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BECKER JAKOB

Channel Codes IOS Press
Provides a tutorial on the basics of network coding theory. Divided into two parts, this book presents a unified framework for understanding the basic notions and fundamental results in network coding. It is aimed at students, researchers and practitioners working in networking research.
Forward Error Correction via Channel Coding Now Publishers Inc
This monograph originated with a course of lectures on information theory which I gave at Cornell University during the academic year 1958-1959. It has no pretensions to exhaustiveness, and, indeed, no pretensions at all. Its purpose is to provide, for mathematicians of some maturity, an easy introduction to the ideas and principal known theorems of a certain body of coding theory. This purpose will be amply achieved if the reader is enabled, through his reading, to read the (sometimes obscurely written) literature and to obtain results of his own. The theory is ob viously in a rapid stage of development; even while this monograph was in manuscript several of its readers obtained important new results. The first chapter is introductory and the subject matter of the monograph is described at the end of the chapter. There does not seem to be a uniquely determined logical order in which the material should be arranged. In determining the final arrangement I tried to obtain an order which makes reading easy and yet is not illogical. I can only hope that the resultant compromises do not earn me the criticism that I failed on both counts. There are a very few instances in the monograph where a stated theorem is proved by a method which is based on a result proved only later.
From Theory to Turbocodes John Wiley & Sons Incorporated
The communication chain is constituted by a source and a recipient, separated by a transmission channel which may represent a portion of cable, an optical fiber, a radio channel, or a satellite link. Whatever the channel, the processing blocks implemented in the communication chain have the same foundation. This book aims to itemize. In this first volume, after having presented the base of the information theory, we will study the source coding techniques with and without loss. Then we analyze the correcting codes for block errors, convutional and concatenated used in current systems.
Part I of Fundamentals of Source and Video Coding Cambridge University Press
Covering the full range of channel codes from the most conventional through to the most advanced, the second edition of Turbo Coding, Turbo Equalisation and Space-Time Coding is a self-contained reference on channel coding for wireless channels. The book commences with a historical perspective on the topic, which leads to two basic component codes, convolutional and block codes. It then moves on to turbo codes which exploit iterative decoding by using algorithms, such as the Maximum-A-Posteriori (MAP), Log-MAP and Soft Output Viterbi Algorithm (SOVA), comparing their

performance. It also compares Trellis Coded Modulation (TCM), Turbo Trellis Coded Modulation (TTCM), Bit-Interleaved Coded Modulation (BICM) and Iterative BICM (BICM-ID) under various channel conditions. The horizon of the content is then extended to incorporate topics which have found their way into diverse standard systems. These include space-time block and trellis codes, as well as other Multiple-Input Multiple-Output (MIMO) schemes and near-instantaneously Adaptive Quadrature Amplitude Modulation (AQAM). The book also elaborates on turbo equalisation by providing a detailed portrayal of recent advances in partial response modulation schemes using diverse channel codes. A radically new aspect for this second edition is the discussion of multi-level coding and sphere-packing schemes, Extrinsic Information Transfer (EXIT) charts, as well as an introduction to the family of Generalized Low Density Parity Check codes. This new edition includes recent advances in near-capacity turbo-transceivers as well as new sections on multi-level coding schemes and of Generalized Low Density Parity Check codes Comparatively studies diverse channel coded and turbo detected systems to give all-inclusive information for researchers, engineers and students Details EXIT-chart based irregular transceiver designs Uses rich performance comparisons as well as diverse near-capacity design examples

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Academic Press

This book provides the first comprehensive and easy-to-read discussion of joint source-channel encoding and decoding for source signals with continuous amplitudes. It is a state-of-the-art presentation of this exciting, thriving field of research, making pioneering contributions to the new concept of source-adaptive modulation. The book starts with the basic theory and the motivation for a joint realization of source and channel coding. Specialized chapters deal with practically relevant scenarios such as iterative source-channel decoding and its optimization for a given encoder, and also improved encoder designs by channel-adaptive quantization or source-adaptive modulation. Although Information Theory is not the main topic of the book OCo in fact, the concept of joint source-channel coding is contradictory to the classical system design motivated by a questionable practical interpretation of the separation theorem OCo this theory still provides the ultimate performance limits for any practical system, whether it uses joint source-channel coding or not. Therefore, the theoretical limits are presented in a self-contained appendix, which is a useful reference also for those not directly interested in the main topic of this book. Sample Chapter(s). Chapter 1: Introduction (98 KB). Contents: Joint Source-Channel Coding: An Overview; Joint Source-Channel Decoding; Channel-Adaptive Scaled Vector Quantization; Index Assignments for Multiple Descriptions Vector Quantizers; Source-Adaptive Modulation; Source-Adaptive Power Allocation; Appendices: Theoretical Performance Limits; Optimal Decoder for a Given Encoder;

Symbol Error Probabilities for M-PSK; Derivative of the Expected Distortion for SAM. Readership: Students at advanced undergraduate and graduate level; practitioners and academics in Electrical and Communications Engineering, Information Technology and Computer Science."

Joint Source-Channel Decoding Imperial College Press

The book discusses modern channel coding techniques for wireless communications such as turbo codes, low parity check codes (LDPC), space-time coding, Reed Solomon (RS) codes and convolutional codes. Many illustrative examples are included in each chapter for easy understanding of the coding techniques. The text is integrated with MATLAB-based programs to enhance the understanding of the subject's underlying theories. It includes current topics of increasing importance such as turbo codes, LDPC codes, LT codes, Raptor codes and space-time coding in detail, in addition to the traditional codes such as cyclic codes, BCH and RS codes and convolutional codes. MIMO communications is a multiple antenna technology, which is an effective method for high-speed or high-reliability wireless communications. PC-based MATLAB m-files for the illustrative examples are included and also provided on the accompanying CD, which will help students and researchers involved in advanced and current concepts in coding theory. Channel coding, the core of digital communication and data storage, has undergone a major revolution as a result of the rapid growth of mobile and wireless communications. The book is divided into 11 chapters. Assuming no prior knowledge in the field of channel coding, the opening chapters (1 - 2) begin with basic theory and discuss how to improve the performance of wireless communication channels using channel coding. Chapters 3 and 4 introduce Galois fields and present detailed coverage of BCH codes and Reed-Solomon codes. Chapters 5–7 introduce the family of convolutional codes, hard and soft-decision Viterbi algorithms, turbo codes, BCJR algorithm for turbo decoding and studies trellis coded modulation (TCM), turbo trellis coded modulation (TTCM), bit-interleaved coded modulation (BICM) as well as iterative BICM (BICM-ID) and compares them under various channel conditions. Chapters 8 and 9 focus on low-density parity-check (LDPC) codes, LT codes and Raptor codes. Chapters 10 and 11 discuss MIMO systems and space-time (ST) coding.

Transmission Techniques for Digital Communications CRC Press

Modern introduction to theory of coding and decoding with many exercises and examples.

Channel Coding Techniques for Wireless Communications Springer Science & Business Media

An important text that offers an in-depth guide to how information theory sets the boundaries for data communication In an accessible and practical style, Information and Communication Theory explores the topic of information theory and includes concrete tools that are appropriate for real-life communication systems. The text investigates the connection between theoretical and practical applications through a wide-variety of topics

including an introduction to the basics of probability theory, information, (lossless) source coding, typical sequences as a central concept, channel coding, continuous random variables, Gaussian channels, discrete input continuous channels, and a brief look at rate distortion theory. The author explains the fundamental theory together with typical compression algorithms and how they are used in reality. He moves on to review source coding and how much a source can be compressed, and also explains algorithms such as the LZ family with applications to e.g. zip or png. In addition to exploring the channel coding theorem, the book includes illustrative examples of codes. This comprehensive text: Provides an adaptive version of Huffman coding that estimates source distribution Contains a series of problems that enhance an understanding of information presented in the text Covers a variety of topics including optimal source coding, channel coding, modulation and much more Includes appendices that explore probability distributions and the sampling theorem

Written for graduate and undergraduate students studying information theory, as well as professional engineers, master's students, Information and Communication Theory offers an introduction to how information theory sets the boundaries for data communication.

Source and Channel Coding Now Publishers Inc

The past few years have witnessed significant developments in algebraic coding theory. This book provides an advanced treatment of the subject from an engineering perspective, covering the basic principles and their application in communications and signal processing. Emphasis is on codes defined on the line, on the plane, and on curves, with the core ideas presented using commutative algebra and computational algebraic geometry made accessible using the Fourier transform. Starting with codes defined on a line, a background framework is established upon which the later chapters concerning codes on planes, and on curves, are developed. The decoding algorithms are developed using the standard engineering approach applied to those of Reed-Solomon codes, enabling them to be evaluated against practical applications. Integrating recent developments in the field into the classical treatment of algebraic coding, this is an invaluable resource for graduate students and researchers in telecommunications and applied mathematics.

Theory and Practice CRC Press

" While multiple-access communication dates back to systems invented in the 1870s to transmit simultaneous data through a single wire, the foundation of the discipline now known as multiuser information theory was laid in 1961, when Claude E. Shannon published his paper on two-way channels. Since then, multiuser information theory has been an extremely active research area, and has seen a large number of fundamental contributions, covering, besides the two-way channel studied in, multiple access, interference, broadcast, and wiretap channels. However, several key canonical problems have defied many efforts. This book brings together

leading experts working in the fields of information theory, coding theory, multiple user communications, discrete mathematics, etc., who survey recent and general results on multiple-access channels (rate regions, rate splitting, etc.), and give an overview of the problems of current CDMA solutions (fading channels, multi-user detection, multiple-antenna systems, iterative joint decoding, OFDMA, etc.). This publication consist of three parts. The first part includes chapters devoted to the information-theoretical aspects of multiple-access communication. In the second part, multiple-access techniques are discussed and the third part of this volume covers coding techniques. "

Coding Theory John Wiley & Sons

This book discusses the latest channel coding techniques, MIMO systems, and 5G channel coding evolution. It provides a comprehensive overview of channel coding, covering modern techniques such as turbo codes, low-density parity-check (LDPC) codes, space–time coding, polar codes, LT codes, and Raptor codes as well as the traditional codes such as cyclic codes, BCH, RS codes, and convolutional codes. It also explores MIMO communications, which is an effective method for high-speed or high-reliability wireless communications. It also examines the evolution of 5G channel coding techniques. Each of the 13 chapters features numerous illustrative examples for easy understanding of the coding techniques, and MATLAB-based programs are integrated in the text to enhance readers' grasp of the underlying theories. Further, PC-based MATLAB m-files for illustrative examples are included for students and researchers involved in advanced and current concepts of coding theory.

Academic Press Library in Mobile and Wireless Communications Springer Science & Business Media

An effective blend of carefully explained theory and practical applications, this text imparts the fundamentals of both information theory and data compression. Although the two topics are related, this unique text allows either topic to be presented independently, and it was specifically designed so that the data compression section requires no prior knowledge of information theory. The treatment of information theory, while theoretical and abstract, is quite elementary, making this text less daunting than many others. After presenting the fundamental definitions and results of the theory, the authors then apply the theory to memoryless, discrete channels with zeroth-order, one-state sources. The chapters on data compression acquaint students with a myriad of lossless compression methods and then introduce two lossy compression methods. Students emerge from this study competent in a wide range of techniques. The authors' presentation is highly practical but includes some important proofs, either in the text or in the exercises, so instructors can, if they choose, place more emphasis on the mathematics. Introduction to Information Theory and Data Compression, Second Edition is ideally suited for an upper-level or graduate course for students in mathematics, engineering, and computer science. Features: Expanded discussion of the historical and theoretical basis of

information theory that builds a firm, intuitive grasp of the subject Reorganization of theoretical results along with new exercises, ranging from the routine to the more difficult, that reinforce students' ability to apply the definitions and results in specific situations. Simplified treatment of the algorithm(s) of Gallager and Knuth Discussion of the information rate of a code and the trade-off between error correction and information rate Treatment of probabilistic finite state source automata, including basic results, examples, references, and exercises Octave and MATLAB image compression codes included in an appendix for use with the exercises and projects involving transform methods Supplementary materials, including software, available for download from the authors' Web site at www.dms.auburn.edu/compression

Channel Coding in the Presence of Side Information Cambridge University Press

Distributed source coding is one of the key enablers for efficient cooperative communication. The potential applications range from wireless sensor networks, ad-hoc networks, and surveillance networks, to robust low-complexity video coding, stereo/Multiview video coding, HDTV, hyper-spectral and multispectral imaging, and biometrics. The book is divided into three sections: theory, algorithms, and applications. Part one covers the background of information theory with an emphasis on DSC; part two discusses designs of algorithmic solutions for DSC problems, covering the three most important DSC problems: Slepian-Wolf, Wyner-Ziv, and MT source coding; and part three is dedicated to a variety of potential DSC applications. Key features: Clear explanation of distributed source coding theory and algorithms including both lossless and lossy designs. Rich applications of distributed source coding, which covers multimedia communication and data security applications. Self-contained content for beginners from basic information theory to practical code implementation. The book provides fundamental knowledge for engineers and computer scientists to access the topic of distributed source coding. It is also suitable for senior undergraduate and first year graduate students in electrical engineering; computer engineering; signal processing; image/video processing; and information theory and communications.

Coding for Channels with Feedback John Wiley & Sons

An unparalleled learning tool and guide to error correction coding Error correction coding techniques allow the detection and correction of errors occurring during the transmission of data in digital communication systems. These techniques are nearly universally employed in modern communication systems, and are thus an important component of the modern information economy. Error Correction Coding: Mathematical Methods and Algorithms provides a comprehensive introduction to both the theoretical and practical aspects of error correction coding, with a presentation suitable for a wide variety of audiences, including graduate students in electrical engineering, mathematics, or computer science. The pedagogy is arranged so that the

mathematical concepts are presented incrementally, followed immediately by applications to coding. A large number of exercises expand and deepen students' understanding. A unique feature of the book is a set of programming laboratories, supplemented with over 250 programs and functions on an associated Web site, which provides hands-on experience and a better understanding of the material. These laboratories lead students through the implementation and evaluation of Hamming codes, CRC codes, BCH and R-S codes, convolutional codes, turbo codes, and LDPC codes. This text offers both "classical" coding theory-such as Hamming, BCH, Reed-Solomon, Reed-Muller, and convolutional codes-as well as modern codes and decoding methods, including turbo codes, LDPC codes, repeat-accumulate codes, space time codes, factor graphs, soft-decision decoding, Guruswami-Sudan decoding, EXIT charts, and iterative decoding. Theoretical complements on performance and bounds are presented. Coding is also put into its communications and information theoretic context and connections are drawn to public key cryptosystems. Ideal as a classroom resource and a professional reference, this thorough guide will benefit electrical and computer engineers, mathematicians, students, researchers, and scientists.

Theory and Practice

Springer Nature

Channel Coding: Theory, Algorithms, and ApplicationsAcademic Press Library in Mobile and Wireless CommunicationsAcademic Press

Digital Communications 1

John Wiley & Sons

How can one exchange information e?ectively when the medium of com-nication introduces errors? This question has been investigated extensively starting with the seminal works of Shannon (1948) and Hamming (1950), and has led to the rich theory of “error-correcting codes”. This theory has traditionally gone hand in hand with the algorithmic theory of “decoding” that tackles the problem of recovering from the errors e?ciently. This thesis presents some spectacular new results in the area of decoding algorithms for error-correctingcodes. Speci?cally,itshowshowthe notionof“list-decoding” can be applied to recover from far more errors, for a wide variety of err-correcting codes, than achievable before. A brief bit of background: error-correcting codes are combinatorial str- tures that show how to represent (or “encode”) information so that it is -silient to a moderate number of errors. Speci?cally, an error-correcting code takes a short binary string, called the message, and shows how to transform it into a longer binary string, called the codeword, so that if a small number of bits of the codewordare ?ipped, the resulting string does not look like any other codeword. The maximum number of errorsthat the code is guaranteed to detect, denoted d, is a central parameter in its design. A basic property of such a code is that if the number of errors that occur is known to be smaller than d/2, the message is determined uniquely. This poses a computational problem,calledthedecodin gproblem:computethemes sagefromacorrupted

codeword, when the number of errors is less than d/2.

List Decoding of Error-Correcting Codes

Springer

Books on information theory and coding have proliferated over the last few years, but few succeed in covering the fundamentals without losing students in mathematical abstraction. Even fewer build the essential theoretical framework when presenting algorithms and implementation details of modern coding systems. Without abandoning the theoret

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World Scientific

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Cambridge University Press

Iterative algorithms are now widely used in all areas of signal processing and digital communications. In modern communication systems, iterative algorithms are notably used for decoding low-density parity-check (LDPC) codes, a popular class of error-correction codes known to have exceptional error-rate performance under iterative decoding. In a more recent field known as compressed sensing, iterative algorithms are used as a method of reconstruction to recover a sparse signal from a linear set of measurements. This work primarily deals with the development of low-complexity iterative algorithms for the two aforementioned fields, namely, the design of low-complexity decoding algorithms for LDPC codes, and the development and analysis of a low complexity reconstruction algorithm for compressed sensing. In the first part of this dissertation, we focus on the decoding algorithms for LDPC codes. It is now well known that LDPC codes suffer from an error floor phenomenon in spite of their exceptional performance. This phenomenon originates from the failures of traditional iterative decoders, like belief propagation (BP), on certain low-noise configurations. Recently, a novel class of decoders, called finite alphabet iterative decoders (FAIDs), were proposed with the capability of surpassing BP in the error floor region at a much lower complexity. We show that numerous FAIDs can be designed, and among them only a few will have the ability of surpassing traditional decoders in the error floor region. In this work, we focus on the problem of the selection of good FAIDs for column-weight-three codes over the binary symmetric channel. Traditional methods for decoder selection use asymptotic techniques such as the density evolution method, but the designed decoders do not guarantee good performance for finite-length codes especially in the error floor region. Instead we propose a methodology to identify FAIDs with good error-rate performance in the error floor. This methodology relies on the knowledge of potentially harmful topologies that could be present in a code. The selection method uses the concept of noisy trapping set. Numerical results are provided to show that FAIDs selected based on our methodology outperform BP in the error floor on a wide range of codes. Moreover first results on column-weight-four codes demonstrate the potential of such decoders on codes which are more used in practice, for example in storage systems. In the second part of this dissertation, we address the area of

iterative reconstruction algorithms for compressed sensing. This field has attracted a lot of attention since Donoho's seminal work due to the promise of sampling a sparse signal with less samples than the Nyquist theorem would suggest. Iterative algorithms have been proposed for compressed sensing in order to tackle the complexity of the optimal reconstruction methods which notably use linear programming. In this work, we modify and analyze a low complexity reconstruction algorithm that we refer to as the interval-passing algorithm (IPA) which uses sparse matrices as measurement matrices. Similar to what has been done for decoding algorithms in the area of coding theory, we analyze the failures of the IPA and link them to the stopping sets of the binary representation of the sparse measurement matrices used. The performance of the IPA makes it a good trade-off between the complex l1-minimization reconstruction and the very simple verification decoding. The measurement process has also a lower complexity as we use sparse measurement matrices. Comparison with another type of message-passing algorithm, called approximate message-passing, show the IPA can have superior performance with lower complexity. We also demonstrate that the IPA can have practical applications especially in spectroscopy.

An Algorithmic Approach Academic Press

This book gives a review of the principles, methods and techniques of important and emerging research topics and technologies in Channel Coding, including theory, algorithms, and applications. Edited by leading people in the field who, through their reputation, have been able to commission experts to write on a particular topic. With this reference source you will: Quickly grasp a new area of research Understand the underlying principles of a topic and its applications Ascertain how a topic relates to other areas and learn of the research issues yet to be resolved Quick tutorial reviews of important and emerging topics of research in Channel Coding Presents core principles in Channel Coding theory and shows their applications Reference content on core principles, technologies, algorithms and applications Comprehensive references to journal articles and other literature on which to build further, more specific and detailed knowledge