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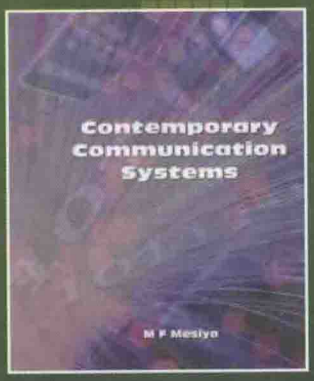
英文版

现代通信系统

Contemporary Communication Systems



[美] Mohammed Farooque Mesiya 著

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内 容 简 介

本书共分 15 章，全面介绍了模拟通信系统和数字通信系统，以及构成目前光纤、无线和卫星通信网基础设施的基本原理。书中列举了数字有线电视、无线通信、蜂窝通信和网络通信等众多应用实例，并结合这些实例详细分析了信源编码、信道编码、调制/解调、复用与同步技术、基带技术和抗噪技术。

本书可作为高等院校通信类、信息类、电子类、计算机类等专业的研究生或高年级本科生的教材，也可供有关的科研和管理人员参考。

Mohammed Farooque Mesiya
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Preface

Communication systems transfer information between different points in space or time. *Contemporary Communication Systems* provides a comprehensive introduction to analog and digital communication systems that form the infrastructure of today's optical fiber, wireless, and satellite communication networks. The book not only provides a logical and easy-to-understand presentation of the fundamental principles but also engages students in the issues relevant to system and product implementation. As such, the book covers several topics that get scant coverage in other textbooks but are very relevant in implementing modern analog and digital communication systems.

The book is designed for introductory courses in communication systems and in digital communications at the upper-level undergraduate, and first-year graduate programs in electrical and computer engineering. It provides detailed coverage of the background required to study communication systems in two chapters, one on signals and systems with emphasis on the frequency-domain analysis, and the other on the probability theory and random processes. Analog communications systems are covered in Chapters 4, 5, and 7. These chapters include not only the traditional material but some new topics that are relevant to the design of today's wireless communication receivers and optical networks employing cascade of optical amplifiers. Digital transmission is the enabling technology for global Internet, optical fiber, and new generations of wireless networks. Chapters 8 to 15 cover various aspects of digital communications systems. ①

Organization

Chapter 1 provides an introduction to communication systems, the history of their development, and major trends driving their evolution.

Chapter 2 is a review of signals and systems with an emphasis on the frequency domain analysis of signal transmission through LTI systems.

Chapter 3 introduces the capabilities of Simulink® for modeling and the simulation of analog and digital communication systems.

Chapter 4 is devoted to various amplitude modulation schemes. We also discuss multiplexing techniques and key operations implemented in communication transmitters and receivers. The chapter concludes with a discussion of various receiver architectures implemented in modern communication systems.

Chapter 5 covers angle modulation systems (FM and PM). This is followed by a detailed treatment of analog phase-locked loops and analog NTSC TV system.

Chapter 6 reviews the basic concepts of probability theory and random processes that are relevant to the modeling and analysis of information signals and ubiquitous noise in communication systems. Transmission of random signals and noise through LTI systems are then analyzed in both time and frequency domains.

Chapter 7 addresses the effect of noise in the demodulation of amplitude- and angle-modulated signals. We compare the performance of analog communication systems and study the effects of transmission losses and noise on the design of analog transmission systems with repeaters.

Chapter 8 considers the conversion of analog signals into digital format. We study sampling theorem and quantization techniques followed by waveform coding methods such as PCM, DPCM, and DM. The chapter concludes with a discussion of sigma-delta converters and bandpass sampling.

Chapter 9 presents baseband modulation schemes for transmission of digital data. Key requirements and characteristics of various line coding schemes are explained. We also study the design of pulse shapes to improve the spectral efficiency of digital baseband transmission systems.

In Chapter 10 we consider the detection of transmission symbols being conveyed in the digitally modulated signals in the presence of additive white Gaussian noise (AWGN). We introduce the representation of signal waveforms and AWGN as vectors in finite-dimensional vector spaces and use these concepts to develop optimum detector structures and analyze their performance.

① 采用本书作为教材的教师，可获得相关英文教辅资源，详见书末所附“教学支持说明”。——编者注

Chapter 11 considers the transmission of digital data by modulating a carrier. We consider binary and quadrature modulation schemes and analyze their performance using vector space concepts. Frequency shift keying and minimum shift keying are also treated. Noncoherent and differentially coherent schemes are then discussed. The chapter concludes with spectral analysis and a comparison of various digital carrier modulation schemes.

Chapter 12 treats the transmission of digitally modulated signals through channels that introduce inter-symbol interference (ISI) in addition to AWGN. We consider signal design and equalization schemes for the mitigation of ISI and noise.

Chapter 13 addresses two major topics in digital communications: digital multiplexing and synchronization. Multiplexing is used to combine multiple user signals for the efficient sharing of a high-speed communication channel. This is followed by the coverage of carrier, symbol timing, and frame sync recovery circuits that are used to properly recover and demultiplex the constituent signals at the receiver.

Chapter 14 is an introduction to information theory where we explain fundamental limits on communication of information. After introducing the concepts of information content of a source and capacity of a communication channel, we study Shannon's theorems on source coding and channel capacity. The chapter concludes with a detailed treatment of text, image, and video compression schemes.

Chapter 15 is devoted to channel coding for reliable transmission of information over noisy communication channels. We consider both linear block codes and convolutional codes and their performance using hard- and soft-decision decoding strategies. Coding for bandlimited channels and capacity-achieving turbo codes are also treated.

Pedagogical Features

The pedagogical features of the book include the following:

- Chapter introductions that preview the material covered in that chapter and its relevance in practice.
- Numerous examples, including MATLAB® exercises, to reinforce the key concepts and mathematical results.
- End-of-chapter problems with varying degrees of difficulty. MATLAB exercises are provided with extensive help to assist students in programming problem solutions.
- Simulink is used as a key pedagogical tool to help students understand theoretical results and develop familiarity with key elements in the design of communication systems. The author believes that Simulink can be used as a *virtual laboratory* to conduct experiments in the classroom setting to
  - Display signal waveforms and spectra at various points in communication systems.
  - Analyze the performance of systems and compare them with theoretical results.
  - Study the design approaches and possible trade-offs.
- Each chapter concludes with final remarks that reiterate the key concepts and comment on important developments.
- Each chapter includes a list of references that point to further reading materials.
- Extensive resources for instructors and students on the book's website are provided.
- The development of communication systems has a rich and interesting history. A special effort has been made in the text to chronicle the milestone events in the field with historical boxes sprinkled throughout the book.
- Most chapters include interviews with modern pioneers and renowned contributors in the field of communications that should inspire and motivate students.

Course Options

The book can be used to offer a variety of courses in communication systems. By a selective choice of chapters and sections therein, the instructor can provide the desired concentration for the course or adjust the content for the background of the students. An important consideration in this context is whether or not the students have already taken a course in probability and random processes at a senior level. We offer the following options for consideration, although many variants are possible.

- A one-semester course in analog and digital communication systems: Selected review of sections from Chapters 2 and 6, Chapters 3 through 5, Chapter 7: Sections 7.1 to 7.5, Chapter 8: Sections 8.1 to 8.4, Chapter 9: Sections 9.1 to 9.2, Chapter 10: Sections 10.1 to 10.2, Chapter 11: Sections 11.1 to 11.2, and selections from Chapters 14 through 15 if time permits.
- A one-semester course in digital communications: Selected review of sections from Chapters 2 and 6, Chapter 3, and Chapters 8 through 15.
- A two-semester course sequence in analog and digital communication systems:
  - Chapters 2 through 8 for the first course
  - Chapters 9 through 15 for the second course

Online Resources

A website to accompany this text can be found at www.mhhe.com/mesiya. The site contains an instructor's solutions manual, lecture PowerPoints, MATLAB m-files, Simulink models for all experiments, additional problems, and an image library. Instructors can also obtain access to COSMOS—a Complete Online Solutions Manual Organization System, which instructors can use to create exams and assignments, create custom content, and edit supplied problems and solutions.

Electronic Textbook Option

This text is offered through CourseSmart for both instructors and students. CourseSmart is an online resource where students can purchase the complete text online at almost half the cost of a traditional text. Purchasing the eTextbook allows students to take advantage of CourseSmart's web tools for learning, which include full text search, notes and highlighting, and email tools for sharing notes between classmates. To learn more about CourseSmart options, contact your sales representative or visit www.CourseSmart.com.

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Notational Conventions

1. Random variables are denoted in a bold font $\mathbf{x}, \mathbf{y}, \ldots$ and the values assumed by them will be displayed by the corresponding lowercase letters $x, y, \ldots$
2. The symbol $x[n]$ is used to denote the entire sequence (i.e., discrete-time signal) as well as the nth sample or number in the sequence. The intended meaning will be obvious from the context. We occasionally use curly brackets $\{\}$ to enclose sequences.
3. Finite-dimensional vectors are denoted by lowercase letters with an underscore. For example, $\underline{x}$ denotes a vector. The ith element of the vector $\underline{x}$ is denoted by x_i.
4. Matrices are denoted by uppercase letters with an underscore. For example, $\underline{A}$ denotes a matrix. The (i, j)-th element of the matrix $\underline{A}$ is denoted by A_{ij}.
5. The length or norm of a vector $\underline{x}$ is denoted by $\|\underline{x}\|$. The Euclidean distance between the vectors $\underline{x}$ and $\underline{y}$ is denoted by $\|\underline{x} - \underline{y}\|$.
6. The inner product between the vectors $\underline{x}$ and $\underline{y}$ is denoted by $(\underline{x} \bullet \underline{y})$.
7. The use of an asterisk as superscript denotes complex conjugate. For example, y^* is complex conjugate of y.
8. The symbol $|\ |$ represents the magnitude of the complex number or the function contained within.
9. The symbol $\angle$ denotes the phase of the complex number or function.
10. The symbol $\overset{\mathfrak{F}}{\longleftrightarrow}$ represents a Fourier transform pair. For example, $x(t) \overset{\mathfrak{F}}{\longleftrightarrow} X(f)$, where a lowercase letter denotes the time function and a corresponding uppercase letter denotes its Fourier transform.
11. The symbol $\otimes$ denotes convolution of two continuous-time functions or sequences.
12. The symbol $\oplus$ denotes modulo-2 addition. In Chapter 15, all arithmetic involving binary sequences is modulo-2 whether or not specifically indicated by $\oplus$ or ordinary $+$ sign.
13. The use of a hat over an unknown parameter or variable indicates the estimate of the unknown parameter or variable. For example, $\hat{a}$ denotes an estimate of the unknown parameter a.
14. The use of a tilde over a function indicates the complex envelope of a bandpass signal. For example, $\tilde{x}(t)$ denotes the complex envelope of the bandpass signal $x(t)$.
15. The symbol $E\{\ \}$ denotes the expected value of a random variable or process inside the brackets.
16. The symbol $Var(\ )$ denotes the variance of a random variable inside the parentheses.
17. The symbol $Cov(\ )$ denotes the covariance of the two random variables inside the parentheses.

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