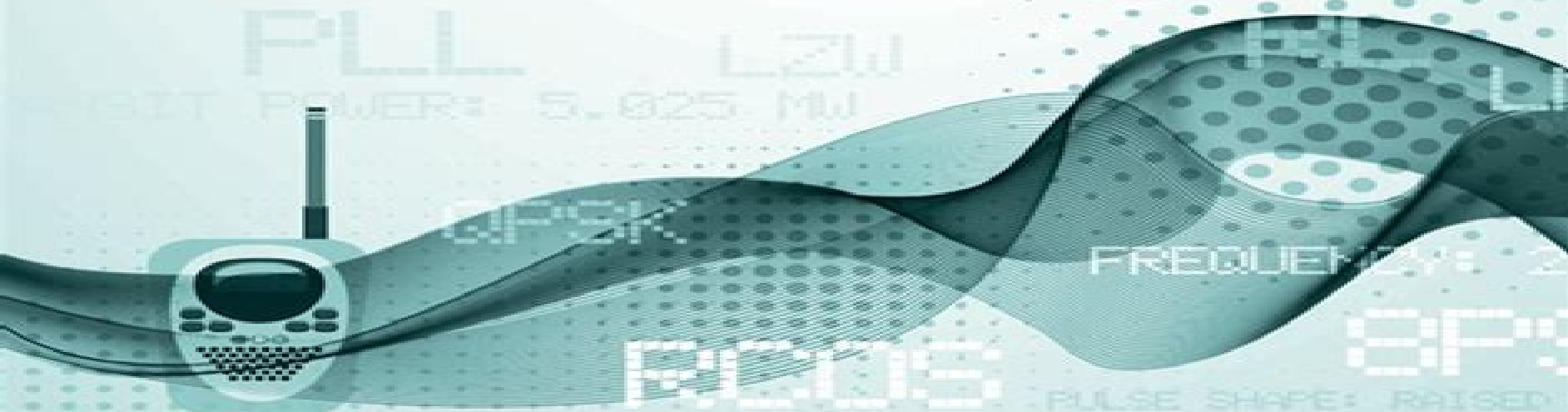# Digital Communication Systems Engineering with Software-Defined Radio

Di Pu
Alexander M. Wyglinski

Digital Communication Systems Engineering With Software Defined Radio Mobile Communications

Alexander M. Wyglinski,Robin Getz,Travis Collins,Di Pu

Digital Communication Systems Engineering With Software Defined Radio Mobile Communications:

Digital Communication Systems Engineering with Software-defined Radio Alexander M. Wyglinski,Di Pu,2013 For a senior level undergraduate course on digital communications this unique resource provides you with a practical approach to quickly learning the software defined radio concepts you need to know for your work in the field   Software-Defined Radio for Engineers Alexander M. Wyglinski,Robin Getz,Travis Collins,Di Pu,2018-04-30 Based on the popular Artech House classic Digital Communication Systems Engineering with Software Defined Radio this book provides a practical approach to quickly learning the software defined radio SDR concepts needed for work in the field This up to date volume guides readers on how to quickly prototype wireless designs using SDR for real world testing and experimentation This book explores advanced wireless communication techniques such as OFDM LTE WLA and hardware targeting Readers will gain an understanding of the core concepts behind wireless hardware such as the radio frequency front end analog to digital and digital to analog converters as well as various processing technologies Moreover this volume includes chapters on timing estimation matched filtering frame synchronization message decoding and source coding The orthogonal frequency division multiplexing is explained and details about HDL code generation and deployment are provided The book concludes with coverage of the WLAN toolbox with OFDM beacon reception and the LTE toolbox with downlink reception Multiple case studies are provided throughout the book Both MATLAB and Simulink source code are included to assist readers with their projects in the field

Introduction to OFDM Receiver Design and Simulation Y.J. Liu,2019-11-30 This practical book is an accessible introduction to Orthogonal frequency division multiplexing OFDM receiver design a technology that allows digitized data to be carried by multiple carriers It offers a detailed simulation study of an OFDM algorithm for Wi Fi and 4G cellular that can be used to understand other OFDM waveforms Extensive simulation studies are included using the transmissionwaveform given by the IEEE 802 11 standard Scrambler error correcting codes interleaver and radio wave propagation model are included OFDM waveform characteristics signal acquisition synchronization issues channel estimation and tracking hard and soft decision decoding are all covered Detailed derivations leading to the final formula for any algorithm are given which allows the reader to clearly understand the approximations and conditions behind the formulas and apply them appropriately The algorithms are selected not just for the best performance from simulation study but also for easy implementation An example is a unique algorithm for signal acquisition using the principle of maximum likelihood detection   The Technical Foundations of IoT Boris Adryan,Dominik Obermaier,Paul Fremantle,2017-06-30 This comprehensive new resource presents a technical introduction to the components architecture software and protocols of IoT This book is especially catered to those who are interested in researching developing and building IoT The book covers the physics of electricity and electromagnetism laying the foundation for understanding the components of modern electronics and computing Readers learn about the fundamental properties of matter along with security and privacy issues related to IoT From the launch of the

internet from ARPAnet in the 1960s to recent connected gadgets this book highlights the integration of IoT in various verticals such as industry smart cities connected vehicles and smart and assisted living The overall design patterns issues with UX and UI and different network topologies related to architectures of M2M and IoT solutions are explored Product development power options for IoT devices including battery chemistry actuators from simple buzzers to complex stepper motors and sensors from gyroscopes to the electrical sensing of organic compounds are covered Hardware development sensors and embedded systems are discussed in detail This book offers insight into the software components that impinge on IoT solutions development network protocols backend software data analytics and conceptual interoperability   Simulation and Software Radio for Mobile Communications Hiroshi Harada,Ramjee Prasad,2002 This cutting edge first of its kind resource gives you a comprehensive understanding of the simulation and evaluation methods used for today s mobile communication systems Written by two highly regarded experts in the field the book focuses on the performance of both the physical and protocol layer transmission scheme It defines and presents several invaluable simulation tools written in MATLAB code along with clear examples that explain their use   **Implementing Full Duplexing for 5G** David B. Cruickshank,2020-05-31 This exciting new book examines the feasibility of using a method of doubling the capacity of cellular networks by simultaneously transmitting and receiving signals at the same frequency a process known as full duplexing FD To realize full duplexing changes in the hardware of the cell base stations relaying equipment hot spot access points and mobile phones are necessary to prevent the hardware s transmitters from interfering with their own receivers This requires looking at how to separate the strong transmitted signal from the very weak received signal a process requiring both hardware analog changes and more complex digital signal processing Different ways of achieving that goal are examined The books reviews the merits of hardware changes involving new duplexing components that may be different depending on the frequency band and cell hardware being used Developing full duplex FD systems in 5G LTE cellular communications and what can be achieved with ferrite based circulators in terms of size reduction and performance enhancement especially at millimetric frequencies is considered The relative merits of ferrite and non ferrite circulators are compared in terms of their fundamental materials and device technologies such as isolation insertion loss bandwidth and non linearity FD in the entire 5G cell is also examined and its resulting range of equipment and device communication This includes front hauling more sophisticated back and front hauling backhaul beam switching and cell extenders and relays all of which could involve FD   *Communication Systems Engineering with GNU Radio* Jean-Michel Friedt,Herve Boeglen,2024-10-15 An approachable guide to an invaluable radio frequency communication toolkit Software defined radio SDR which emerged in the 1990s has become a core development method in certain high profile fields including military and space communications High cost and problems with hardware availability however prevented this technology from being widely disseminated The advent of low cost hardware beginning in the 2010s however has made GNU Radio the leading open

source software toolkit for developing SDR systems an increasingly viable and even critical tool for a new generation of radio frequency communication engineers Communication Systems Engineering with GNU Radio provides an accessible overview of this toolkit and its applications Beginning with the fundamentals of using GNU radio for digital signal processing the volume then moves to the practicalities of decoding data and the advantages of accessing raw data normally unavailable in hardware defined radio frequency receivers The result is a potentially crucial tool for engineers looking to adopt this cost effective and flexible standard for transmitting and processing radio frequency signals Readers will also find A careful balance of radio communications theory with GNU Radio practicalities Practical implementation examples employing well developed open source GNU Radio platforms Extensive accompanying documentation and explanation Communication Systems Engineering with GNU Radio is ideal for graduate and undergraduate students in communications systems courses as well as professionals working in SDR   *Third Generation Mobile Telecommunication Systems* Peter Stavroulakis,2012-12-06 One hundred years ago the notion of transmitting information without the use of wires must have seemed like magic In 1896 the first patent for wireless communication was granted to Marchese Guglielmo Marconi Since then the field of wireless communications which includes cellular systems has taken various forms of development It basically evolved through three Eras The Pioneer Era over the period of 1860 1921 the Precellular Era over 1921 1980 and the Cellular Era after 1980 and beyond The first generation cellular era started with the Analog Systems and evolved in the digital domain utilizing Time Division Multiple Access TDMA and Code Division Multiple Access CDMA thus comprising the Second Generation Mobile Systems The first generation RF cellular communications systems deployed in the early to mid 1980 s had air interfaces comprised of analog technology Among them were AMPS Advanced Mobile Phone System NMT Nordic Mobile Telephone and TACS Total Access Communications System These were designed for use in a specific geographic area and not intended to be deployed in other areas There was not much commonality beyond using the same air interface technology and same modulation The air interface technology was Frequency Division Multiple Access FDMA and the modulation was analog FM but with different deviations and channel spacings The frequency bands air interface protocols number of channels and data rates were different In general these systems provided local and national coverage **Military Communications in the Future Battlefield** Marko Suojanen,2018-07-31 Taking an applications oriented view this unique volume delivers a forward looking roadmap to military communications This hands on reference offers military and security technology practitioners insights into the key issues related to long term development within the battlefield communications area The book presents the technological alternatives for communication in the battlefield in unexpected situations and environments This authoritative resource discusses unstructured formations of actors using a holistic approach that considers key capability requirements Professionals and officers learn how to prepare for the unexpected and start building agile adaptive and cognitive systems that are needed in future operating environments From scenario based

capability planning to situational and context awareness to unmanned ground and aerial platforms this easy to understand book covers the critical topics that practitioners need to master to achieve top performance in the battlefield <u>Starting Digital Signal Processing in Telecommunication Engineering</u> Tomasz P. Zieliński,2021-01-29 This hands on laboratory driven textbook helps readers understand principles of digital signal processing DSP and basics of software based digital communication particularly software defined networks SDN and software defined radio SDR In the book only the most important concepts are presented Each book chapter is an introduction to computer laboratory and is accompanied by complete laboratory exercises and ready to go Matlab programs with figures and comments available at the book webpage and running also in GNU Octave 5 2 with free software packages showing all or most details of relevant algorithms Students are tasked to understand programs modify them and apply presented concepts to recorded real RF signal or simulated received signals with modelled transmission condition and hardware imperfections Teaching is done by showing examples and their modifications to different real world telecommunication like applications The book consists of three parts introduction to DSP spectral analysis and digital filtering introduction to DSP advanced topics multi rate adaptive model based and multimedia speech audio video signal analysis and processing and introduction to software defined modern telecommunication systems SDR technology analog and digital modulations single and multi carrier systems channel estimation and correction as well as synchronization issues Many real signals are processed in the book in the first part mainly speech and audio while in the second part mainly RF recordings taken from RTL SDR USB stick and ADALM PLUTO module for example captured IQ data of VOR avionics signal classical FM radio with RDS digital DAB DAB radio and 4G LTE digital telephony Additionally modelling and simulation of some transmission scenarios are tested in software in the book in particular TETRA ADSL and 5G signals Provides an introduction to digital signal processing and software based digital communication Presents a transition from digital signal processing to software defined telecommunication Features a suite of pedagogical materials including a laboratory test bed and computer exercises experiments <u>Recent Trends in Image and Signal Processing in Computer Vision</u> Shruti Jain,Sudip Paul,2020-03-04 This book highlights recent advances and emerging technologies that utilize computational intelligence in signal processing computing imaging science artificial intelligence and their applications It covers all branches of artificial intelligence and machine learning that are based on computation at some level e g artificial neural networks evolutionary algorithms fuzzy systems and automatic medical identification systems Exploring recent trends in research and applications the book offers a valuable resource for professors researchers and engineers alike **Software Defined Radio** Walter H.W. Tuttlebee,2003-04-11 Software defined radio SDR is one of the most important topics of research and indeed development in the area of mobile and personal communications SDR is viewed as an enabler of global roaming and as a unique platform for the rapid introduction of new services into existing live networks It therefore promises mobile communication networks a major increase in flexibility and capability SDR brings

together two key technologies of the last decade digital radio and downloadable software It encompasses not only reconfiguration of the air interface parameters of handset and basestation products but also the whole mobile network to facilitate the dynamic introduction of new functionality and mass customised applications to the user s terminal post purchase This edited book contributed by internationally respected researchers and industry practitioners describes the current technological status of radio frequency design data conversion reconfigurable signal processing hardware and software issues at all levels of the protocol stack and network The book provides a holistic treatment of SDR addressing the full breadth of relevant technologies radio frequency design signal processing and software at all levels As such it provides a solid grounding for a new generation of wireless engineers for whom radio design in future will assume dynamic flexibility as a given In particular it explores The unique demands of SDR upon the RF subsystem and their implications for front end design methodologies The recent concepts of the digital front end and parametrization The role and key influence of data conversion technologies and devices within software radio essential to robust product design The evolution of signal processing technologies describing new architectural approaches Requirements and options for software download Advances in soft protocols and on the fly software reconfiguration Management of terminal reconfiguration and its network implications The concepts of the waveform description language The book also includes coverage of Potential breakthrough technologies such as superconducting RSFQ technology and the possible future role of MEMS in RF circuitry Competing approaches eg all software radios implemented on commodity computing vs advanced processing architectures that dynamically optimise their configuration to match the algorithm requirements at a point in time The book opens with an introductory chapter by Stephen Blust Chair of the ITU R WP8F Committee and Chair of the SDR Forum presenting a framework for SDR in terms of definitions evolutionary perspectives introductory timescales and regulation Suitable for today s engineers technical staff and researchers within the wireless industry the book will also appeal to marketing and commercial managers who need to understand the basics and potential of the technology for future product development Its balance of industrial and academic contributors also makes it suitable as a text for graduate and post graduate courses aiming to prepare the next generation of wireless engineers *Radio Receivers for Systems of Fixed and Mobile Communications* Vasiliy V. Logvinov,Sergey M. Smolskiy,2022-05-13 The textbook acquaints the reader with the architecture of receivers of analog and digital radio systems helps to study the stages of designing a modern radio receiver and reveals the reasons and methods for its effective operation in networks for various purposes Particular attention is paid to the methods of generating and processing signals in the receivers of digital systems with multiple access which make it possible to provide data transfer rates close to the maximum possible according to Shannon As a textbook for students studying methods of optimal signal reception the book will also be useful to specialists in the field of telecommunications involved in the development of radio receivers The book shows how the development of theoretical circuitry and integrated technologies

led to the active introduction of algorithmic methods for signal processing changed both the design of receivers and the methods of forming the information flow in free space MIMO beamforming The creation of a global 5G network based on heterogeneous networks puts forward new requirements for the architecture of receivers which are determined by the requirements to achieve high data rates low time delays or use in networks with coordinated multipoint transmission and reception CoMP To consolidate the knowledge gained the book includes a complete set of materials for online classes including questions and answers a guide to solving problems for each chapter and computer modeling units of receivers in the MicroCAP environment based on preliminary calculations   Internet of Things and Sensors Networks in 5G Wireless Communications Lei Zhang,Guodong Zhao,Muhammad Ali Imran ,2020-01-24 The Internet of Things IoT has attracted much attention from society industry and academia as a promising technology that can enhance day to day activities and the creation of new business models products and services and serve as a broad source of research topics and ideas A future digital society is envisioned composed of numerous wireless connected sensors and devices Driven by huge demand the massive IoT mIoT or massive machine type communication mMTC has been identified as one of the three main communication scenarios for 5G In addition to connectivity computing and storage and data management are also long standing issues for low cost devices and sensors The book is a collection of outstanding technical research and industrial papers covering new research results with a wide range of features within the 5G and beyond framework It provides a range of discussions of the major research challenges and achievements within this topic   **Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems** Hüseyin Arslan,2007-09-05 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 **Radio Over Fiber Technologies for Mobile Communications Networks** Hamed Al-Raweshidy,Shozo Komaki,2002 Over the past decade there have been massive advances in the areas of mobile and optical fiber communications This unique book shows you how to combine these methods to create new radio over fiber technologies that offer seamless operation and greater multimedia application potential for your current and third generation mobile communication networks *Software Defined Radio: Theory and Practice* John M. Reyland,2023-11-30 Software Defined Radio Theory and Practice is a comprehensive resource covering software defined radio SDR from theory to practical applications The book provides foundational knowledge for communication engineers and SDR enthusiasts It covers digital modulation techniques from basic to advanced techniques such as SC OFDM and GMSK The book then discusses RF channel impairments and strategies for eliminating them along with the use of channel equalization and modern frequency domain equalizers utilized in cellular telephony Source and channel coding are introduced and receiver analog design is thoroughly researched comparing traditional and modern designs The book includes important review topics such as complex numbers fixed point numeric formats decision theory Doppler and more Software Defined Radio Theory and Practice offers a well rounded approach to understanding and applying SDR combining theoretical knowledge with practical exercises and simulations for a comprehensive learning experience **Software Defined Mobile Networks (SDMN)** Madhusanka Liyanage,Andrei Gurtov,Mika Ylianttila,2015-06-17 This book describes the concept of a Software Defined Mobile Network SDMN which will impact the network architecture of current LTE 3GPP networks SDN will also open up new opportunities for traffic resource and mobility management as well as impose new challenges on network security Therefore the book addresses the main affected areas such as traffic resource and mobility management virtualized traffics transportation network management network security and techno economic concepts Moreover a complete introduction to SDN and SDMN concepts Furthermore the reader will be introduced to cutting edge knowledge in areas such as network virtualization as well as SDN concepts relevant to next generation mobile networks Finally by the end of the book the reader will be familiar with the feasibility and opportunities of SDMN concepts and will be able to evaluate the limits of performance and scalability of these new technologies while applying them to mobile broadb and networks *Mobile Lightweight Wireless Systems* Periklis Chatzimisios,Christos Verikoukis,Ignacio Santamaria,Massimiliano Laddomada,Oliver Hoffmann,2010-10-21 Following the success of the First MOBILIGHT 2009 in Athens Greece the Second International Conference on Mobile Lightweight Systems MOBILIGHT was held in Barcelona Spain on May 10 12 2010 It was not an easy decision to carry on organizing a scientific event on wireless communications where competition is really enormous This decision was motivated by discussion with many colleagues about the current unprecedented demand for lig weight wireless communication devices with high usability and performance able to support added value services in a highly mobile environment Such devices follow the users everywhere they go at work at home while travelling in a classroom etc and result in exciting research development

and business opportunities Such scenarios clearly demand significant upgrades to the existing communication paradigm in terms of infrastructure devices and services to support the anytime anywhere any device philosophy providing novel and fast evolving requirements and expectations on search and development in the field of information and communication technologies The core issue is to support wireless users desire for 24 7 network availability and transparent access to their own services In this context we continue to envision an international forum where practitioners and researchers coming from the many areas involved in lightweight wireless systems design and deployment would be able to interact and exchange experiences   Digital Communications Mitra, Atis D., Digital Communications is the result of the author s 38 years experience in teaching and in design and development of various wireless communication systems It covers all primary areas in digital communication systems in engineering The book intends to give the students a grasp of the basic issues of communication systems during transition from analog to digital To make the reading interesting as well as systematic conscious efforts have been made to explain the basics of technology avoiding complex mathematics as far as possible Numerical problems are then introduced to help the students fully understand the concepts and applications KEY FEATURES Complete and thorough introduction to the analysis and design of digital communication systems Concepts explained with practical applications derived from the personal experience of the author Analytical steps of all derivation without any external reference Numerous numerical examples to help students understand the fundamental applications of the concepts in practice

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