<<数字通信原理>>

图书基本信息

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前言

Digital communication is an enormous and rapidly growing industry, roughly comparable in size to the computer industry. The objective of this text is to study those aspects of digital communication systems that are unique. That is, rather than focusing on hardware and software for these systems (which is much like that in many other fields), we focus on the fundamental system aspects of modem digital communication. Digital communication is a field in which theoretical ideas have had an unusuallypowerful impact on system design and practice. The basis of the theory was developedin 1948 by Claude Shannon, and is called information theory. For the first 25 years or so of its existence, information theory served as a rich source of academic research prob-lems and as a tantalizing suggestion that communication systems could be made more efficient and more reliable by using these approaches. Other than small experiments and a few highly specialized military systems, the theory had little interaction with practice. By the mid 1970s, however, mainstream systems using information-theoretic ideas began to be widely implemented. The first reason for this was the increasing number of engineers who understood both information theory andcommunication system practice. The second reason was that the low cost and increasing processing power of digital hardware made it possible to implement the sophisticated algorithms suggested by information theory. The third reason was that the increasing complexity of communication systems required the architectural principles of information theory. The theoretical principles here fall roughly into two categories - the first provides analytical tools for determining the performance of particular systems, and the second puts fundamental limits on the performance of any system. Much of the first category can be understood by engineering undergraduates, while the second category is dis-tinctly graduate in nature. It is not that graduate students know so much more than undergraduates, but rather that undergraduate engineering students are trained to mas-ter enormous amounts of detail and the equations that deal with that detail. They are not used to the patience and deep thinking required to understand abstract performance limits. This patience comes later with thesis research. My original purpose was to write an undergraduate text on digital communication, but experience teaching this material over a number of years convinced me that I could not write an honest exposition of principles, including both what is possible and what is not possible, without losing most undergraduates. There are many excellent undergraduate texts on digital communication describing a wide variety of systems, and I did not see the need for another. Thus this text is now aimed at graduate students, but is accessible to patient undergraduates. The relationship between theory, problem sets, and engineering/design in an aca-demic subject is rather complex. The theory deals with relationships and analysis for models of real systems. A good theory (and information theory is one of the best)allows for simple analysis of simplified models. It also provides structural principles that allow insights from these simple models to be applied to more complex and realistic models. Problem sets provide students with an opportunity to analyze these highly simplified models, and, with patience, to start to understand the general princi-ples. Engineering deals with making the approximations and judgment calls to create simple models that focus on the critical elements of a situation, and from there to design workable systems. The important point here is that engineering (at this level) cannot really be separated from theory. Engineering is necessary to choose appropriate theoretical models, and theory is necessary to find the general properties of those models. To oversimplify, engineering determines what the reality is and theory determines the consequences and structure of that reality. At a deeper level, however, the engineering perception of real-ity heavily depends on the perceived structure (all of us carry oversimplified models around in our heads). Similarly, the structures created by theory depend on engi-neering common sense to focus on important issues. Engineering sometimes becomes overly concerned with detail, and theory becomes overly concerned with mathematical niceties, but we shall try to avoid both these excesses here. Each topic in the text is introduced with highly oversimplified toy models. The results about these toy models are then related to actual communication systems, and these are used to generalize the models. We then iterate back and forth between analysis of models and creation of models. Understanding the performance limits on classes of models is essential in this process.

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内容概要

本书是世界通信权威、信息领域泰斗Robert G. Gallager博士新作，在数字通信原理的基础上精炼，重点阐述了理论、问题和工程设计之间的关系。
内容涉及离散源编码、量化、信道波形、向量空间和信号空间、随机过程和噪声、编码、解码等数字通信基本问题，最后还简单介绍了无线数字通信。
本书是通信专业高年级本科生和研究生教材，也可供工程技术人员参考。

作者简介

Robert G. Gallager，博士，信息理论界世界级权威，美国工程院院士，美国科学院院士，先后荣获1990年IEEE荣誉奖章、2003年马可尼奖、2004年Dijkstra奖等多项殊荣。
师从信息论创始人香农，不但自己科研成果卓著，还为通信领域培育了很多优秀人才，包括《无线通信基础》的作者David Tse。

书籍目录

章节摘录

For any encoder, there must be a decoder that maps the encoded bit sequenceback into the source symbol sequence. For prefix-free codes on k-tuples of sourcesymbols, the decoder waits for each variable-length codeword to arrive, maps it intothe corresponding k-tuple of source symbols, and then starts decoding for the nextk-tuple. For fixed-to-fixed-length schemes, the decoder waits for a block of codesymbols and then decodes the corresponding block of source symbols. In general, the source produces a nonending sequence X1, X2 of source letterswhich are encoded into a nonending sequence of encoded binary digits. The decoderobserves this encoded sequence and decodes source symbol Xn when enough bits havearrived to make a decision on it. For any given coding and decoding scheme for a given iid source, define the rvDn as the number of received bits that permit a decision on Xn = X1……Xn. Thisincludes the possibility of coders and decoders for which some sample source stringsxn are decoded incorrectly or postponed infinitely. For these xn, the sample value ofDn is taken to be infinite. It is assumed that all decisions are final in the sense thatthe decoder cannot decide on a particular xn after observing an initial string of theencoded sequence and then change that decision after observing more of the encodedsequence. What we would like is a scheme in which decoding is correct with highprobability and the sample value of the rate, Dn/n, is small with high probability.What the following theorem shows is that for large n, the sample rate can be strictlybelow the entropy only with vanishingly small probability. This then shows that theentropy lowerbounds the data rate in this strong sense.

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“ Gallager教授是一位传奇人物……他的书见解独到、叙述方式简明扼要，备受学生推崇。
”　　——童朗，康奈尔大学教授　　“ 本书必将成为业界经典参考！
”　　——今井秀树，东京大学教授　　“ 这是一本详尽的数字通信教材，值得每一位通信专业师生和相关工程人员拥有。
”　　——Telatar，洛桑联邦理工学院教授

编辑推荐

国际信息领域泰斗Robert G. Gallager博士最新力作。
香农的信息论中有一个重要结论，即信源/信道分离定理：如果能够以任意某种方式通过信道传输信源，那么也一定能够通过二进制接口传输该信源。
这就为数字通信成为通信系统的标准形式提供了理论依据。
另外，数字电路成本低廉、性能可靠、易于小型化，更容易实现。
因此，近十年来，数字通信技术发展迅猛，已经深入人们日常生活的每个角落，这也驱使大量人才投身数字通信领域。
《数字通信原理(英文版)》融会了Gallager博士数十年的教学科研心得，介绍了信息论方面的基本概念及其对通信系统设计的作用，旨在帮助数字通信领域的师生和工程技术人员理解数字通信背后的基本原理。
《数字通信原理(英文版)》内容全面，包括了数字通信基本知识，离散信源的编码，量化，信源波形与信道波形，向量空间与信号空间，信道、调制与解调，随机过程与噪声，信号的检测与编解码，无线通信，等等。
书中为数字通信原理搭建了一个简单的框架，以直观、简洁的方式介绍了复杂的现代通信系统。
《数字通信原理(英文版)》甫一出版，即被业界奉为经典，目前已被麻省理工学院等世界级名校作为教材。
配有习题答案，读者可登录图灵公司网站免费注册获取。