

# DEPARTMENTS

## BOOK REVIEWS

### Photonic Aspects of Modern Radar

Henry Zmuda and Edward N. Toughlian, Eds., 554 pp., illus., index, and references. ISBN 0-89006-670-1. Artech House, 685 Canton Street, Norwood, MA 02062 (1994) \$89 hardbound.

Reviewed by Martin B. Mark, United States Air Force Wright Laboratory, Electro-Optic Techniques Section, WL/AARI-2, 3109 P Street, Building 622, Wright-Patterson Air Force Base, OH 45433-7700.

Radar and photonics crossed paths a long time ago. Probably the best known examples of the overlap in these two fields are the use of optical techniques to process synthetic aperture radar data (recorded on optical film) in the early 1960s and the emergence of laser radar starting in the mid-1970s. The maturation of optical technologies such as high-power stable lasers, semiconductor diode lasers and detectors, spatial light modulators, optical fibers, and integrated optical components has led to greater cross-breeding between the disciplines of radar and photonics. With this technological evolution in mind and with an eye to expanded future overlap between these fields, the editors of this book set out to compile a kind of cross-cultural reference manual for microwave radar engineers working with photonic tools and electro-optical engineers designing components for the next generation of microwave radars.

The book is organized into six sections containing 18 chapters, each covering a different technology or application area, and is written by 23 different authors. Since I do not have significant expertise in all 18 areas covered in this reference manual, it would be difficult to produce an informed analysis of the quality of all the technical work in the book. Therefore, I will comment mostly on the organization and approach the editors chose to use, how well the book achieves the editors' purpose, who will find the book useful, and what I feel is missing that would make the book more useful.

Because this book is intended as a refer-

ence manual, it is most useful to actually list the topics it covers and the organization of the topics.

#### Sec. 1 Introduction

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#### Sec. 2 Introduction to Radar Systems

##### Chap. 2 Radar Fundamentals for Optical Engineers

##### Chap. 3 System Considerations

#### Sec. 3 Fundamentals of Photonics

##### Chap. 4 Foundations of Optical Engineering

##### Chap. 5 High-Speed Semiconductor

##### Laser Sources and Detectors for Microwave Fiber-Optic Applications

##### Chap. 6 Spatial Light Modulators for Optically Controlled Phased-Array Radar Signal Processors

##### Chap. 7 Acousto-Optic Bragg Cell Devices

##### Chap. 8 Optical Waveguide

##### Chap. 9 Optical Integrated Circuits

#### Sec. 4 Optical Beamforming for Phased-Array Systems

##### Chap. 10 Control Requirements for Dynamic Beam Steering Systems

##### Chap. 11 Spatial Optical Processing

##### Chap. 12 RF Fiber Optic Links

##### Chap. 13 Switched Fiber-Optic Delay Architectures

#### Sec. 5 Signal Processing Systems

##### Chap. 14 Optical Processing of Synthetic Aperture Radar Data

##### Chap. 15 Correlation Systems

##### Chap. 16 Acousto-Optic Processing for Receiver Technologies

##### Chap. 17 Fiber-Optic Delay Line Signal Processing Architectures

#### Sec. 6 Future Opportunities and Directions

##### Chap. 18 Summary, Future Opportunities, and Directions.

The first and last chapters are both very brief and very general. Most readers will find them of little practical use. The chapters in Sec. 2 are geared to an electro-optical engineer making a foray into the world of microwave radars. Chapter 2 in particular is

a mostly successful attempt to condense something like Skolnik's *Introduction to Radar Systems* into less than 50 pages. Any attempt to cover such a broad topic in such a short space must cut out significant details and runs the risk of oversimplifying. In this respect, the explanation of the difference between coherent and incoherent integration stood out as one area where the author stumbled, but otherwise it is a very fine job. The level of detail and the choice of system-related topics are very appropriate to the book's purpose.

Section 3 is the complement to Sec. 2; it is geared to a radar engineer making a foray into the world of electro-optics. It starts with a review of Fourier optics and then describes five classes of optical devices that the radar engineer is most likely to encounter in subsystem design. There is a wide spread here in the level of mathematical detail chosen by the authors of different sections. The explanation of diode lasers and detectors (Chap. 5) covers the material from a reasonably sophisticated level, whereas Chap. 9 on optical integrated circuits hardly contains a single equation. Considering the book's purpose, the most appropriate level is somewhere in between these two extremes, but closer to the level of Chap. 9. Fortunately, these chapters are the exception, and the editors steered most of the book's authors to the proper middle ground.

Sections 4 and 5 move from background theory and devices into specific subsystem applications and processing techniques. Both of these sections will be of use to both types of engineers who are likely to use this book. In these sections, the editors have kept their focus clearly on the application of optical technologies to radar systems in their choice of topics, the level of coverage, and the manner of covering the topics. These sections are the heart of the book, and those chapters covering material that I am familiar with were well done.

Overall, this will be a useful book for the radar and electro-optic engineers in the situations I have mentioned. However, the book is still a little disappointing, because there is a third class of radar/electro-optic engineers (of which I am a member) that is not well

served by this book: laser radar engineers. Although laser radar (ladar and lidar) is one of the most obvious examples of the overlap between the fields of radar and photonics, there is barely a single mention of ladar in the book. This is clearly because ladar is outside the editors' intended focus for the book, however, the book would be even more useful and appealing to a wider audience if the editors had chosen to add an additional chapter on ladar, with discussion on the similarities to and differences with microwave radar and on the potential for application of microwave technologies to optical radars.

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### Semiconductor Optoelectronic Devices

Pallab Bhattacharya, 535 pages, index, references, and 11 appendixes. ISBN 0-13-805748-6. Prentice Hall, Englewood Cliffs, NJ 07632 (1994) \$66 hardbound.

Reviewed by Niloy K. Dutta, AT&T Bell Laboratories, Room 6E-414, 600 Mountain Avenue, P.O. Box 636, Murray Hill, NJ 07974-0636.

Progress in optoelectronics technology has been considerable over the last decade. Semiconductor lasers, photodiodes, quantum-well devices, switching devices, and optoelectronic integrated circuits are some of the key elements that have been developed within the last 10 years by researchers at various industrial laboratories and universities worldwide. Prof. Bhattacharya's book considers all of these devices and their operating principles in a coherent and succinct form. Although intended for a senior-level or graduate-level course, it provides an excellent introduction to the subject for new researchers in optoelectronics and at the same time provides enough depth for a full-time researcher such as myself.

The book can be subdivided into three parts. The first part (Chaps. 1 to 4) deals with semiconductor properties and physics. The discussion of optical properties (Chap. 3) and junction theory (Chap. 4) is really at the heart of understanding the semiconductor devices that follow. I believe these last two chapters would fill the needs of a physics or electrical engineering curriculum. They provide an excellent bridge from traditional solid-state physics to the physics of devices. Chapters 5 to 10 describe the operating principles and structures of several major device categories such as light-emitting diodes, lasers, photodetectors, and solar cells. The author has taken time to search through the literature in each category, so that most of the major developments are described. The last two chapters (optical switching and optoelectronic integration) describe areas of current research

interest. The treatment here is very thorough. I enjoyed reading both of these chapters and discovered some research ideas as well.

Each chapter has a good list of problems and an excellent list of additional reading material. A graduate student or a new researcher going through this book would become very knowledgeable in optoelectronics. The book fills a need, namely, the need for a single source of up-to-date information in optoelectronics for both newcomers and researchers in the field. I hope Prof. Bhattacharya will have the opportunity to update this book as time progresses.

The book is a welcome addition in the semiconductor area. I recommend it in particular as a graduate-level text and for newcomers in the field. It will certainly be on my bookshelf.

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### BOOKS RECEIVED

**Laser Electronics: Second Edition**, by Joseph T. Verdeyen. xvii + 622 pp., illus., author and subject index, references, suggested readings and problems at end of each chapter, two appendixes. From the Solid State Physical Electronics Series. ISBN 0-13-523630-4. Prentice Hall, Englewood Cliffs, NJ 07632 (1989) \$70 hardbound. In his second edition of *Laser Electronics*, the author emphasizes new developments in laser electronics and continues to provide a bridge between phenomena and concepts of the optical domain with those of the microwave domain. The text prepares the student for quantum phenomena.

**Handbook of Carbon, Graphite, Diamond and Fullerenes: Properties, Processing, and Applications**, by Hugh O. Pierson. xx + 399 pp., illus., subject index, glossary, references following each chapter. From the Materials Science and Process Technology Series. ISBN 0-8155-1339-9. Noyes Publications, 120 Mill Road, Park Ridge, NJ 07656 (1993) \$86 hardbound. In this book the author provides a valuable up-to-date account of both the newer and traditional forms of carbon, both naturally occurring and man-made. This volume will be a valuable resource for both specialists in, and occasional users of, carbon materials.

**Handbook of Deposition Technologies for Films and Coatings, Second Edition**, edited by Rointan F. Bunshah. xxvi + 861 pp., illus., subject index, list of contributors, references following each chapter. From the Materials Science and Process Technology Series. ISBN 0-8155-1337-2. Noyes Publications, 120 Mill Road, Park Ridge, NJ 07656 (1993) \$98 hardbound. Covers various technologies for the deposition of films and

coatings, and the resulting microstructure, properties, and applications; evaporation; ion plating; sputtering; chemical vapor deposition; deposition from aqueous solutions; and plasma and detonation gun deposition techniques.

**Advanced Light Microscopy, Volume 3: Measuring Techniques**, by Maksymilian Pluta. xvi + 702 pp., color illus., subject and author index, references at end of book. From the Advanced Light Microscopy Series. ISBN 0-444-98819-X. Elsevier Science Publishing Co., 52 Vanderbilt Ave., New York, NY 10010 (1993) \$243 hardbound. Covers micrometry and fundamentals of microstereology; microphotometry, microfluorometry, and flow cytometry; quantitative polarizing microscopy; microinterferometry; microdiffractometry; automatic analyzers of microscopic images; and laser Doppler microscopy.

**Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering**, by Steven H. Strogatz. xi + 498 pp., color illus., subject and author index, references at end of book, exercises following each chapter and answers at end of book. ISBN 0-201-54344-3. Addison-Wesley Publishing Company, One Jacob Way, Reading, Massachusetts 01867 (1994) \$55.95 hardbound. This textbook is aimed at newcomers to nonlinear dynamics and chaos, especially students taking a first course in the subject. The presentation stresses analytical methods, concrete examples, and geometric intuition. The theory is developed systematically, starting with first-order differential equations and their bifurcations, followed by phase plane analysis, limit cycles and their bifurcations, and culminating with the Lorenz equations, chaos, iterated maps, period doubling, renormalization, fractals, and strange attractors.

**Design and Fabrication of Acousto-Optic Devices**, edited by Akis P. Goutzoulis, Dennis R. Pape; editor of Russian contributions, Sergei V. Kulakov. xv + 497 pp., illus., subject index, references following each chapter, two appendixes. Volume 41 from the Optical Engineering Series. ISBN 0-8247-8930-X. Marcel Dekker, Inc., 270 Madison Avenue, New York, New York 10016 (1994) \$165 hardbound. Covers principles of acousto-optics; design of acousto-optic deflectors; design of acousto-optic modulators; acousto-optic tunable filters; transducer design; acousto-optic device manufacturing; testing of acousto-optic devices; a computer-aided design program for acousto-optic deflectors; and a computer program for the analysis and design of transducer structures.