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Book Reviews

Steven C. Gustafson, Book Reviews Editor

Principles of Modern Optical Systems

Ivan Andonovic and Deepak Uttamchandani, eds., xv + 608 pp., illus., index, references. ISBN 0-89006-351-6. Artech House, Inc., 685 Canton St., Norwood, MA 02062 (1989) $85 hardbound.

Reviewed by Mohammad A. Karim, University of Dayton, Electrical Engineering Dept. and Center for Electro-Optics, 300 College Park, Dayton, OH 45469-0001.

This book originates from an annual course taught at Strathclyde University, Glasgow, Scotland. Interestingly, this book of 17 chapters was authored by a total of 22 contributors, all of whom are from Europe. In the preface, the editors express the hope that the book will serve the needs of recent science or engineering graduates, experienced scientists wishing to shift their research emphasis into optics, and executives interested in new technology. To simultaneously satisfy these three groups of readers with one book is indeed a very challenging objective. After reading it, the reviewer is more convinced of the difficulty of such a lofty goal. This goal was further complicated by the fact that editors have somewhat failed to smooth out the presentation styles of the contributors. While some chapters (e.g., 8 and 17) are written with executives in mind, there are some chapters (e.g., 3, 5, 7, 11, and 14) written with either recent graduates or experienced scientists in mind.

The book aims to introduce optoelectronics from basic physical principles to applications. Definitely, this aim has been met. However, the particular areas of emphasis include only optical fiber communications, optical signal processing, optical fiber sensors, and optical disk storage.

Following a short introduction on the various areas of optoelectronics in Chap. 1 (Garrett), Chap. 2 (Stewart) reviews basic optics and its connections with fibers, sources, and detectors, and Chap. 3 (Rogers) introduces coherence and polarization. The next three chapters treat semiconductor sources (Collar and Kirkby), detection principles (Johnstone), and fibers (Gambling). The chapter on detection principles is perhaps the most comprehensive.

Four of the next six chapters deal with important issues pertaining to fibers, such as cables and connectors (Mossman), couplers, polarizers, and modulators (Boucouvalas), receivers and detection systems (Garrett), and sensors and sensor networks (Uttamchandani and Dakin). Two of these six chapters (6 and 10) deal with nonlinear effects in fibers (Taylor) and integrated optics (Parsons). Perhaps these two chapters would read better if they were introduced after all other fiber-related issues were discussed.

Chapter 13 (Swan) elaborates on remote sensing, and the following two chapters deal with optical information processing (Hall) and guided wave signal processing (Clark, Shabeer, and Andonovic). Very few pattern recognition applications are covered in these two chapters. Optical disk storage systems are discussed in Chap. 16 (Carey, Newman, and Thomas). Finally, Chap. 17 (Long) analyzes optoelectronics market trends, with primary emphasis on the European market.

On too many occasions in this book a term is used repeatedly but is not defined or discussed until a later chapter. For example, the Verdet constant is mentioned on p. 153 but is defined on p. 258, and the fact that it is defined on the latter page is not mentioned on the former. Also, while normalized frequency is mentioned on p. 152, its meaning is defined (eventually, twice!) on pp. 244 and 270. Such problems are among the consequences of having engaged too many contributors. Added to these problems are various redundancies. For example, linearly polarized modes are derived at least twice—once in Chap. 2 and again in Chap. 6. There are many examples of sloppiness. Symbols used in Eqs. (2.13) and (2.15), for example, deal with both Bessel and modified Bessel functions, but these symbols are neither defined nor referred to in the accompanying text.

Executives, who are perhaps more interested in buzz words than in physical or mathematical principles, will most probably find this book too difficult, and engineering graduates may find it somewhat sloppy. As for scientists, the book may be satisfactory, but professional journals may be more rewarding.

Infrared Technology Fundamentals

Irving J. Spiro and Monroe Schlessinger, Optical Engineering Series Vol. 22, xi + 368 pp., illus., index, references. ISBN 0-8247-8134-1. Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016 (1989) $99.75 hardbound.

Reviewed by Abdul Ahad S. Awwal, Wright State University, Computer Science and Engineering Department, Dayton, OH 45435.

The purpose of this book is to provide an understanding of the physical background and engineering considerations necessary for the design of infrared systems. The book is a result of tutorials and minicourses that were offered both in the U.S. and in Europe.

The authors begin the first chapter by reviewing the history of development of infrared technology and classical radiation laws. Radiometric terms and units are presented next. The second chapter, on infrared radiometry, discusses fundamental issues that relate to radiation. A substantial amount of space is devoted to discussing sterance-related concepts. This discussion should be helpful to readers who are otherwise overwhelmed by the different definitions for the measurement of radiation. Contrary to the conventional approach that begins with blackbody radiation, the authors start with a "microscopic concept of sterance" and then "synthesize" other concepts such as intensity and flux. Toward the end of this chapter expressions relating to radiance and range are developed.

Chapter 3 contains discussions on both natural and artificial target characteristics. These characteristics are introduced to identify their influence on emitted IR radiation. Chapter 4 discusses characteristics of the atmosphere. In particular, the authors discuss LOWTRAN models and compare different versions to facilitate the selection process for applications. The concept of scattering is introduced but without mathematical detail.

In Chap. 5 the authors acknowledge the vastness of optical design methods for infrared systems. Nevertheless, they point out important differences between visible and IR radiation that affect design methodology. Among other topics, they review geometric imaging rules,

thin lenses, IR telescopes, diffraction, filters, and stray light rejection systems.

In Chap. 6 the authors present devices and concepts that are representative of modern technology. They classify detectors into several categories, depending on the effect used in detection and the mechanism used in converting detected signals to appropriate outputs. Following a background review of semiconductors, the authors elaborate on the working principles and performance characteristics of various detector arrays.

Staring and scanning sensors are introduced in Chap. 7. The authors show that staring sensors result in smaller systems with better background rejection capability. Chapter 8 describes thermal image acquisition systems. The authors compare parallel, serial, and SPRITE (signal processing in the element) scanner characteristics. A number of different scanning mechanisms as well as their drawbacks and ways to improve them are discussed.

Signal processing aspects of thermal images are topics of the following chapter. Techniques for preprocessing of images for background suppression and improving dynamic range are included. Schemes for using digital or analog filters for background suppression are also discussed. This discussion is followed by a comparison of several target detection algorithms such as those involving multiple thresholds, recursive filters, adaptive pole filters, and Boolean filters. The applicability of each algorithm for specific detector types is also considered.

Chapter 10 discusses several IR systems that cover a wide range of space-based surveillance applications. The basic range equations for search and detection systems are developed. Range equations for both scanning and staring systems are also addressed in this chapter. The final section provides numerical examples as well as discussions pertaining to satellite detection systems for tracking orbiting or earth background targets and FLIR (forward-looking infrared) radiometer systems.

The objective of the book was to provide an understanding of the advantages and limitations of the optics necessary for IR systems, but the book does have several weaknesses: It does not elaborate on design principles, and the IR systems design chapter is relatively incomplete. A broader discussion would have allowed readers to take advantage of the authors' expertise in this area. Another weakness is a lack of sufficient references at the end of each chapter; since this is mainly a reference book and cannot cover all related aspects of IR imaging in detail, references to appropriate works should have been provided for subject matter completeness. There are several typographical errors and technical mistakes as well. For example, on p. 43 power is described as the product of "area times the solid angle to the adjacent area," and on p. 161, the figures of energy diagrams for metals and insulators appear interchanged. The descriptions of IR systems, especially in Chap. 8, are very short, and the authors have provided illustrations but have not explained them well in the text. However, there are not many books available in the infrared technology area. In my opinion, this book will serve as a good reference for IR engineers.

Books Received

A History of the Photographic Lens, by Rudolf Kingslake. xi + 334 pp., illus., subject index, index of lens names, glossary of optical terms, brief biographies of notable opticians and lens designers of the past. ISBN 0-12-408640-3. Academic Press, Inc.,1250 Sixth Ave., San Diego, CA 92101 (1989) $29.95 hardbound. Traces the historical development of various types of lenses, detailing each major advance in design and fabrication from early lenses to designs made possible through such innovations as lens coating, rare-earth glasses, and computer-aided design and testing.

Optical Sensing and Measurement, edited by Aaron D. Gara. Proceedings of the 7th International Congress on Applications of Lasers and Electrooptics ICALEO '88. vi + 147 pp., illus., references. ISBN 0-387-51593-3. Springer-Verlag, 175 Fifth Ave., New York, NY 10010 (1989) $73.80 hardbound. Sections cover optical guaging and inspection, interferometric metrology, and thermal and infrared sensing.

Practical Laser Safety, Second Edition, by D. C. Winburn. Vol. 18 in Occupational Safety and Health Series, Alan L. Kling, series editor. x + 241 pp., illus., index. ISBN 0-8247-8240-2. Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016 (1990). Revised and expanded; contains latest revision of ANSI Z136.1 on laser safety. Presents damage threshold values of lens materials used in laser-protective eyewear and discusses electrical hazards associated with lasers.

Short Courses

SPIE EDUCATIONAL PROGRAMS

SPIE short courses are organized to provide fundamental, practical instruction to scientists, engineers, and technical managers whose work focuses on, or is expanding into, optics, electro-optics, and integrated optoelectronics. Course lengths range from a half day (3 1/2 hours) to a full day (6 1/2 hours) to two days (12 hours) of instruction. For more information on SPIE short courses, contact SPIE's Educational Programs Department, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Fax 206/647-1445. Telex 46-7053.

April 1990—Orlando, Florida

These courses will be offered in conjunction with SPIE's OE/Aerospace Sensing '90, April 16-20, Orlando, Fla.

Avionic Displays

Principles and Uses of Optical Holography, Nicholas George, Univ. of Rochester, Mon., 8:30 am-12:30 pm.

Advances in Head-Up Display (HUD) Systems, B. Jin Chang, Kaiser Optical Systems, Wed., 2:00-6:00 pm.

Liquid Crystal Electro-Optic Effects and Display Applications, John C. Varney, Ketek Inc., Mon., 2:00-6:00 pm.

Basics for Electrical Engineers

Introduction to Artificial Intelligence, Jon Sticklen, Michigan State Univ., Mon., 2:00-6:00 pm.

Basic Optical Engineering for Electrical Engineers, Glenn D. Boreman, CREOL/Univ. of Central Florida, Mon., 8:30 am-5:30 pm.

Fundamentals of Digital Signal Processing, Sohail A. Dianat, Rochester Inst. of Technology, Mon., 8:30 am-5:30 pm.

Digital Image Processing Fundamentals, Mohan M. Trivedi, Univ. of Tennessee/Knoxville, Mon., 8:30 am-5:30 pm.

Fundamentals of Image Tube Technology, Illes P. Csorba, Imaging Tubes Technology, Wed., 8:00 am-noon.

Processor Optoelectronics

VLSI Implementation for Visual Communications, Peter Pirsch, Univ. Hannover, Mon., 8:30 am-5:30 pm.

Signal Processing and Applications of Acousto-Optics, Anthony VanderLugt, North Carolina State Univ., Tues., 8:00 am-5:30 pm.

Performance Characteristics of Laser Diodes, S. C. Wang, Lockheed Palo Alto Research Lab., Fri., 8:00 am-noon.

Downlink Video Communications

Digital Image Compression, Majid Rabbani, Eastman Kodak Co., Tues., 8:00 am-5:30 pm.

Digital Image Enhancement, Majid Rabbani, Eastman Kodak Co., Mon., 8:30 am-12:30 pm.

Digital Image Restoration, Majid Rabbani, Eastman Kodak Co., Wed., 8:00 am-noon.

Advanced Digital Communications: Baseband to Optical, Bernard Sklar, The Aerospace Corp., Fri.-Sat., 9:00 am-6:00 pm.