WIRELESS COMMUNICATION SIGNALS: A LABORATORY-BASED APPROACH

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Prof. Huseyin Arslan, in *Wireless Communication Signals: A Laboratory-Based Approach*, has provided a comprehensive set of tools for communication engineers and interested researchers for the analysis and design of wireless systems by discussing not only the basic theory, but also modeling, computer simulation, and hardware testing of the various building blocks of modern communication systems. The code snippets throughout the book enable readers to attain hands-on experience by implementing them on software and observing the effect of various parameters on the performance of the system. While the book is not explicitly divided into different parts, there is a general harmony and progression in the way the chapters are arranged. Specifically, Chapters 1–4 give an overview of the different components of communication systems, the relevant performance metrics, and general guidelines about simulating such systems. Chapters 5–11 provide more in-depth discussion of the aforementioned building blocks. The book concludes with Chapters 12 and 13 highlighting two advanced topics, namely blind signal analysis and radio environment monitoring, which can be used as baseline for developing more sophisticated academic and/or research projects.

Chapter 1, "Hands-on Wireless Communication Experience," describes the main motivation of the book, discusses the importance of a laboratory-based approach to wireless communications, and provides a general model of a practical test bench. The chapter concludes with a sample realization of a laboratory course, which serves as the blueprint for the remainder of the book. Chapter 2, "Performance Metrics and Measurements," aims to enable the readers to evaluate the performance of different building blocks of a communication system by describing the various metrics and measurements that can be utilized for each block. Chapter 3, "Multidimensional Signal Analysis," allows readers to understand and observe how the wireless signals are represented in different domains including time, frequency, code, angle, and so on. This not only encourages readers to better understand the target systems, but also allows them to develop advanced algorithms related to synchronization, estimation, and equalization at the receiver. Chapter 4, "Simulating a Communication System," describes the basics of computer simulations including strategy and approach, modeling, link vs. network level simulations, and error sources generally encountered in practice.

Chapter 5, "RF Impairments," provides the baseband equivalent models for hardware impairments to improve readers' understanding of these imperfections, which are critical in real-world applications. Chapter 6, "Digital Modulation and Pulse Shaping," describes and analyzes various modulation and pulse shaping techniques commonly used in wireless systems along with their impact on the performance of the system. Chapter 7, "OFDM Signal Analysis and Performance Evaluation," focuses on orthogonal frequency-division multiplexing (OFDM), which is commonly used in various communication systems and standards. The chapter describes in detail the concept of OFDM before discussing its performance in a multipath propagation environment and in the presence RF impairments. Despite the high popularity of OFDM, single-carrier systems are still relevant for various scenarios and applications. Accordingly, Chapter 8, "Analysis of Single-Carrier Communication Systems," analyzes the performance of single-carrier systems in various propagation scenarios including additive white Gaussian noise (AWGN), and frequency-flat and frequency-selective channels. Chapter 9, "Multiple Accessing, Multi-Numerology, Hybrid Waveforms," tackles the issue of resource sharing and multiple accessing in a hyperspace consisting of time, frequency, space, beam, and code. Apart from conventional approaches, this chapter also explores, explains, and provides tools for understanding and developing hybrid approaches depending on users' requirements. Chapter 10, "Wireless Channel and Interference," discusses various aspects of the wireless channel, starting with its explanation, mathematical modeling, and simulation. It also discusses the techniques commonly used to empirically measure and mathematically model these effects. Finally, this chapter sheds light on the channel emulation techniques that are normally used to reproduce various wireless propagation effects in the laboratory environment for testing and educational purposes. Chapter 11, "Carrier and Time Synchronization," explicitly focuses on time and frequency synchronization for linearly modulated signals in single-carrier systems, where different synchronization approaches are discussed.

Chapter 12, "Blind Signal Analysis," motivates the concept of blind signal analysis, which can be used by receivers that are unaware of transmission parameters such as bandwidth, carrier frequency, and symbol rate. The chapter discusses laboratory implementation as well as a case study involving a blind receiver to help understand multiple model-based estimation and identification techniques. Moreover, maximum-likelihood-based methods are introduced along with their potential applications and challenges. Chapter 13, "Radio Environment Monitoring," discusses methods to store, process, and utilize radio signals to acquire information about the propagation environment. Methods such as channel-state-information-based sensing and joint radar and communication are also discussed. These advanced concepts not only provide additional information about the environment, but also can be beneficial for futuristic wireless communication by enabling attractive features such as high spectrum, energy, and cost efficiency.

Considering the broad scope of this book and its in-depth coverage of many practical issues regarding modern wireless communication systems, we believe that it can be used as a textbook or a valuable reference for a senior undergraduate or graduate-level laboratory-oriented course focusing on wireless digital communications. The book is organized in such a way that it can be used to support various wireless and/or digital communication courses from beginner to advanced levels, and can serve as a reference for research projects of both undergraduate and graduate students. More importantly, the models and codes introduced in this book are universal and can be used in conjunction with any software-defined radio platform. Considering all these, *Wireless Communication Signals: A Laboratory-Based Approach* from Wiley might be a valuable resource for our community.