covered in the book include: Spectrum Sensing: Basic Techniques; Cooperative Spectrum Sensing Wideband Spectrum Sensing; Agile Transmission Techniques: Orthogonal Frequency Division Multiplexing Multiple Input Multiple Output for Cognitive Radio; Convex Optimization for Cognitive Radio; Cognitive Core (I): Algorithms for Reasoning and Learning; Cognitive Core (II): Game Theory; Cognitive Radio Network IEEE 802.22: The First Cognitive Radio Wireless Regional Area Network Standard, and Radio Platforms and Testbeds.

Proceedings of the 2nd International Conference on Communication, Devices and Computing Aug 02 2020 This book gathers high-quality papers presented at the 2nd International Conference on Communication, Devices & Computing (ICCDC 2019), held at Haldia Institute of Technology from March 14–15, 2019. The papers are divided into three main areas: communication technologies, electronics circuits & devices and computing. Written by students and researchers from around the world, they accurately reflect the global status quo.

Cooperative Cognitive Radio Networks May 23 2022 Cooperative Cognitive Radio Networks: The Complete Spectrum Cycle provides a solid understanding of the foundations of cognitive radio technology, from spectrum sensing, access, and handoff to routing, trading, and security. Written in a tutorial style with several illustrative examples, this comprehensive book: Gives an overview of cognitive radio systems and explains the different components of the spectrum cycle Features step-by-step analyses of the different algorithms and systems, supported by extensive computer simulations, figures, tables, and references Fulfills the need for a single source of information on all aspects of the spectrum cycle, including the physical, link, medium access, network, and application layers Offering a unifying view of the various approaches and methodologies, Cooperative Cognitive Radio Networks: The Complete Spectrum Cycle presents the state of the art of cognitive radio technology, addressing all phases of the spectrum access cycle.

Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems Nov 05 2020 Today's wireless services have come a long way since the roll out of the conventional voice-centric cellular systems. The demand for wireless access in voice and high rate data multi-media applications has been increasing. New generation wireless communication systems are aimed at accommodating this demand through better resource management and improved transmission technologies. The interest in increasing Spectrum Access and improving Spectrum Efficiency combined with both the introduction of Software Defined Radios and the realization that machine learning can be applied to radios has created new intriguing possibilities for wireless radio researchers. This book is aimed to discuss the cognitive radio, software defined radio (SDR), and adaptive radio concepts from several aspects. Cognitive radio and cognitive networks will be investigated from a broad aspect of wireless communication system enhancement while giving special emphasis on better spectrum utilization. Applications of cognitive radio, SDR and cognitive radio architectures, spectrum efficiency and soft spectrum usage, adaptive wireless system design, measurements and awareness of various parameters including interference temperature and geo-location information are some of the important topics that will be covered in this book. Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems is intended to be both an introductory technology survey/tutorial for beginners and an advanced mathematical overview intended for technical professionals in the communications industry, technical managers, and researchers in both academia and industry.

Cognitive Radios Oct 24 2019 Cognitive Radio can smartly sense and adapts with the changing environment by altering its transmitting parameters, such as modulation, frequency, frame format etc. The main challenges with cognitive radios are that it should not interfere with the licensed users and should vacate the band when required. For this it should sense the signals faster. For this purpose various detection schemes like energy detector, matched filter and cyclostationary feature detector are discussed in this report and performance evaluation of these is calculated. Besides this a performance evaluation is done between cooperative and non cooperative spectrum sensing schemes which uses Amplify-and-Forward algorithm is also discussed. All simulations are done in MATLAB.

Advancement in Sensing Technology Apr 22 2022 The book presents the recent advancements in the area of sensors and sensing technology, specifically in environmental monitoring, structural health monitoring, dielectric, magnetic, electrochemical, ultrasonic, microfluidic, flow, surface acoustic wave, gas, cloud computing and bio-medical. This book will be useful to a variety of readers, namely, Master and PhD degree students, researchers, practitioners, working on sensors and sensing technology. The book will provide an opportunity of a dedicated and a deep approach in order to improve their knowledge in this specific field.

Cognitive Radio Networks May 31 2020 Resource allocation is an important issue in wireless communication networks. In recent decades, cognitive radio-based networks have garnered increased attention and have been well studied to overcome the problem of spectrum scarcity in future wireless communications systems. Many new challenges in resource allocation appear in cognitive radio-based networks. This book focuses on effective resource allocation solutions in several important cognitive radio-based networks, including opportunistic spectrum access networks, cooperative sensing networks, cellular networks, high-speed vehicle networks, and smart grids. Cognitive radio networks are composed of cognitive, spectrum-agile devices capable of changing their configuration on the fly based on the spectral environment. This capability makes it possible to design flexible and dynamic spectrum access strategies with the purpose of opportunistically reusing portions of the spectrum temporarily vacated by licensed primary users. Different cognitive radio-based networks focus on different network resources, such as transmission slots, sensing nodes, transmission power, white space, and sensing channels. This book introduces several innovative resource allocation schemes for different cognitive radio-based networks according to their network characteristics: Opportunistic spectrum access networks – Introduces a probabilistic slot allocation scheme to effectively allocate the transmission slots to secondary users to maximize throughput Cooperative sensing networks – Introduces a new adaptive collaboration sensing scheme in which the resources of secondary users are effectively utilized to sense the channels for efficient acquisition of spectrum opportunities Cellular networks – Introduces a framework of cognitive radio-assisted cooperation for downlink transmissions to allocate transmission modes, relay stations, and transmission power/sub-channels to secondary users to maximize throughput High-speed vehicle networks – Introduces schemes to maximize the utilized TV white space through effective allocation of white space resources to secondary users Smart grids – Introduces effective sensing channel allocation strategies for acquiring enough available spectrum channels for communications between utility and electricity consumers

Cooperative Cognitive Spectrum Sensing Based on Optimized Time-Frequency Signal Analysis Jul 25 2022 Spectrum sensing is used in cognitive radio to detect the free portions of spectrum in a licensed frequency band. We introduce a cooperative spectrum sensing scenario in which the decisions from the secondary users are combined for better sensing accuracy. Each secondary user sends its decision to a central node which combines all individual decisions. A discrete Fourier transform (DFT) filter bank based architecture is used by each secondary user for efficient detection of a primary user signal in a desired time-frequency slot. The prototype filters underlying the DFT filter banks are optimized to provide maximum time-frequency resolution. We formulate an objective function to represent the time-frequency distribution of signal energy and use numerical methods to obtain optimized prototype filter To address the problem of noise power uncertainty in cognitive radio systems, we introduce a method for denoising the received signal which is based on goodness-of-fit statistical test. We compare the performance of the proposed method with other spectrum sensing methods in terms of receiver operating characteristics (ROC). The spectrum sensing performance is also analyzed in the presence of noise power uncertainty. Finally, the hardware implementation aspects of the proposed architecture are also analyzed using a field programmable gate array (FPGA).

Artificial Intelligent Techniques for Wireless Communication and Networking Jun 24 2022 ARTIFICIAL INTELLIGENT TECHNIQUES FOR WIRELESS COMMUNICATION AND NETWORKING The 20 chapters address AI principles and techniques used in wireless communication and networking and outline their benefit, function, and future role in the field. Wireless communication and networking based on AI concepts and techniques are explored in this book, specifically focusing on the current research in the field by highlighting empirical results along with theoretical concepts. The possibility of applying AI mechanisms towards security aspects in the communication domain is elaborated; also explored is the application side of integrated technologies that enhance AI-based innovations, insights, intelligent predictions, cost optimization, inventory management, identification processes, classification mechanisms, cooperative spectrum sensing techniques, ad-hoc network architecture, and protocol and simulation-based environments. Audience Researchers, industry IT engineers, and graduate students working on and implementing AI-based wireless sensor networks, 5G, IoT, deep learning, reinforcement learning, and robotics in WSN, and related technologies.

Cooperative Spectrum Sensing for Cognitive Radio Networks Aug 26 2022 Cognitive networks assure to tackle spectrum deficiency problems by accommodating secondary (unlicensed) users, in the spectrum region which is under-utilized. Cooperative Spectrum Sensing methodologies are still an open window of research. This work is related to cope up the problem of spectrum deficiency and associated problems, by developing an approach for establishment of grouping/clustering among secondary users in a cooperative spectral environment. This approach ensures that members within a group are highly correlated. As a result, the workload on each sensing node within a group is reduced. The effectiveness of this approach depends upon the accuracy of fused decision related to the presence or absence of primary (licensed) user at a particular band (50MHZ to 100MHZ). This approach also depends on the factor that time taken in sensing the primary (licensed) users should be less enough so that decision in vacating the band by the Cognitive Radio secondary users could be taken in fewer time frames. This latter metric is known as 'agility', which eventually comes with the outcome of minimum interference to primary users via their early recognition.

Cognitive Radio Networks Optimization with Spectrum Sensing Algorithms Jul 13 2021 In recent years, a considerable amount of effort has been devoted, both in industry and academia, towards the efficient utilization of the available spectrum under the various propagation models which lead towards the design and dimensioning of the future network Internet of Things (IoT). This book focuses on Television White Space (TVWS) opportunities and regulatory aspects for cognitive radio applications, and includes case studies for the exploitation of TVWS depending on user's mobility, and the geo-location between user and the Base Station. The book presents recent advances in spectrum sensing, reflecting state of the art technology and research achievements in this area as well as a new insights in spectrum sensing of performance modeling, analysis and worldwide applications. Technical topics discussed include: Novel Application of TV White Space Spectrum Sensing in Cognitive Radio Cooperative Spectrum Sensing DoA Estimation Algorithms

Dynamic Spectrum Management Jul 01 2020 This open access book, authored by a world-leading researcher in this field, describes fundamentals of dynamic spectrum management, provides a systematic overview on the enabling technologies covering cognitive radio,

blockchain, and artificial intelligence, and offers valuable guidance for designing advanced wireless communications systems. This book is intended for a broad range of readers, including students and professionals in this field, as well as radio spectrum policy makers.

Cooperative Spectrum Sensing and Resource Allocation Strategies in Cognitive Radio Networks Oct 28 2022 Cognitive radio networks (CRN) will be widely deployed in the near future, and this SpringerBrief covers some important aspects of it, as well as highlighting optimization strategies in Resource Allocation and Spectrum Sensing in CRNs. The cognitive approach in radio access is introduced in the first part of this SpringerBrief, and then next the benefits of cooperative spectrum sensing are highlighted and a framework for studying it under realistic channel conditions is described. New exact closed-form expressions for average false alarm probability and average detection probability are derived in this scenario. A novel approximation to alleviate the computational complexity of the proposed models are also discussed. Once the spectrum opportunities are identified, efficient and systematic resource allocation (RA) shall be performed. The second part of this SpringerBrief describes the taxonomy for the RA process in CRN. A comprehensive overview of the optimization strategies of the CRN RA is also provided. The device-to-device (D2D) communication scenario is discussed, then as a case study and various optimization strategies for the application of the CR technology in the D2D realm is studied. The application of advanced geometric water-filling (GWF) approach in CRN D2D environment for optimum resource allocation is presented in detail. Numerical results provide more insight quantitatively. Overall, this book is suitable for a wide audience that include students, faculty and researchers in wireless communication area and professionals in the wireless service industry.

Distributed Cooperative Control Mar 09 2021 Examines new cooperative control methodologies tailored to real-world applications in various domains such as in communication systems, physics systems, and multi-robotic systems Provides the fundamental mechanism for solving collective behaviors in naturally-occurring systems as well as cooperative behaviors in man-made systems Discusses cooperative control methodologies using real-world applications, including semi-conductor laser arrays, mobile sensor networks, and multi-robotic systems Includes results from the research group at the Stevens Institute of Technology to show how advanced control technologies can impact challenging issues, such as high energy systems and oil spill monitoring

Spectrum Sensing Based on Capon Power Spectral Density Estimation Jan 07 2021

Cognitive Radio Networks Nov 24 2019 Resource allocation is an important issue in wireless communication networks. In recent decades, cognitive radio-based networks have garnered increased attention and have been well studied to overcome the problem of spectrum scarcity in future wireless communications systems. Many new challenges in resource allocation appear in cognitive radio-based networks. This book focuses on effective resource allocation solutions in several important cognitive radio-based networks, including opportunistic spectrum access networks, cooperative sensing networks, cellular networks, high-speed vehicle networks, and smart grids. Cognitive radio networks are composed of cognitive, spectrum-agile devices capable of changing their configuration on the fly based on the spectral environment. This capability makes it possible to design flexible and dynamic spectrum access strategies with the purpose of opportunistically reusing portions of the spectrum temporarily vacated by licensed primary users. Different cognitive radio-based networks focus on different network resources, such as transmission slots, sensing nodes, transmission power, white space, and sensing channels. This book introduces several innovative resource allocation schemes for different cognitive radio-based networks according to their network characteristics: Opportunistic spectrum access networks - Introduces a probabilistic slot allocation scheme to effectively allocate the transmission slots to secondary users to maximize throughput Cooperative sensing networks - Introduces a new adaptive collaboration sensing scheme in which the resources of secondary users are effectively utilized to sense the channels for efficient acquisition of spectrum opportunities Cellular networks - Introduces a framework of cognitive radio-assisted cooperation for downlink transmissions to allocate transmission modes, relay stations, and transmission power/sub-channels to secondary users to maximize throughput High-speed vehicle networks - Introduces schemes to maximize the utilized TV white space through effective allocation of white space resources to secondary users Smart grids - Introduces effective sensing channel allocation strategies for acquiring enough available spectrum channels for communications between utility and electricity consumers Dynamic Spectrum Access and Management in Cognitive Radio Networks Sep 22 2019 An all-inclusive introduction to this revolutionary technology, presenting the key research issues and state-of-the-art design, analysis, and optimization techniques.

Spectrum Sensing for Cognitive Radio Apr 10 2021 "This comprehensive reference text discusses concepts of cognitive radio and the advances in the field of spectrum sensing. This text discusses the concept of cognitive radio for next generation wireless communication and a very critical aspect of cognitive radio - that is, spectrum sensing - in detail. It covers important topics including narrowband spectrum sensing, wideband spectrum sensing, cooperative spectrum sensing, system and channel models, detection algorithms, approximation of decision statistics and theoretical analysis of detection algorithms in detail. Separate chapters are dedicated to discussing the analysis and use of detection algorithms for narrowband spectrum sensing, wideband spectrum sensing and cooperative wideband spectrum sensing. Aimed at graduate students and academic researchers in the fields of electrical engineering and electronics and communication engineering, this text: Discusses concepts of cognitive radio and research in spectrum sensing; presents mathematical analysis of algorithms considering practical environment; explains novel wideband spectrum sensing algorithms with detailed analysis; provides mathematical derivations to help readers; discusses basic spectrum sensing algorithms from narrowband spectrum sensing to the more advanced wideband spectrum sensing."--

Sensing Techniques for Next Generation Cognitive Radio Networks Feb 20 2022 The inadequate use of wireless spectrum resources has recently motivated researchers and practitioners to look for new ways to improve resource efficiency. As a result, new cognitive radio technologies have been proposed as an effective solution. Sensing Techniques for Next Generation Cognitive Radio Networks is a pivotal reference source that provides vital research on the application of spectrum sensing techniques. While highlighting topics such as radio identification, compressive sensing, and wavelet transform, this publication explores the standards and the methods of cognitive radio network architecture. This book is ideally designed for IT and network engineers, practitioners, and researchers seeking current research on radio scene analysis for cognitive radios and networks.

Spectrum Sharing Aug 14 2021 Combines the latest trends in spectrum sharing, both from a research and a standards/regulation/experimental standpoint Written by noted professionals from academia, industry, and research labs, this unique book provides a comprehensive treatment of the principles and architectures for spectrum sharing in order to help with the existing and future spectrum crunch issues. It presents readers with the most current standardization trends, including CEPT / CEE, eLSA, CBRS, MulteFire, LTE-Unlicensed (LTE-U), LTE WLAN integration with Internet Protocol security tunnel (LWIP), and LTE/Wi-Fi aggregation (LWA), and offers substantial trials and experimental results, as well as system-level performance evaluation results. The book also includes a chapter focusing on spectrum policy reinforcement and another on the economics of spectrum sharing. Beginning with the historic form of cognitive radio, Spectrum Sharing: The Next Frontier in Wireless Networks continues with current standardized forms of spectrum sharing, and reviews all of the technical ingredients that may arise in spectrum sharing approaches. It also looks at policy and implementation aspects and ponders the future of the field. White spaces and data base-assisted spectrum sharing are discussed, as well as the licensed shared access approach and cooperative communication techniques. The book also covers reciprocity-based beam forming techniques for spectrum sharing in MIMO

networks; resource allocation for shared spectrum networks; large scale wireless spectrum monitoring; and much more. Contains all the latest standardization trends, such as CEPT / ECC, eLSA, CBRS, MulteFire, LTE-Unlicensed (LTE-U), LTE WLAN integration with Internet Protocol security tunnel (LWIP) and LTE/Wi-Fi aggregation (LWA) Presents a number of emerging technologies for future spectrum sharing (collaborative sensing, cooperative communication, reciprocity-based beamforming, etc.), as well as novel spectrum sharing paradigms (e.g. in full duplex and radar systems) Includes substantial trials and experimental results, as well as system-level performance evaluation results Contains a dedicated chapter on spectrum policy reinforcement and one on the economics of spectrum sharing Edited by experts in the field, and featuring contributions by respected professionals in the field world wide *Spectrum Sharing: The Next Frontier in Wireless Networks* is highly recommended for graduate students and researchers working in the areas of wireless communications and signal processing engineering. It would also benefit radio communications engineers and practitioners.

Cognitive Radio Techniques Nov 17 2021 Providing an in-depth treatment of the core enablers of cognitive radio technology, this unique book places emphasis on critical areas that have not been sufficiently covered in existing literature. You find expert guidance in the key enablers with respect to communications and signal processing. The book presents fundamentals, basic solutions, detailed discussions of important enabler issues, and advanced algorithms to save you time with your projects in the field. For the first time in any book, you find an adequately detailed treatment of spectrum sensing that covers nearly every aspect of the subject. Moreover, this valuable resource provides you with thorough working knowledge of localization and interference mitigation as enablers of cognitive radio technology. The book includes all the necessary mathematics, statistical and probabilistic treatments, and performance analysis to give you a comprehensive understanding of the material.

Cognitive Radio Sensor Networks: Applications, Architectures, and Challenges Feb 08 2021 "This book examines how wireless sensor nodes with cognitive radio capabilities can address these network challenges and improve the spectrum utilization, presenting a broader picture on the applications, architecture, challenges, and open research directions in the area of WSN research"--Provided by publisher.

Intelligent Spectrum Handovers in Cognitive Radio Networks Feb 26 2020 This book highlights the need for an efficient Handover Decision (HD) mechanism to perform switches from one network to another and to provide unified and continuous mobile services that include seamless connectivity and ubiquitous service access. The author shows how the HD involves efficiently combining handover initiation and network selection process. The author describes how the network selection decision is a challenging task that is a central component to making HD for any mobile user in a heterogeneous environment that involves a number of static and dynamic parameters. The author also discusses prevailing technical challenges like Dynamic Spectrum Allocation (DSA) methods, spectrum sensing, cooperative communications, cognitive network architecture protocol design, cognitive network security challenges and dynamic adaptation algorithms for cognitive system and the evolving behavior of systems in general. The book allows the reader to optimize the sensing time for maximizing the spectrum utilization, improve the lifetime of the cognitive radio network (CRN) using active scan spectrum sensing techniques, analyze energy efficiency of CRN, find a secondary user spectrum allocation, perform dynamic handovers, and use efficient data communication in the cognitive networks. Identifies energy efficient spectrum sensing techniques for Cooperative Cognitive Radio Networks (CRN); Shows how to maximize the energy capacity by minimizing the outage probability; Features end-of-chapter summaries, performance measures, and case studies.

2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) Sep 03 2020 This conference gives scope to researchers, academicians, students, industrialist etc This conference focuses on main new technologies such as AI, Big data, robotics, energy management, power system, power electronics, renewable energy, wireless communication, control system, robotics, machine learning, deep learning etc This conference will provide an knowledge exposure to the participants by listening to the well renowned speakers at national and international level

On Spectrum Sensing, Resource Allocation, and Medium Access Control in Cognitive Radio Networks Jun 12 2021 The cognitive radio-based wireless networks have been proposed as a promising technology to improve the utilization of the radio spectrum through opportunistic spectrum access. In this context, the cognitive radios opportunistically access the spectrum which is licensed to primary users when the primary user transmission is detected to be absent. For opportunistic spectrum access, the cognitive radios should sense the radio environment and allocate the spectrum and power based on the sensing results. To this end, in this thesis, I develop a novel cooperative spectrum sensing scheme for cognitive radio networks (CRNs) based on machine learning techniques which are used for pattern classification. In this regard, unsupervised and supervised learning-based classification techniques are implemented for cooperative spectrum sensing. Secondly, I propose a novel joint channel and power allocation scheme for downlink transmission in cellular CRNs. I formulate the downlink resource allocation problem as a generalized spectral-footprint minimization problem. The channel assignment problem for secondary users is solved by applying a modified Hungarian algorithm while the power allocation subproblem is solved by using Lagrangian technique. Specifically, I propose a low-complexity modified Hungarian algorithm for subchannel allocation which exploits the local information in the cost matrix. Finally, I propose a novel dynamic common control channel-based medium access control (MAC) protocol for CRNs. Specifically, unlike the traditional dedicated control channel-based MAC protocols, the proposed MAC protocol eliminates the requirement of a dedicated channel for control information exchange.

Complex, Intelligent, and Software Intensive Systems Apr 29 2020 This book provides a platform of scientific interaction between the three challenging and closely linked areas of ICT-enabled-application research and development: software intensive systems, complex systems and intelligent systems. Software intensive systems strongly interact with other systems, sensors, actuators, devices, other software systems and users. More and more domains are using software intensive systems, e.g. automotive and telecommunication systems, embedded systems in general, industrial automation systems and business applications. Moreover, web services offer a new platform for enabling software intensive systems. Complex systems research is focused on the overall understanding of systems rather than their components. Complex systems are characterized by the changing environments in which they interact. They evolve and adapt through internal and external dynamic interactions. The development of intelligent systems and agents, which are increasingly characterized by their use of ontologies and their logical foundations, offer impulses for both software intensive systems and complex systems. Recent research in the field of intelligent systems, robotics, neuroscience, artificial intelligence, and cognitive sciences are vital for the future development and innovation of software intensive and complex systems.

Cognitive Radio, Mobile Communications and Wireless Networks Oct 16 2021 This book provides an overview of the latest research and development of new technologies for cognitive radio, mobile communications, and wireless networks. The contributors discuss the research and requirement analysis and initial standardization work towards 5G cellular systems and the capacity problems it presents. They show how cognitive radio, with the capability to flexibly adapt its parameters, has been proposed as the enabling technology for unlicensed secondary users to dynamically access the licensed spectrum owned by legacy primary users on a negotiated or an opportunistic basis. They go on to show how cognitive radio is now perceived in a much broader paradigm that will contribute to solve the resource allocation problem that 5G requirements raise. The chapters represent hand-selected expanded papers from EAI sponsored and hosted conferences such as the 12th

EAI International Conference on Mobile and Ubiquitous Systems, the 11th EAI International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness, the 10th International Conference on Cognitive Radio Oriented Wireless Networks, the 8th International Conference on Mobile Multimedia Communications, and the EAI International Conference on Software Defined Wireless Networks and Cognitive Technologies for IoT.

Cooperative Cognitive Radio Networks Dec 18 2021 *Cooperative Cognitive Radio Networks: The Complete Spectrum Cycle* provides a solid understanding of the foundations of cognitive radio technology, from spectrum sensing, access, and handoff to routing, trading, and security. Written in a tutorial style with several illustrative examples, this comprehensive book: Gives an overview of cognitive radio systems and explains the different components of the spectrum cycle Features step-by-step analyses of the different algorithms and systems, supported by extensive computer simulations, figures, tables, and references Fulfills the need for a single source of information on all aspects of the spectrum cycle, including the physical, link, medium access, network, and application layers Offering a unifying view of the various approaches and methodologies, *Cooperative Cognitive Radio Networks: The Complete Spectrum Cycle* presents the state of the art of cognitive radio technology, addressing all phases of the spectrum access cycle.

Techno-Societal 2020 Jun 19 2019 This book, divided in two volumes, originates from *Techno-Societal 2020: the 3rd International Conference on Advanced Technologies for Societal Applications*, Maharashtra, India, that brings together faculty members of various engineering colleges to solve Indian regional relevant problems under the guidance of eminent researchers from various reputed organizations. The focus of this volume is on technologies that help develop and improve society, in particular on issues such as sensor and ICT based technologies for the betterment of people, Technologies for agriculture and healthcare, micro and nano technological applications. This conference aims to help innovators to share their best practices or products developed to solve specific local problems which in turn may help the other researchers to take inspiration to solve problems in their region. On the other hand, technologies proposed by expert researchers may find applications in different regions. This offers a multidisciplinary platform for researchers from a broad range of disciplines of Science, Engineering and Technology for reporting innovations at different levels.

Spectrum Sensing for Cognitive Radio May 11 2021 This comprehensive reference text discusses concepts of cognitive radio and the advances in the field of spectrum sensing. This text discusses the concept of cognitive radio for next generation wireless communication and a very critical aspect of cognitive radio – that is, spectrum sensing – in detail. It covers important topics including narrowband spectrum sensing, wideband spectrum sensing, cooperative spectrum sensing, system and channel models, detection algorithms, approximation of decision statistics, and theoretical analysis of detection algorithms in detail. Separate chapters are dedicated to discussing the analysis and use of detection algorithms for narrowband spectrum sensing, wideband spectrum sensing, and cooperative wideband spectrum sensing. Aimed at graduate students and academic researchers in the fields of electrical engineering and electronics and communication engineering, this text: Discusses concepts of cognitive radio and research in spectrum sensing. Presents mathematical analysis of algorithms considering practical environment. Explains novel wideband spectrum sensing algorithms with detailed analysis. Provides mathematical derivations to help readers. Discusses basic spectrum sensing algorithms, from narrowband spectrum sensing to the more advanced wideband spectrum sensing.

Cognitive Radio Networks Sep 15 2021 Fueled by ongoing and increasing consumer demand, the explosive growth in spectrum-based communications continues to tax the finite resources of the available spectrum. One possible solution, Cognitive Radio Network (CRN), allows unlicensed users opportunistic access to licensed bands without interfering with existing users. Although some initial study has been conducted in this field, researchers need a systematic reference book that presents clear definitions, functions, and current challenges of the CRNs. *Cognitive Radio Networks* presents state-of-the-art approaches and novel technologies for cognitive wireless radio networks and sheds light on future developments in these areas. Comprising the contributions of many prominent world-wide cognitive radio researchers, this book covers all CRN essentials including spectrum sensing, spectrum handoff, spectrum sharing, and CRN routing schemes. Divided into five parts, the book addresses the physical layer, medium access control, the routing layer, cross-layer considerations and advanced topics in cognitive radio networks. The chapters also review research, management, support, and cognitive techniques such as position and network awareness, infrastructure and physical and link layer concerns. The editors of this volume are noted experts in the field of wireless networks and security. Dr. Yang Xiao's research has been supported by the U.S. National Science Foundation (NSF), U.S. Army Research, Fleet & Industrial Supply Center San Diego (FISCSD), and the University of Alabama's Research Grants Committee. Dr. Fei Hu has worked with NSF, Cisco, Lockheed Martin, Sprint, and other organizations. By bringing together the combined input of international experts, these editors have advanced the field of this nascent technology and helped to forge new paths of discovery for progressive communications possibilities.

2019 IEEE Globecom Workshops (GC Wkshps) Aug 22 2019 IEEE GLOBECOM Workshops will take place on the first and last day of the conference The workshop program will include keynote talks, oral poster presentations of close to 500 research papers

Handbook of Cognitive Radio Oct 04 2020 This major reference work provides the most up-to-date research advances and theories in cognitive radio technology, from cognitive radio principles and theory to cognitive radio standards and systems, from fundamental limits of cognitive radio channels to cognitive radio networks, from the current cognitive radio practices and examples to future 5G cognitive cellular networks. This handbook will include some emerging applications of cognitive radio in areas such as smart grid, internet-of-things, big data, small cell/heterogeneous networks, and in 5G. The potential readers include postgraduate students, academic staff, telecommunications engineering, spectrum policy makers, and industry entrepreneurs.

Spectrum Sharing for Wireless Communications Jan 27 2020 This SpringerBrief presents intelligent spectrum sharing technologies for future wireless communication systems. It explains the widely used opportunistic spectrum access and TV white space sharing, which has been approved by the FCC. Four new technologies to significantly increase the efficiency of spectrum sharing are also introduced. The four technologies presented are Dynamic Spectrum Co-Access, Incentivized Cooperative Spectrum Sharing, On-Demand Spectrum Sharing and Licensed Shared Spectrum Access. These technologies shed light on future wireless communication systems and pave the way for innovative spectrum sharing with increased spectrum utilization. Increased utilization will allow networks to meet the demand for radio spectrum and promote the growth of wireless industry and national economy. Spectrum Sharing is a valuable resource for researchers and professionals working in wireless communications. Advanced-level students in electrical engineering and computer science will also find this content helpful as a study guide.

Spectrum Sharing in Cognitive Radio Networks Mar 21 2022 *SPECTRUM SHARING IN COGNITIVE RADIO NETWORKS* Discover the latest advances in spectrum sharing in wireless networks from two internationally recognized experts in the field *Spectrum Sharing in Cognitive Radio Networks: Towards Highly Connected Environments* delivers an in-depth and insightful examination of hybrid spectrum access techniques with advanced frame structures designed for efficient spectrum utilization. The accomplished authors present the energy and spectrum efficient frameworks used in high-demand distributed architectures by relying on the self-scheduled medium access control (SMC-MAC) protocol in cognitive radio networks. The book begins with an exploration of the fundamentals of recent advances in spectrum sharing techniques before moving onto advanced frame structures with spectrum accessing approaches and the role of spectrum prediction and

spectrum monitoring to eliminate interference. The authors also cover spectrum mobility, interference, and spectrum management for connected environments in substantial detail. *Spectrum Sharing in Cognitive Radio Networks: Towards Highly Connected Environments* offers readers a recent and rational theoretical mathematical model of spectrum sharing strategies that can be used for practical simulation of future generation wireless communication technologies. It also highlights ongoing trends, revealing fresh research outcomes that will be of interest to active researchers in the area. Readers will also benefit from: An inclusive study of connected environments, 3GPP Releases, and the evolution of wireless communication generations with a discussion of advanced frame structures and access strategies in cognitive radio networks A treatment of cognitive radio networks using spectrum prediction and monitoring techniques An analysis of the effects of imperfect spectrum monitoring on cognitive radio networks An exploration of spectrum mobility in cognitive radio networks using spectrum prediction and monitoring techniques An examination of MIMO-based CR-NOMA communication systems for spectral and interference efficient designs Perfect for senior undergraduate and graduate students in Electrical and Electronics Communication Engineering programs, *Spectrum Sharing in Cognitive Radio Networks: Towards Highly Connected Environments* will also earn a place in the libraries of professional engineers and researchers working in the field, whether in private industry, government, or academia.

Performance of Cooperative Spectrum Sensing in Cognitive Radio Networks Sep 27 2022 Doctoral Thesis / Dissertation from the year 2020 in the subject Engineering - Communication Technology, grade: A, , language: English, abstract: Cooperative spectrum sensing technique is used to maximize the utilization of unused licensed spectrum. As the cooperation among the secondary users increases the detection performance increases, which increases the average channel throughput and energy efficiency but it depends on the number of cooperative secondary users, fusion rules, channel conditions and detection threshold. In this thesis average channel throughput, energy consumption and energy efficiency are estimated for variable number of secondary users and detection thresholds using hard fusion rules i.e. AND, OR and MAJORITY fusion rules. From the results it has been observed that the performance of AND fusion rule is better at low detection thresholds and for less number of secondary users. The performance of OR fusion rule is better at high detection thresholds and for large number of secondary users. The performance of MAJORITY fusion rule follows the performance of AND fusion rule at low detection thresholds and it follows the performance of OR fusion rule at high detection thresholds. However as the number of cooperative secondary users increases the energy required for spectrum sensing and reporting sensing results to the fusion center increases, which increases the energy consumption and reduces the energy efficiency. Therefore energy efficiency can be improved by maximizing the average channel throughput or by minimizing the energy consumption. To minimize the energy consumption in cooperative spectrum sensing, optimization technique has been proposed in this thesis and it is used for further improvement of energy efficiency. With this optimization technique, optimal number of cooperative secondary users are derived by maximizing the energy efficiency using AND and OR fusion rules but not with MAJORITY fusion rule. Because it is very difficult to estimate the optimal number of cooperative secondary users using MAJORITY fusion rule, so optimization of final decision threshold was proposed in the existing methods to maximize the energy efficiency using MAJORITY fusion rule. Therefore AND and OR fusion rules are used in this work to optimize the number of cooperative secondary users.

Measure and Integral Dec 26 2019 This volume develops the classical theory of the Lebesgue integral and some of its applications. The integral is initially presented in the context of n-dimensional Euclidean space, following a thorough study of the concepts of outer measure and measure. A more general treatment of the integral, based on an axiomatic approach, is later given.

Modeling and Design of Secure Internet of Things Jan 19 2022 An essential guide to the modeling and design techniques for securing systems that utilize the Internet of Things Modeling and Design of Secure Internet of Things offers a guide to the underlying foundations of modeling secure Internet of Things' (IoT) techniques. The contributors—noted experts on the topic—also include information on practical design issues that are relevant for application in the commercial and military domains. They also present several attack surfaces in IoT and secure solutions that need to be developed to reach their full potential. The book offers material on security analysis to help with in understanding and quantifying the impact of the new attack surfaces introduced by IoT deployments. The authors explore a wide range of themes including: modeling techniques to secure IoT, game theoretic models, cyber deception models, moving target defense models, adversarial machine learning models in military and commercial domains, and empirical validation of IoT platforms. This important book: Presents information on game-theory analysis of cyber deception Includes cutting-edge research finding such as IoT in the battlefield, advanced persistent threats, and intelligent and rapid honeynet generation Contains contributions from an international panel of experts Addresses design issues in developing secure IoT including secure SDN-based network orchestration, networked device identity management, multi-domain battlefield settings, and smart cities Written for researchers and experts in computer science and engineering, Modeling and Design of Secure Internet of Things contains expert contributions to provide the most recent modeling and design techniques for securing systems that utilize Internet of Things.

Adversary Detection For Cognitive Radio Networks Jul 21 2019 This SpringerBrief provides a comprehensive study of the unique security threats to cognitive radio (CR) networks and a systematic investigation of the state-of-the-art in the corresponding adversary detection problems. In addition, detailed discussions of the underlying fundamental analytical tools and engineering methodologies of these adversary detection techniques are provided, considering that many of them are quite general and have been widely employed in many other related fields. The exposition of this book starts from a brief introduction of the CR technology and spectrum sensing in Chapter 1. This is followed by an overview of the relevant security vulnerabilities and a detailed discussion of two security threats unique to CR networks, namely, the primary user emulation (PUE) attack and the Byzantine attack. To better prepare the reader for the discussions in later chapters, preliminaries of analytic tools related to adversary detection are introduced in Chapter 2. In Chapter 3, a suite of cutting-edge adversary detection techniques tailor-designed against the PUE and the Byzantine attacks are reviewed to provide a clear overview of existing research in this field. More detailed case studies are presented in Chapters 4 – 6. Specifically, a physical-layer based PUE attack detection scheme is presented in Chapter 4, while Chapters 5 and 6 are devoted to the illustration of two novel detection techniques against the Byzantine attack. Concluding remarks and outlooks for future research are provided in Chapter 7. The primary audience for this SpringerBrief include network engineers interested in addressing adversary detection issues in cognitive radio networks, researchers interested in the state-of-the-art on unique security threats to cognitive radio networks and the corresponding detection mechanisms. Also, graduate and undergraduate students interested in obtaining comprehensive information on adversary detection in cognitive radio networks and applying the underlying techniques to address relevant research problems can use this SpringerBrief as a study guide.

Cognitive Radio-Oriented Wireless Networks Dec 06 2020 This book constitutes the refereed proceedings of the 14th International Conference on Cognitive Radio-Oriented Wireless Networks, CROWNCOM 2019, held in Poznan, Poland, in June 2019. The 30 revised full papers were selected from 48 submissions and present a large scope of research topic also covering IoT in 5G and how cognitive mechanisms shall help leveraging access for numerous devices; mmWave and how specific propagation and operation in these bands bring new sharing mechanisms ; how resource allocation amongst bands (including offload mechanisms) shall be solved. The key focus will be on how rich data analysis can improve the delivery of above defined services.

