

# SPIE Reports

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## Book Reviews

Steven C. Gustafson, Book Reviews Editor

### Computer Vision for Electronics Manufacturing

L. F. Pau, *Advances in Computer Vision and Machine Intelligence Series*, Martin D. Levine, ed. xvi + 324 pp., illus., index, references, suggested readings, glossary and abbreviations, list of relevant journals, units and conversion tables. ISBN 0-306-43182-3. Plenum Press, 233 Spring St., New York, NY 10013-1578 (1990) \$65 hardbound.

Reviewed by Allan J. Lightman, University of Dayton Research Institute, Dayton, OH 45469-0140.

This book presents a menu of applications for computer vision in the electronics manufacturing industry. Each item is explained in a cursory fashion, with reference to the instrumentation that would be used to obtain the information and to the algorithms that are used to analyze it. There is a great deal of commonality in the many diverse applications for computer vision in the electronics manufacturing industry, and the author states that his goals for this book are to point out this commonality and "to serve as a reference when specialists from one discipline need to specify and/or implement techniques from the others." This book is not a primer on computer vision; rather, it is really directed only to the specialists. In this community, the book can provide a handy reference for quickly learning the lexicon of a new application area and the types of issues that are significant in this application.

The author divides the book into two parts: applications and systems aspects vision algorithms for electronics manufacturing. It might have proved clearer to divide part 1 into two distinct parts: systems aspects, addressing the hardware issues, and applications, addressing areas of electronics manufacturing where computer vision is applied. Chapter 1 deals with the vision hardware (cameras, etc.), lighting, and system architecture. Chapter 2 is concerned with the types of "vision" systems employed to

visualize the inspection. (Many systems operate outside the visible spectrum.) Chapters 3 through 12 describe various areas of inspection applications in electronics manufacturing. The particular measurements of concern in each area are outlined and the vision systems and types of analysis algorithms applicable are also listed.

Chapters 13 through 21 provide a discussion of the philosophy of the interpretation algorithms used to process the vision information. Each chapter is devoted to a particular issue in image processing: image quantization and thresholding, geometrical corrections, image registration and subtraction, edge and line detection, region segmentation and boundaries, feature extraction, etc. The author works through the logic of algorithms relevant to these subject areas.

This book serves to tie together the common computer vision analysis algorithms used in a wide variety of applications in the electronics manufacturing industry. If you are a vision applications specialist working in a particular area of this industry and you need to learn quickly about the needs and tools used in another area, this book will prove valuable. If you are working in the general area of computer vision, it is interesting to go through this book and appreciate the applications and the variety of hardware and software needed by this industry.

### Fiber Optics Handbook: For Engineers and Scientists

Frederick C. Allard, editor, xiv + ~530 pages, illus., subject index, bibliographies following chapters. ISBN 0-07-001013-7. McGraw-Hill Publishing Co., 11 W. 19th St., New York, NY 10011 (1990) \$69.50 hardbound.

Reviewed by Edward E. Harstead, AT&T Bell Laboratories, Whippany, NJ 07891.

In his preface, Allard states that the goals of his Handbook are, in short, to provide comparative engineering information on fiber optics components and methods for the engineer, scientist, or

technical manager and to show how to apply it. Toward these goals, the book enjoys uneven success.

D. E. Quinn begins Chap. 1 with a good, intuitive physical description of light propagation in optical fibers, writing in tutorial fashion as if for the neophyte. But what follows is an electromagnetic treatment so spare it offers little pedagogical value. There are good descriptions of fiber loss mechanisms (in particular, absorption) and the mechanical properties of fiber. Dispersion and specialty fibers are also covered, but not in depth. Apparently written for the user, there is little discussion of fiber fabrication.

In Chap. 2, M. M. Ramsay provides a wealth of information on fiber optic cables. The author introduces the material with a good section on the objectives of cabling: minimization of attenuation and protection of the fiber. Sloppy editing results in two treatments of fiber mechanical properties within 16 pages of each other! Despite extensive redundancy, this section and the one from Chap. 1 provide an excellent overview of the subject. A brief summary of fiber coatings precedes a thorough treatment of cabling techniques and structures that includes many examples. The chapter is adorned with clear illustrations of various cable designs.

Chapter 3, written by P. Morra and E. Vezonni, describes splices, connectors, and couplers. Generous space is allotted for multimode applications, a characteristic of this book in general. Coupling loss theory is followed by splicing technology. Included is a solid presentation of fusion splicing, with a good description of the splicing process and fusion phenomena. The section on connector technology and types is thorough. System impairments due to reflections are reviewed, but incompletely. A comprehensive section on fiber optic couplers and wavelength division multiplexers, often missing from other books, is particularly welcome. The chapter concludes with a brief section on microlenses.

F. P. Kapron presents a useful chapter on fiber optic test methods. The author states that the material is written for the user of fiber optic

components. The emphasis is on standardized measurements based on EIA/TIA test procedures and BellCore requirements documents. Although not exhaustive, it is a practical treatment that covers power, attenuation, and bandwidth measurements for both multimode and single-mode media.

In a single chapter, authors P. K. L. Yu and K. Li attempt to cover the subject of optical sources for fibers. Apparently, the reader is assumed to have a knowledge of the basic physical theory (electronic transitions, laser oscillation) as well as some of the details (e.g., Lambertian radiation). LED and laser diode structures, bandwidth, and fiber coupling are well covered, while transmitter circuit design is quickly disposed of. Aging and reliability are discussed in some detail. This chapter is purely reference material, probably best suited for those interested in the manufacturing processes.

The next two chapters are unusually organized. Chapter 6, written by the same authors as the preceding chapter, is titled Optical Detectors for Fibers. It begins with an inadequate section on receiver design and sensitivity and a mere two pages on noise sources. Organizational anomalies abound. APDs are briefly discussed, but the reader is directed to two other sections in the book to find more information; one of them, Sec. 7.4.4 (really 7.5.4) is in the next chapter, titled Modulation! The reader is told that APDs are more sensitive than pin photodiodes; although the avalanche gain mechanism is eventually explained, the reader is never shown why this is true. The majority of this short, confused chapter is a description of photodiode structures and characteristics.

Chapter 7 is a curious hodgepodge of information. A broad summary of analog and digital modulation techniques is presented. A section on filtering, too short to be of much use, follows. But here, instead of in Chap. 5, the reader finds, among other things, the best explanations offered of direct and indirect bandgap materials and the fundamentals of laser physics. In another editorial oversight, the authors, J. C. Daly and A. Fascia, are allowed to duplicate some of the material on diode structures. There is a brief section on external modulation, and a few more pages on noise. The treatment of coherent systems is not very illuminating: for instance, laser linewidth requirements are oversimplified, and there is no discussion of polarization control. This is followed by a few pages on receiver sensitivity. The fractured treatment of noise mechanisms and receiver sensitivity may be the book's greatest shortcoming.

I expect that Chap. 8, by G. D. Pitt, will be welcomed by those looking for a thorough review of the field of optical sensors. The second-largest chapter in the book, it covers in detail all types of sensors, grouped under the headings of

intensity-modulated, evanescent, and intrinsic (interferometric and polarimetric) sensors. The stated emphasis is on sensors that have progressed beyond the laboratory. Also discussed, in less detail, are relevant optical components, sensor multiplexing, and applications.

Fiber optics system design is covered in Chap. 9. In order to be relevant for all systems designers, a generic approach is pursued. H. R. D. Sunak methodically presents checklists of system considerations for the designer. Tradeoffs in component technologies and the procedures for component selection are emphasized. The section on digital systems design provides design recipes and numerous examples of component selection for various hypothetical applications. The author has wisely included a section on the increasingly important field of analog systems. A general discussion of the topic is followed by descriptions of analog system impairments and subcarrier multiplexing. Design procedures are outlined. A system designer will find this chapter useful as a guide but will need to go elsewhere for a more thorough treatment of specific systems applications, such as optical LANS, undersea systems, etc.

With the word "handbook" in its title, one would expect this book to excel in its qualitative description of technologies while skimping on theory and derivations. This expectation is for the most part fulfilled. The handbook format is well suited to the autonomous and descriptive Chaps. 1, 2, 3, 4, and 8. The authors of these chapters have compiled valuable practical information on passive fiber components, test procedures, and sensors, and their work will serve as useful references. On the other hand, designers of optical transmitters and receivers will probably find other references more accessible, if nothing else.

Also, it is unfortunate that the *Handbook* does not prepare the reader for the imminent commercial availability of optical fiber amplifiers. In general, topics not associated with ubiquitous commercial products are not treated in depth. This is true for integrated optics, midinfrared fibers, solitons, and multi-quantum well devices, to name a few.

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## BOOKS RECEIVED

**Oscillator Design & Computer Simulation**, by Randall W. Rhea. x + 258 pp., illus., subject index, five appendixes, references following each chapter, diskette included. ISBN 0-13-642513-5. Prentice Hall, Inc., Englewood Cliffs, NJ 07632 (1990). A simple to understand reference outlining the steps required to design RF and microwave oscillators. Discusses analysis fundamentals, oscillator fundamentals, limiting and starting, noise, biasing, computer simulation, circuits, L-C oscillators, distributed oscil-

lators, SAW oscillators, and quartz crystal oscillators.

**Handbook of Microwave and Optical Components, Volume 2: Microwave and Solid-State Components**, edited by Kai Chang. xiv + 635 pp., illus., subject index, references following each chapter, volume two in a set of four volumes. ISBN 0-471-84365-2. John Wiley and Sons, Inc., 605 Third Avenue, New York, NY 10158-0012 (1990) \$74.95 hardbound. Designed for the practicing microwave and optical engineer, as well as for engineers in other disciplines who wish to understand the capabilities and limitations of microwave and optical systems. Covers molecular beam epitaxy, mixers and detectors, multipliers and parametric devices, semiconductor control devices, transferred electron devices, IMPATT and related transit-time devices, bipolar transistors and monolithic integrated circuits, high-electron mobility transistors, and field-effect transistors.

**Laser Technology: Laser Driven Processes**, by Stjepan Lugomer. xiv + 449 pp., illus., subject index, references following each chapter, and appendixes covering prefixes and abbreviations of SI units, relations between SI and non-SI units (units of length), and units of pressure. ISBN 0-13-523671-1. Prentice Hall, Inc., Englewood Cliffs, NJ 07632 (1990). Designed for students as well as research workers in industry to broaden their knowledge of laser-driven processes, ultimately guiding them in designing and developing new processing equipment. Topics covered include laser chemical technology, laser semiconductors technology, laser metals technology, laser mechanical technology, architecture of the laser processing system, laser power technology, and surface topographic structures generated in laser-driven processes.

**Lightwave Technology: An Introduction**, by J. C. A. Chaimowicz. xvii + 362 pp., illus., subject index, bibliography, notation list, abbreviations and acronyms, and 13 appendixes. ISBN 0-408-01314-1. Butterworths, Borough Green, Sevenoaks, Kent TN15 8PH, England (1989). An introductory text for students of electronic engineering, as well as engineers and technicians coming to electro-optics from other fields. Discusses how lenses work, emitting and receiving semiconductor junctions, light units, optical communications with and without fibers, principles and applications of lasers, optocouplers, red and infrared rays in sensing, detecting and measuring, holography, Fourier optics, and integrated optics.

**Handbook of Fiber Optics: Theory and Applications**, by Chai Yeh. xv + 382 pp., illus., subject index, references following each chapter. ISBN 0-12-770455-8. Academic Press, Inc., 1250 Sixth Avenue, San Diego, CA 92101 (1990). Discusses light propagation in fibers, fiber fabrication, loss mechanisms, dispersal properties, fiber splicing, fiber-based communications networks, semiconductor light sources and detectors, couplers, LEDs, coherent optics, and lasers. ☺