

DEPARTMENTS

BOOK REVIEWS

Handbook of Display Technology

Joseph A. Castellano, 344 pages, illus., index, bibliography at the end of each chapter. ISBN 0-12-163420-5. Academic Press, 1250 Sixth Ave., San Diego, CA 92101 (1992) \$79.95 hardbound.

Reviewed by Robert W. Verona, UES, Inc., 102 Natchez Road, Enterprise, AL 36330.

In the late 1960s, display developers professed that new flat panel displays would soon replace waning cathode ray tube displays. This same proclamation was voiced throughout the 1970s and 1980s. But developers underestimated the complexity of the technical problems that would have to be solved to move from prototype panels to production panels. Castellano discusses these problems and reviews the historical development of many electronic display technologies in the first chapter. In subsequent chapters, each focusing on a specific technology, the author provides a detailed discussion of the configuration variations, theory of operation, fabrication and performance challenges, product and application trends, and advantages and disadvantages of the technology. Also included are chapters on image quality and visual performance measurements and manufacturing techniques and processes.

Overall, this book is well written and makes effective use of illustrations. It is intended for readers with engineering or science backgrounds. The author adopts a qualitative approach in his discussions of the various technologies, emphasizing the functional aspects in engineering terms. However, where appropriate, quantitative information regarding critical performance parameters is presented.

The historical chapter effectively introduces the various display technologies and gives credit to their inventors and developers. The second chapter is very brief and has the somewhat misleading title "The Visual Impact of Displays." This chapter is the weakest

chapter in the book and has a minimal number of references. It also is apparent in this chapter that the author's primary focus is directed toward alphanumeric and computer-generated graphic information displays rather than television-type imagery displays. He makes unsubstantiated statements (i.e., "the human eye cannot distinguish the difference once the contrast ratio is above about 10:1") without identifying a reference and without qualification. Castellano provides definitions in this chapter, but some of them are not consistent with technical dictionaries that have been in publication for many years. For example, he defines a monochrome display as having no more than two colors, one for the backgrounds and one for the foreground. He considers a black-and-white display as a monochrome display with two colors. The Photonics Dictionary [38th edition, Photonics Spectra Magazine, Pittsfield, MA 01202 (1992)] defines monochromatic as made up of a single color. Even as a brief tutorial on the visual impact of displays, this chapter fails.

In the remaining chapters, the only major criticism noted is the presentation of business and technology trends as facts rather than projections. Magazine articles and technical papers are a more appropriate forum for trends and forecasts. In a handbook, the material is expected to be more factual and less speculative. Some of the material is already outdated in this book: the material was current in 1989 but now some of the projections are false.

A minor, but annoying, aspect of the book is the inconsistent manner in which the author uses luminance measurement units. Sometimes the author uses candelas/meter², footlamberts, nits, and millilamberts interchangeably. To someone unfamiliar with conversion factors, this causes unnecessary confusion.

In summary, the book is informative and a good reference on emerging display tech-

nologies. The human factor section is weak, but the other technical information is well presented and the illustrations are a valuable aid to understanding the technologies. The reader should not use the product and application trend sections for investment purposes. The advantage and disadvantage sections are very helpful for equipment designers investigating technology options to satisfy their alphanumeric and graphical display needs. This handbook is less helpful for those designers investigating displays for imaging sensors.

Remote Sensing by Fourier Transform Spectrometry

Reinhard Beer, 153 pages, illus., index, bibliography, appendix. ISBN 0-471-55346-8. John Wiley & Sons, 605 Third Ave., New York 10158 (1992) \$74.95 hardbound.

Reviewed by Rudolf A. Hanel, 31 Brinkwood Road, Brookeville, MD 20833.

Fourier transfer spectrometry (FTS) has contributed significantly to the art of remote sensing in recent decades. From ground-based locations to spaceborne platforms, FTS instruments have occupied prominent places as observation tools. Reinhard Beer's book *Remote Sensing by Fourier Transform Spectrometry* addresses this subject. In Chap. 1, the author introduces the concept of FTS in an elementary way, using the basic configuration of the Michelson interferometer as a prototype. Discussions of the convolution theorem and of Fourier transformation in general conclude this chapter.

Chapter 2 is devoted to the properties of an ideal interferometer. The étendue (area times solid angle) is brought into the discussion and the maximum permissible solid angle of an FTS instrument is derived. Comparison of the étendue of a dispersive system (a conventional grating spectrometer) with that of an

FTS device demonstrates the Jacquinot advantage. The multiplex property of the FTS instrument helps in the explanation of the Fellgett advantage. Discussions follow on spectral resolution, instrumental line shape, frequency accuracy, and modulation efficiency. FTS and dispersive spectrometers are compared again, this time with respect to their spectral imaging capabilities.

The third chapter concerns the physics and chemistry of remote sensing. This topic spans an enormously wide field, including the physical state and the composition of atmospheres and surfaces, as well as the theories of radiative transfer and molecular spectroscopy. These topics, including 13 figures, are condensed into 24 pages. The text of each topic must necessarily be rather short. The discussion of the physics of the atmosphere consists of the derivation of the hydrostatic equation. The chemistry discussion is limited to an enumeration of the radiatively active minor constituents. The section on radiative transfer is equally minimal. A solution of the radiative transfer equation [Eq. (3.9)] stands somewhat isolated. It is not used further, except for the statement that the equation must be inverted to derive a number of atmospheric and surface parameters. In a book that carries remote sensing in the title, one would expect some discussion of how this inversion is to be achieved. Incidentally, there is a misprint in Eq. (3.9); in the last line, $\tau(-\Omega, \dots)$ should be replaced by $\tau(\Omega, \dots)$.

The section on "Remote Sensing Spectroscopy" shows a CO and a CO₂ sample spectrum, mentions line intensities and their temperature dependence, and provides a short treatment of atmospheric line shapes. The section titled "Qualitative Atmospheric Spectral Analysis" displays a spectrum recorded by the Atmospheric Trace Molecule Spectrometer (ATMOS) and one synthesized on a computer. The comparison of both spectra is impressive and shows the excellent quality of the ATMOS data. However, I miss the quantitative conclusions on the gas concentrations as promised in the section title. Near-infrared laboratory spectra of a few common minerals conclude this chapter.

While Chap. 3 is somewhat disappointing, Chap. 4 on real FTS instruments is very informative. Here, the author is clearly at home. The treatment of a radiometric model and its application to an FTS instrument attached to a ground-based telescope is very systematic. Section 4.1 includes calculations on the background flux and on the effect of pointing jitter and should be read by everyone planning observations with an FTS instrument. The comparison between FTS and dispersive systems concerning SNR considerations is illuminating. The discussion of

interferogram sampling and the consequences of sampling errors is good and supported well by diagrams. Optical configurations, in particular the Connes-type interferometers, are treated very well. The discussions of phase errors, spectral channeling, mechanical vibrations, and electromagnetic interferences reflect the author's long experience with FTS systems. Ratio recording, dynamic range considerations, digitization processes, and the effect of nonlinearities in the analog part of the signal path are all discussed in a concise, adequate manner. An analysis of radiometric calibration methods is lacking, however. I suspect this chapter was the core of the lecture series on which the book is based.

Chapter 5 is very good. It is devoted to case studies of five instruments: the IRIS on Voyager, the FTS device on the Canada-France-Hawaii telescope, the ATMOS on Spacelab 3, the Mark IV intended for balloon and aircraft operation, and the FTS instrument now under construction at the Jet Propulsion Laboratory for the Earth Observation System. Specifications, schematic diagrams, and sample spectra obtained with these instruments (except for the last one) demonstrate the power of FTS in a variety of remote sensing tasks. Unfortunately, the Martin-Puplett polarization interferometer, flown on the Cosmic Background Explorer, is omitted.

Chapter 6 on remote sensing environment discusses the subtle and not-so-subtle differences of operating an FTS device on a ground-based telescope, in an aircraft, on a balloon, or on a spacecraft. Anyone trying to build or modify a laboratory instrument for these environments will benefit from reading this chapter.

Chapter 7 is a one-page summary of the text. I wholeheartedly support the last sentence: "On the scale of an FTS the world is made of rubber!" An appendix on optimum filters concludes the book. References are limited to the absolute minimum and are grouped according to chapters.

In summary, some parts of this book are very good, others are more modest. Anyone planning to build or to use an FTS instrument will find valuable hints and good insight into the finer points of operating such a system. For this reason, I recommend this book to present and future practitioners of FTS.

BOOKS RECEIVED

Optoelectronics Lightwave Technology by J. E. Midwinter and Y. L. Guo. 304 pp., illus., index, references. ISBN 0-471-92934-4. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012 (1992) \$64.95 hard-

bound. Covers introduction to optoelectronics and lightwave technology, coherent lightwave transmission technology, optical frequency division multiplexing (FDM) technology, high-speed and time division multiplexing optical transmission, optical fibers-waveguides and devices, semiconductor lasers and quantum well devices, and guided-wave optical devices.

Photoelectronic Properties of Semiconductors by Richard H. Bube. xviii + 318 pp., illus., subject index, bibliography. ISBN 0-521-40681-1. Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211 (1992) \$32.95 softbound. Covers photoconductivity parameters, one-center recombination models, the Shockley-Read one-center model, two-center recombination effects, recombination processes, steady state photoelectronic analysis, transient photoelectronic analysis, photoeffects at grain boundaries, amorphous semiconductors, photovoltaic effects, and quantum wells and superlattices.

Introduction to Glass Integrated Optics, edited by S. Iraj Najafi. vii + 170 pp., illus., subject index, references. ISBN 0-89006-547-0. Artech House, 685 Canton Street, Norwood, MA 02062 (1992) \$74 hardbound. Covers ion exchange from salt melts, physics and chemistry of the ion-exchange process, materials and conditions for ion exchange from melts, experimental considerations and process parameters, silver-film ion-exchange process, slab waveguides, channel waveguides, theoretical analysis of ion-exchanged glass waveguides, optical waveguide-characterization techniques, and waveguides and devices.

Modern Lens Design: A Resource Manual by Warren J. Smith, edited by Robert E. Fischer and Warren J. Smith. xi + 471 pp., illus., subject index, appendix. Part of the Optical and Electro-Optical Engineering Series. ISBN 0-07-059178-4. McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, NY 10020 (1992) \$49.95 hardbound. Covers automatic lens design; improving a design; lens design data; telescope objectives; eyepieces and magnifiers; Cooke triplet anastigmats; reverse telephoto; telephoto lenses; double-meniscus anastigmats; the Tessar, Heliar, and other compounded triplets; the Petzval lens; head-up display lenses; split triplets; microscope objectives; mirror and catadioptric systems; the biotar or double-Gauss lens; wide-angle lenses with negative outer elements; projection TV lenses and macro lenses; zoom lenses; infrared systems; and tolerance budgeting.