Error Control Coding For Computer Systems Prentice Hall Series In Computer Engineering

Electrical Engineering/Communications/Information Theory "The Berlekamp article alone will make this book worth having." --David Forney, Vice President, Motorola Codex Reed-Solomon Codes and Their Applications Edited by Stephen B. Wicker, Georgia Institute of Technology and Vijay K. Bhargava, University of Victoria On the Voyager spacecraft, they were responsible for sending clear pictures of the planets back to earth. They have also played a key role in the digital audio revolution. They are Reed-Solomon error codes: the extremely powerful codes that provide critical error control for many different types of digital communications systems. This outstanding collection of thirteen original articles written by leading researchers in the field provides a uniquely comprehensive overview of the history and practical applications--some never before published--of these important codes. Key features include: * Thirteen original articles from leading researchers in the field, with a historical overview by Reed and Solomon * An explanation of how Reed-Solomon codes were used in the Voyager spacecraft and how they are currently used in the compact disc player * Specific applications for digital audio, data transfer over mobile radio, satellite communications, spread spectrum systems, and more * New techniques for improving the performance of your own communications systems This book will be of interest to design and research engineers in the telecommunications field, particularly those in the aerospace/satellite and mobile radio industries. It is also well-suited for use as an advanced-level textbook on the subject of error control coding. Books of Related Interest from IEEE Press Clauide Elwood Shannon: Collected Papers Edited by N. J. A. Sloane and A. D. Wyner. AT&T Bell Labs The first published collection of papers by Claude E. Shannon, including his seminal article "The Mathematical Theory of Communication." 1993 Hardcover 968 pp IEEE Order Number PC0331-9 ISBN 0-7803-0434-9 Multiple Access Communications: Foundations for Emerging Technologies Edited by Norman Abramson, University of Hawaii at Manoa The first book to explain the connection between spread spectrum and ALOHA channels, providing a collection of key developments in the theory and practice of multiple user communications channels. 1993 Hardcover 528pp IEEE Order Number PC0287-3 ISBN 0-87942-292-0

Channel coding lies at the heart of digital communication and data storage, and this detailed introduction describes the core theory as well as decoding algorithms, implementation details, and performance analyses. In this book, Professors Ryan and Lin provide clear information on modern channel codes, including turbo and low-density parity-check (LDPC) codes. They also present detailed coverage of BCH codes, Reed-Solomon codes, convolutional codes, finite geometry codes, and product codes, providing a one-stop resource for both classical and modern coding techniques. Assuming no prior knowledge in the field of channel coding, the opening chapters begin with basic theory to introduce newcomers to the subject. Later chapters then extend to advanced topics such as code ensemble performance analyses and algebraic code design. 250 varied and stimulating end-of-chapter problems are also included to test and enhance learning, making this an essential resource for students and practitioners alike.

The purpose of Error-Control Coding for Data Networks is to provide an accessible and comprehensive overview of the fundamental techniques and practical applications of the error-control coding needed by students and engineers. An additional purpose of the book is to acquaint the reader with the analytical techniques used to design an error-control coding system for many new applications in data networks. Error~control coding is a field in which elegant theory was motivated by practical problems so that it often leads to important useful advances. Claude Shannon in 1948 proved the existence of error-control codes that, under suitable conditions and at rates less than channel capacity, would transmit error-free information for all practical applications. The first practical binary codes were introduced by Richard Hamming and Marcel Golay from which the drama and excitement have infused researchers and engineers in digital communication and error-control coding for more than fifty years. Nowadays, error-control codes are being used in almost all modem digital electronic systems and data networks. Not only is coding equipment being implemented to increase the energy and bandwidth efficiency of communication systems, but coding also provides innovative solutions to many related data-networking problems.

This practical resource provides you with a comprehensive understanding of error control coding, an essential and widely applied area in modern digital communications. The goal of error control coding is to encode information in such a way that even if the channel (or storage medium) introduces errors, the receiver can correct the errors and recover the original transmitted information. This book includes the most useful modern and classic codes, including block, Reed Solomon, convolutional, turbo, and LDPC codes. You find clear guidance on code construction, decoding algorithms, and error correcting performances. Moreover, this unique book introduces computer simulations integrally to help you master key concepts. Including a companion DVD with MATLAB programs and supported with over 540 equations, this hands-on reference provides you with an in-depth treatment of a wide range of practical implementation issues.

This book discusses both the theory and practical applications of self-correcting data, commonly known as error-correcting codes. The applications included demonstrate the importance of these codes in a wide range of everyday technologies, from smartphones to secure communications and transactions. Written in a readily understandable style, the book presents the authors' twenty-five years of research organized into five parts: Part I is concerned with the theoretical performance attainable by using error correcting codes to achieve communications efficiency in digital communications systems. Part II explores the construction of error-correcting codes and explains the different families of codes and how they are designed. Techniques are described for producing the very best codes. Part III addresses the analysis of low-density parity-check (LDPC) codes, primarily to calculate their stopping sets and low-weight codeword spectrum which determines the performance of th ese codes. Part IV deals with decoders designed to realize optimum performance. Part V describes applications which include combined error correction and detection, public key

cryptography using Goppa codes, correcting errors in passwords and watermarking. This book is a valuable resource for anyone interested in error-correcting codes and their applications, ranging from non-experts to professionals at the forefront of research in their field. This book is open access under a CC BY 4.0 license.

Constrained Coding and Soft Iterative Decoding is the first work to combine the issues of constrained coding and soft iterative decoding (e.g., turbo and LDPC codes) from a unified point of view. Since constrained coding is widely used in magnetic and optical storage, it is necessary to use some special techniques (modified concatenation scheme or bit insertion) in order to apply soft iterative decoding. Recent breakthroughs in the design and decoding of error-control codes (ECCs) show significant potential for improving the performance of many communications systems. ECCs such as turbo codes and low-density parity check (LDPC) codes can be represented by graphs and decoded by passing probabilistic (a.k.a. `soft') messages along the edges of the graph. This message-passing algorithm yields powerful decoders whose performance can approach the theoretical limits on capacity. This exposition uses `normal graphs,' introduced by Forney, which extend in a natural manner to block diagram representations of the system and provide a simple unified framework for the decoding of ECCs, constrained codes, and channels with memory. Soft iterative decoding is illustrated by the application of turbo codes and LDPC codes to magnetic recording channels. For magnetic and optical storage, an issue arises in the use of constrained coding, which places restrictions on the sequences that can be transmitted through the channel; the use of constrained coding in combination with soft ECC decoders is addressed by the modified concatenation scheme also known as `reverse concatenation.' Moreover, a soft constraint decoder yields additional coding gain from the redundancy in the constraint, which may be of practical interest in the case of optical storage. In addition, this monograph presents several other research results (including the design of sliding-block lossless compression codes, and the decoding of array codes as LDPC codes). Constrained Coding and Soft Iterative Decoding will prove useful to students, researchers and professional engineers who are interested in understanding this new soft iterative decoding paradigm and applying it in communications and storage systems.

Essentials of Error-Control Coding Techniques presents error-control coding techniques with an emphasis on the most recent applications. It is written for engineers who use or build error-control coding equipment. Many examples of practical applications are provided, enabling the reader to obtain valuable expertise for the development of a wide range of error-control coding systems. Necessary background knowledge of coding theory (the theory of error-correcting codes) is also included so that the reader is able to assimilate the concepts and the techniques. The book is divided into two parts. The first provides the reader with the fundamental knowledge of the coding theory that is necessary to understand the material in the latter part. Topics covered include the principles of error detection and correction, block codes, and convolutional codes. The second part is devoted to the practical applications of error-control coding in various fields. It explains how to design cost-effective error-control coding systems. Many examples of actual error-control coding systems are described and evaluated. This book is particularly suited for the engineer striving to master the practical applications of error-control coding. It is also suitable for use as a graduate text for an advanced course in coding theory. 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.

Error-correction coding is being used on an almost routine basis in most new communication systems. Not only is coding equipment being used to increase the energy efficiency of communication links, but coding ideas are also providing innovative solutions to many related communication problems. Among these are the elimination of intersymbol interference caused by filtering and multipath and the improved demodulation of certain frequency modulated signals by taking advantage of the "natural" coding provided by a continuous phase. Although several books and nu merous articles have been written on coding theory, there are still noticeable deficiencies. First, the practical aspects of translating a specific decoding algorithm into actual hardware have been largely ignored. The information that is available is sketchy and is widely dispersed. Second, the information required to evaluate a particular technique under situations that are en countered in practice is available for the most part only in private company reports. This book is aimed at correcting both of these problems. It is written for the design engineer who must build the coding and decoding equipment and for the communication system engineer who must incorporate this equipment into a system. It is also suitable as a senior-level or first-year graduate text for an introductory one-semester course in coding theory. The book U"Ses a minimum of

mathematics and entirely avoids the classical theorem/proof approach that is often seen in coding texts. Fundamentals of Codes, Graphs, and Iterative Decoding is an explanation of how to introduce local connectivity, and how to exploit simple structural descriptions. Chapter 1 provides an overview of Shannon theory and the basic tools of complexity theory, communication theory, and bounds on code construction. Chapters 2 - 4 provide an overview of "classical" error control coding, with an introduction to abstract algebra, and block and convolutional codes. Chapters 5 - 9 then proceed to systematically develop the key research results of the 1990s and early 2000s with an introduction to graph theory, followed by chapters on algorithms on graphs, turbo error control, low density parity check codes, and low density generator codes.

The papers in this volume were presented at the CRYPTO '88 conference on theory and applications of cryptography, held in Santa Barbara, California, August 21-25, 1988. The papers were chosen for their perceived originality and often represent preliminary reports on continuing research. The main sections deal with the following topics: Zero-Knowledge, Number Theory, Pseudorandomness, Signatures, Complexity, Protocols, Security, Cryptoanalysis. As such, they will give the committed reader a unique insight into the very latest developments in the field.

Fundamentals of Error Correcting Codes is an in-depth introduction to coding theory from both an engineering and mathematical viewpoint. As well as covering classical topics, there is much coverage of techniques which could only be found in specialist journals and book publications. Numerous exercises and examples and an accessible writing style make this a lucid and effective introduction to coding theory for advanced undergraduate and graduate students, researchers and engineers, whether approaching the subject from a mathematical, engineering or computer science background.

With the massive amount of data produced and stored each year, reliable storage and retrieval of information is more crucial than ever. Robust coding and decoding techniques are critical for correcting errors and maintaining data integrity. Comprising chapters thoughtfully selected from the highly popular Coding and Signal Processing for Magnetic Recording Systems, Advanced Error Control Techniques for Data Storage Systems is a finely focused reference to the state-of-the-art error control and modulation techniques used in storage devices. The book begins with an introduction to error control codes, explaining the theory and basic concepts underlying the codes. Building on these concepts, the discussion turns to modulation codes, paying special attention to run-length limited sequences, followed by maximum transition run (MTR) and spectrum shaping codes. It examines the relationship between constrained codes and error control and correction systems from both code-design and architectural perspectives as well as techniques based on convolution codes. With a focus on increasing data density, the book also explores multi-track systems, soft decision decoding, and iteratively decodable codes such as Low-Density Parity-Check (LDPC) Codes, Turbo codes, and Turbo Product Codes. Advanced Error Control Techniques for Data Storage Systems offers a comprehensive collection of theory and techniques that is ideal for specialists working in the field of data storage systems.

Introduction to Convolutional Codes with Applications is an introduction to the basic concepts of convolutional codes, their structure and classification, various error correction and decoding techniques for convolutionally encoded data, and some of the most common applications. The definition and representations, distance properties, and important classes of convolutional codes are also discussed in detail. The book provides the first comprehensive description of table-driven correction and decoding of convolutionally encoded data. Complete examples of Viterbi, sequential, and majority-logic decoding technique are also included, allowing a quick comparison among the different decoding approaches.

Introduction to Convolutional Codes with Applications summarizes the research of the last two decades on applications of convolutional codes in hybrid ARQ protocols. A new classification allows a natural way of studying the underlying concepts of hybrid schemes and accommodates all of the new research. A novel application of fast decodable invertible convolutional codes for lost packet recovery in high speed networks is described. This opens the door for using convolutional coding for error recovery in high speed networks. Practicing communications, electronics, and networking engineers who want to get a better grasp of the underlying concepts of convolutional coding and its applications will greatly benefit by the simple and concise style of explanation. An up-to-date bibliography of over 300 papers is included. Also suitable for use as a textbook or a reference text in an advanced course on coding theory with emphasis on convolutional codes.

Error-correcting codes are ubiquitous. They are adopted in almost every modern digital communication and storage system, such as wireless communications, optical communications, Flash memories, computer hard drives, sensor networks, and deep-space probing. New-generation and emerging applications demand codes with better error-correcting capability. On the other hand, the design and implementation of those high-gain error-correcting codes pose many challenges. They usually involve complex mathematical computations, and mapping them directly to hardware often leads to very high complexity. VLSI Architectures for Modern Error-Correcting Codes serves as a bridge connecting advancements in coding theory to practical hardware implementations. Instead of focusing on circuit-level design techniques, the book highlights integrated algorithmic and architectural transformations that lead to great improvements on throughput, silicon area requirement, and/or power consumption in the hardware implementation. The goal of this book is to provide a comprehensive and systematic review of available techniques and architectures, so that they can be easily followed by system and hardware designers to develop en/decoder implementations that meet error-correcting performance and cost requirements. This book can be also used as a reference for graduate-level courses on VLSI design and error-correcting coding. Particular emphases are placed on hard- and soft-decision Reed-Solomon (RS) and Bose-Chaudhuri-Hocquenghem (BCH) codes, and binary and non-binary low-density parity-check (LDPC) codes. These codes are among the best candidates for modern and emerging applications due to their good error-correcting performance and lower implementation complexity compared to other codes. To help explain the computations and en/decoder architectures, many examples and case studies are included. More importantly, discussions are provided on the advantages and drawbacks of different implementation approaches and architectures.

028M> A reorganized and comprehensive major revision of a classic book, this edition provides a bridge between introductory digital communications and more advanced treatment of information theory. Completely updated to cover the latest developments, it presents state-of-the-art error control techniques. 028M> Coverage of the fundamentals of coding and the applications of codes to the design of real error control systems. Contains the most recent developments of coded modulation, trellises for codes, soft-decision decoding algorithms, turbo coding for reliable data transmission and other areas. There are two new chapters on Reed-Solomon codes and concatenated coding schemes. Also contains hundreds of new and revised examples; and more than 200 illustrations of code structures, encoding and decoding circuits and error performance of many important codes and error control coding systems. 028M> Appropriate for those with minimum mathematical background as a comprehensive reference for coding theory.

This book is a collection of essays devoted in part to new research direc tions in systems, networks, and control theory, and in part to the growing interaction of these disciplines with new sectors of engineering and applied sciences like coding, computer vision, and hybrid systems. These are new areas of rapid growth and of increasing importance in modern technology. The essays, written by world-leading experts in the field, reproduce and expand the plenary and minicoursejminisymposia invited lectures which were delivered at the Mathematical Theory of Networks and Systems Sym posium (MTNS-98), held in Padova, Italy, on July 6-10, 1998. Systems, control, and networks theory has permeated the development of much of present day technology. The impact has been visible in the past fifty years through the dramatic expansion and achievements of the aerospace and avionics industry, through process control and factory au tomation, robotics, communication signals analysis and synthesis, and, more recently, even finance, to name just the most visible applications. The theory has developed from the early phase of its history when the ba sic tools were elementary complex analysis, Laplace transform, and linear differential equations, to present day, where the mathematics ranges widely from functional analysis, PDE's, abstract algebra, stochastic processes and differential geometry. Irrespective of the particular tools, however, the ba sic unifying paradigms of feedback, stability, optimal control, and recursive filtering, have remained the bulk of the field and continue to be the basic motivation for the theory, coming from the real world. Rapid advances in electronic and optical technology have enabled the implementation of powerful error-control codes, which are now used in almost the entire range of information systems with close to optimal performance. These codes and decoding methods are required for the detection and correction of the errors and erasures which inevitably occur in digital information during transmission, storage and processing because of noise, interference and other imperfections. Error-control coding is a complex, novel and unfamiliar area, not yet widely understood and appreciated. This book sets out to provide a clear description of the essentials of the subject, with comprehensive and up-to-date coverage of the most useful codes and their decoding algorithms. A practical engineering and information technology emphasis, as well as relevant background material and fundamental theoretical aspects, provides an in-depth guide to the essentials of Error-Control Coding. Provides extensive and detailed coverage of Block, Cyclic, BCH, Reed-Solomon, Convolutional, Turbo, and Low Density Parity Check (LDPC) codes, together with relevant aspects of Information Theory EXIT chart performance analysis for iteratively decoded error-control techniques Heavily illustrated with tables, diagrams, graphs, worked examples, and exercises Invaluable companion website features slides of figures, algorithm software, updates and solutions to problems Offering a complete overview of Error Control Coding, this book is an indispensable resource for students, engineers and researchers in the areas of telecommunications engineering, communication networks, electronic engineering, computer science, information systems and technology, digital signal processing and applied mathematics. Quantum Information Processing and Quantum Error Correction is a self-contained, tutorial-based introduction to quantum information, quantum computation, and quantum error-correction. Assuming no knowledge of quantum mechanics and written at an intuitive level suitable for the engineer, the book gives all the essential principles needed to design and implement quantum electronic and photonic circuits. Numerous examples from a wide area of application are given to show how the principles can be implemented in practice. This book is ideal for the electronics, photonics and computer engineer who requires an easy- to-understand foundation on the principles of quantum information processing and quantum error correction, together with insight into how to develop quantum electronic and photonic circuits. Readers of this book will be ready for further study in this area, and will be prepared to perform independent research. The reader completed the book will be able design the information processing circuits, stabilizer codes, Calderbank-Shor-Steane (CSS) codes, subsystem codes, topological codes and entanglement-assisted quantum error correction codes; and propose corresponding physical implementation. The reader completed the book will be proficient in quantum fault-tolerant design as well. Unique Features Unique in covering both quantum information processing and quantum error correction - everything in one book that an engineer needs to understand and implement quantum-level circuits. Gives an intuitive understanding by not assuming knowledge of quantum mechanics, thereby avoiding heavy mathematics. In-depth coverage of the design and implementation of quantum information processing and quantum error correction circuits. Provides the right balance among the quantum mechanics, quantum error correction, quantum computing and quantum communication. Dr. Djordjevic is an Assistant Professor in the Department of Electrical and Computer Engineering of College of Engineering, University of Arizona, with a joint appointment in the College of Optical Sciences. Prior to this appointment in August 2006, he was with University of Arizona, Tucson, USA (as a Research Assistant Professor); University of the West of England, Bristol, UK; University of Bristol, Bristol, UK; Tyco Telecommunications, Eatontown, USA; and National Technical University of Athens, Athens, Greece. His current research interests include optical networks, error control coding, constrained coding, coded modulation, turbo equalization, OFDM applications, and quantum error correction. He presently directs the Optical Communications Systems Laboratory (OCSL) within the ECE Department at the University of Arizona. Provides everything an engineer needs in one tutorial-based introduction to understand and implement quantum-level circuits Avoids the heavy use of mathematics by not assuming the previous knowledge of quantum mechanics Provides in-depth coverage of the design and implementation of quantum information processing and quantum error correction circuits

With VLSI chip transistors getting smaller and smaller, today's digital systems are more complex than ever before. This increased complexity leads to more cross-talk, noise, and other sources of transient errors during normal operation. Traditional off-line testing strategies cannot guarantee detection of these transient faults. And with critical applications relying on faster, more powerful chips, fault-tolerant, self-checking mechanisms must be built in to assure reliable operation. Self-Checking and Fault-Tolerant Digital Design deals extensively with self-checking design techniques and is the only book that emphasizes major techniques for hardware fault tolerance. Graduate students in VLSI design courses as well as practicing designers will appreciate this balanced treatment of the concepts and theory underlying fault tolerance along with the practical techniques used to create

fault-tolerant systems. Features: Introduces reliability theory and the importance of maintainability Presents coding and the construction of several error detecting and correcting codes Discusses in depth, the available techniques for fail-safe design of combinational circuits Details checker design techniques for detecting erroneous bits and encoding output of self-checking circuits Demonstrates how to design self-checking sequential circuits, including a technique for fail-safe state machine design

Digital Signal Processing Algorithms describes computational number theory and its applications to deriving fast algorithms for digital signal processing. It demonstrates the importance of computational number theory in the design of digital signal processing algorithms and clearly describes the nature and structure of the algorithms themselves. The book has two primary focuses: first, it establishes the properties of discrete-time sequence indices and their corresponding fast algorithms; and second, it investigates the properties of the discrete-time sequences and the corresponding fast algorithms for processing these sequences. Digital Signal Processing Algorithms examines three of the most common computational tasks that occur in digital signal processing; namely, cyclic convolution, acyclic convolution, and discrete Fourier transformation. The application of number theory to deriving fast and efficient algorithms for these three and related computationally intensive tasks is clearly discussed and illustrated with examples. Its comprehensive coverage of digital signal processing, computer arithmetic, and coding theory makes Digital Signal Processing Algorithms an excellent reference for practicing engineers. The authors' intent to demystify the abstract nature of number theory and the related algebra is evident throughout the text, providing clear and precise coverage of the quickly evolving field of digital signal processing.

The coding problem; Introduction to algebra; Linear codes; Error correction capabilities of linear codes; Important linear block codes; Polynomial rings and galois fields; Linear switching circuits; Cyclic codes; Bose-chaudhuri-hocquenghem codes; Arithmetic codes.

This 2006 book introduces the theoretical foundations of error-correcting codes for senior-undergraduate to graduate students.

For introductory graduate courses in coding for telecommunications engineering, digital communications. This introductory text on error control coding focuses on key implementation issues and performance analysis with applications valuable to both mathematicians and engineers.

Details the most important techniques used to make the storage and transmission of data fast, secure, and reliable. Accessible to both specialists and nonspecialists: Avoids complex mathematics

In the world of digital electronic it is essential to detect and correct errors in digital signals. This introductory book tackles the complex subject of error detection and correction in an easily accessible way for undergraduate students of computer science and electronic engineering. This book leads the reader with no prior knowledge through this important topic while avoiding unnecessary and difficult mathematical proofs.

After historical introduction, the aspiration technique and imaging modalities are described. Thereafter, the use of aspiration cytology in the diagnosis and mainly in the sta- ging of urologic cancers is on still not well known appli- cations of the procedure in the staging of some organs (bladder, adrenals, penis, testis and secondary ureteral strictures) are reported.

Building on the success of the first edition, which offered a practical introductory approach to the techniques of error concealment, this book, now fully revised and updated, provides a comprehensive treatment of the subject and includes a wealth of additional features. The Art of Error Correcting Coding, Second Edition explores intermediate and advanced level concepts as well as those which will appeal to the novice. All key topics are discussed, including Reed-Solomon codes, Viterbi decoding, soft-output decoding algorithms, MAP, log-MAP and MAX-log-MAP. Reliability-based algorithms GMD and Chase are examined, as are turbo codes, both serially and parallel concatenated, as well as low-density parity-check (LDPC) codes and their iterative decoders. Features additional problems at the end of each chapter and an instructor's solutions manual Updated companion website offers new C/C ++programs and MATLAB scripts, to help with the understanding and implementation of basic ECC techniques Easy to follow examples illustrate the fundamental concepts of error correcting codes Basic analysis tools are provided throughout to help in the assessment of the error performance block and convolutional codes of a particular error correcting coding (ECC) scheme for a selection of the basic channel models This edition provides an essential resource to engineers, computer scientists and graduate students alike for understanding and applying ECC techniques in the transmission and storage of digital information.

Presents all of the key ideas needed to understand, design, implement and analyse iterative-based error correction schemes.

Teaching the theory of error correcting codes on an introductory level is a difficulttask. The theory, which has immediate hardware applications, also concerns highly abstractmathematical concepts. This text explains the basic circuits in a refreshingly practical way thatwill appeal to undergraduate electrical engineering students as well as to engineers and techniciansworking in industry.Arazi's truly commonsense approach provides a solid grounding in the subject,explaining principles intuitively from a hardware perspective. He fully covers error correctiontechniques, from basic parity check and single error correction cyclic codes to burst errorcorrecting codes and convolutional codes. All this he presents before introducing Galois fieldtheory - the basic algebraic treatment and theoretical basis of the subject, which usually appearsin the opening chapters of standard textbooks. One entire chapter is devoted to specific practicalissues, such as Reed-Solomon codes (used in compact disc equipment), and maximum length sequences(used in various fields of communications). The basic circuits explained throughout the book areredrawn and analyzed from a theoretical point of view for readers who are interested in tackling themathematics at a more advanced level.Benjamin Arazi is an Associate Professor in the Department ofElectrical and Computer Engineering at the Ben-Gurion University of the Negev. His book is includedin the Computer Systems Series, edited by Herb Schwetman.

Essentials of Error-Control Coding Techniques presents error-control coding techniques with an emphasis on the most recent applications. It is written for engineers who use or build error-control coding equipment. Many examples of practical applications are provided, enabling the reader to obtain valuable expertise for the development of a wide range of error-control coding systems. Necessary background knowledge of coding theory (the theory of error-correcting codes) is also included so that the reader is able to assimilate the concepts and the techniques. The book is divided into two parts.

When the 50th anniversary of the birth of Information Theory was celebrated at the 1998 IEEE International Symposium on Informa tion Theory in Boston, there was a great deal of reflection on the the year 1993 as a critical year. As the years pass and more perspec tive is gained, it is a fairly safe bet that we will view 1993 as the year when the "early years" of error control coding came to an end. This was the

year in which Berrou, Glavieux and Thitimajshima pre sented "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes" at the International Conference on Communications in Geneva. In their presentation, Berrou et al. claimed that a combi nation of parallel concatenation and iterative decoding can provide reliable communications at a signal to noise ratio that is within a few tenths of a dB of the Shannon limit. Nearly fifty years of striving to achieve the promise of Shannon's noisy channel coding theorem had come to an end. The implications of this result were immediately apparent to all -coding gains on the order of 10 dB could be used to dramatically extend the range of communication receivers, increase data rates and services, or substantially reduce transmitter power levels. The 1993 ICC paper set in motion several research efforts that have permanently changed the way we look at error control coding.

This book presents an extensive survey and report of related research on important developments in cellular automata (CA) theory. The authors introduce you to this theory in a comprehensive manner that will help you understand the basics of CA and be prepared for further research. They illustrate the matrix algebraic tools that characterize group CA and help develop its applications in the field of VLSI testing. The text examines schemes based on easily testable FSM, bit-error correcting code, byte error correcting code, and characterization of 2D cellular automata. In addition, it looks into CA-based universal pattern generation, data encryption, and synthesis of easily testable combinational logic. The book covers new characterizations of group CA behavior, CA-based tools for fault diagnosis, and a wide variety of applications to solve real-life problems.

It has long been recognized that there are fascinating connections between cod ing theory, cryptology, and combinatorics. Therefore it seemed desirable to us to organize a conference that brings together experts from these three areas for a fruitful exchange of ideas. We decided on a venue in the Huang Shan (Yellow Mountain) region, one of the most scenic areas of China, so as to provide the additional inducement of an attractive location. The conference was planned for June 2003 with the official title Workshop on Coding, Cryptography and Combi natorics (CCC 2003). Those who are familiar with events in East Asia in the first half of 2003 can guess what happened in the end, namely the conference had to be cancelled in the interest of the health of the participants. The SARS epidemic posed too serious a threat. At the time of the cancellation, the organization of the conference was at an advanced stage: all invited speakers had been selected and all abstracts of contributed talks had been screened by the program committee. Thus, it was de cided to call on all invited speakers and presenters of accepted contributed talks to submit their manuscripts for publication in the present volume. Altogether, 39 submissions were received and subjected to another round of refereeing. After care ful scrutiny, 28 papers were accepted for publication.