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About the Author; 1 Elements of Information Theory; 1.1 Introduction; 1.2 Basic Concepts; 1.3 Communication System Model; 1.4 Concept of Information and Measure of Amount of Information; 1.5 Message Sources and Source Coding; 1.5.1 Models of Discrete Memory Sources; 1.5.2 Discrete Memoryless Source; 1.5.3 Extension of a Memoryless Source; 1.5.4 Markov Sources; 1.5.5 Entropy of the Markov Source; 1.5.6 Source Associated with the Markov Source; 1.6 Discrete Source Coding; 1.6.1 Huffman Coding; 1.6.2 Shannon-Fano Coding; 1.6.3 Dynamic Huffman Coding; 1.6.4 Arithmetic Coding; 1.6.5 Lempel-Ziv Algorithm; 1.6.6 Case study: Source Coding in Facsimile Transmission; 1.7 Channel Models from the Information Theory Point of View; 1.7.1 Discrete Memoryless Channel; 1.7.2 Examples of Discrete Memoryless Channel Models; 1.7.3 Example of a Binary Channel Model with Memory; 1.8 Mutual Information; 1.9 Properties of Mutual Information; 1.10 Channel Capacity; 1.11 Decision Process and its Rules; 1.11.1 Idea of Decision Rule; 1.11.2 Maximum a Posteriori Probability (MAP) Decision Rule; 1.11.3 Maximum Likelihood Decision Rule; 1.12 Differential Entropy and Average Amount of Information for Continuous Variables; 1.13 Capacity of Band-Limited Channel with Additive White Gaussian Noise; 1.14 Implication of AWGN Channel Capacity for Digital Transmission; 1.15 Capacity of a Gaussian Channel with a Given Channel Characteristic; 1.16 Capacity of a Flat Fading Channel; 1.17 Capacity of a Multiple-Input Multiple-Output Channel; Problems; 2 Channel Coding; 2.1 Idea of Channel Coding; 2.2 Classification of Codes; 2.3 Hard- and Soft-Decision Decoding; 2.4 Coding Gain; 2.5 Block Codes; 2.5.1 Parity Check Matrix; 2.5.2 Generator Matrix; 2.5.3 Syndrome; 2.5.4 Hamming Codes; 2.5.5 The Iterated Code; 2.5.6 Polynomial Codes; 2.5.7 Codeword Generation for the Polynomial Codes; 2.5.8 Cyclic Codes; 2.5.9 Parity Check Polynomial; 2.5.10 Polynomial Codes Determined by Roots; 2.5.11 Syndrome Polynomial; 2.5.12 BCH Codes; 2.5.13 Reed-Solomon Codes; 2.5.14 Golay Codes; 2.5.15 Maximum Length Codes; 2.5.16 Code Modifications; 2.6 Nonalgebraic Decoding for Block Codes; 2.6.1 Meggitt Decoder; 2.6.2 Majority Decoder; 2.6.3 Information Set Decoding; 2.7 Algebraic Decoding Methods for Cyclic Codes; 2.8 Convolutional Codes and Their Description; 2.8.1 Convolutional Code Description; 2.8.2 Code Transfer Function; 2.8.3 Convolutional Codes with Rate k/n ; 2.9 Convolutional Code Decoding; 2.9.1 Viterbi Algorithm; 2.9.2 Soft-Output Viterbi Algorithm (SOVA); 2.9.3 Error Probability Analysis for Convolutional Codes; 2.10 Concatenated Coding; 2.11 Case Studies: Two Examples of Concatenated Coding; 2.11.1 Concatenated Coding in Deep Space Communications; 2.11.2 Channel Coding in the DVB Satellite Segment; 2.12 Turbo Codes; 2.12.1 RSCC Code; 2.12.2 Basic Turbo Code Encoder Scheme; 2.12.3 RSCC Code MAP Decoding

Sommario/riassunto

Combining theoretical knowledge and practical applications, this advanced-level textbook covers the most important aspects of contemporary digital communication systems. Introduction to Digital Communication Systems focuses on the rules of functioning digital communication system blocks, starting with the performance limits set by the information theory. Drawing on information relating to turbo codes and LDPC codes, the text presents the basic methods of error correction and detection, followed by baseband transmission methods, and single- and multi-carrier digital modulations. The basi