DEPARTMENTS

BOOK REVIEWS

Highly Coherent Semiconductor Lasers

Motoichi Ohtsu, 341 pages, illus., index, refs., and five appendixes. ISBN 0-89006-462-8. Artech House, Inc., 685 Canton Street, Norwood, MA 02062 (1992) $74.00 hardbound.

Reviewed by Gary A. Evans, Southern Methodist University, Department of Electrical Engineering, 3145 Dyer Street, Dallas TX 75275.

This book covers recent developments in single frequency semiconductor lasers including gain-coupled distributed feedback lasers, wavelength tunable semiconductor lasers, quantum wire lasers, quantum dot lasers, vertical cavity lasers, and strained quantum well lasers. In addition, the book discusses noise characteristics and the effects on coherence, detection, and modulation techniques.

The book emphasizes the use of external methods (negative electrical feedback, optical feedback, and injection locking) to decrease noise and linewidth, although the basic concepts useful to the design of low-noise, narrow linewidth semiconductor lasers are included. A large portion of the book discusses applications such as optical communication, fiber gyroscopes, metrology, laser radar, isotope separation, atomic clocks, and spectroscopy. Optical system designers will find Chap. 5 on phase-locked loops and frequency sweeping useful.

Because of the range of topics, depth and clarity are sometimes sacrificed, making this book most useful as a handbook rather than a textbook. For example, a few brief, murky paragraphs at the beginning of the second chapter consider temporal and spatial coherence from a classical viewpoint before coherence is defined using quantized light notation (developed in an appendix). A definite strong point is the extensive and current list of references for all of the topics.

Finally, the book would benefit from thorough editing and proofing. Several misspellings and sentence fragments as well as awkward grammar distract from the flow. In some cases, acronyms are not defined until long after the first use, and some page numbers listed in the table of contents are not accurate. I hope these errors will be corrected in the next edition.

Optical Scanning

Edited by Gerald F. Marshall. Vol. 31 in the Dekker Optical Engineering Series, 868 pages, illus., index, refs., appendix. ISBN 0-8247-8473-1. Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016 (1991) $150 hardbound.

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

This collection of articles is an expansion and modification of an earlier volume in this series entitled *Laser Beam Scanning* (Vol. 7), also edited by Gerald Marshall. The first noted difference is that the new volume has been considerably expanded and the material is presented with a more pedagogical flow. Also, the printed pages in the new volume are much easier to read than the reduced Courier type format of the previous book. Several chapters have been repeated almost verbatim, indicating that the subject matter covers a mature technology and that there are not many (if any) new developments in the field. In other chapters that repeat material, the authors have included different applications and/or the material development has been refined to provide a clearer, easier to follow presentation. The title has changed, indicating that the book covers a broader range of topics than laser scanning, although laser scanning remains the predominant subject.

This book covers the state of the art in scanning issues, and each chapter is written by an authority in the field. It is a recommended reference volume for anyone using scanner systems for image collection or presentation. The newer volume is a more complete and easier to read text than the earlier version. For those who have the earlier volume on their shelves, the decision to purchase this moderately expensive volume should be based on an individual review of the new material.

The order of the material has been modified to better lead the reader into the subject matter. Because the principle application for optical scanners is writing with laser beams, Chap. 1, Gaussian Laser Beam Diameters and Divergence (Gerald F. Marshall), provides an explanation of the underlying issues associated with laser beams. This explanation is needed to ensure that all readers have the minimum required understanding before dealing with the scanning and related interactive issues that follow. In the earlier volume this material was in a later chapter.

Chapters 2 and 3 are new to this volume. Chapter 2, Optical Systems for Laser Scanners (Robert E. Hopkins and David Stephenson), introduces the constraints of optical systems in realizing precision location control. Scanner redirection of the view/writing angle is only part of the task. The optical system must be capable of providing the required resolution at the plane of interest, as well as reshaping the beam (if needed) and linearizing the scan. Many innovative lens designs for specific applications exist. The authors use some of these to illustrate the issues and solutions that have been developed. This chapter provides system designers with a better appreciation for the intricacies of lens issues. The discussion is cursory, which is as expected in an overview text.

Chapter 3, Scanned Image Quality (Donald R. Lehmbeck and John C. Urbach), discusses the impact of nonideal system behavior with emphasis on the interaction of system properties with particular applications. A trade-off always exists between attainable optical performance, price, and visual performance. Certain attributes of the optical system manifest them-

selves in peculiar, human-recognizable features. The authors deal with human perception, psychophysical relationships, and subjective responses. They also discuss scanning systems and how foibles in these systems impact performance The authors focus on image gathering, but, by extension, the material is related to image placement.

Chapter 4, Holographic Scanners for Bar Code Readers (LeRoy D. Dickson and Glenn T. Sincerbox), details requirements for one of the most common applications of laser scanners: bar-code reading. In order to present requirements for scanner systems, the authors go into detail about the types of bar codes available and their uses. To fully appreciate the material presented, a better understanding of scanners is necessary. This is one part of the new book where the chapter Holographic Scanners by Glenn Sincerbox from the earlier text is essential companion material.

Graphic arts applications present some of the most demanding requirements on scanning systems. In addition to the standard requirements of scan straightness, linearity, and beam shape, the systems must be consistent over broad wavelength ranges. Chapter 5, Holographic Deflector for Graphic Arts Systems (Charles J. Kramer), describes a variety of graphic arts applications, the scanner requirements in these applications, and systems that have responded to these needs. The author provides sufficient detail on scanner idiosyncracies and related mathematics to provide a reasonable understanding without wading through the tedium of comprehensive development. As with other chapters in the book, the reader is directed to the references for more detail, if needed.

Chapters 6 through 9 are devoted to polygon scanners. Except for Chap. 7, High-Performance Polygonal Scanners, Motors, and Control Systems (Gerald A. Rynkowski), this material is largely a repeat of the earlier volume. High-speed scanners are almost exclusively polygon systems. The details of drive motors, bearings, and windage, which at slower speeds are not significant, become very important for performance at the speeds of these scanners. The technology has been well established for some time. This material is important to include for completeness in a reference on scanning, but there is not much new to present.

Chapter 10, Galvanometric and Resonant Low-Inertia Scanners (Jean I. Montagu), describes the low-inertia scanners primarily used for on-demand motion, principally vector positioning. These beam deflectors can quickly respond to electric drive signals. Again, this is largely a mature technology, and advances are incremental, i.e., refinements in control and positioning. The author has chosen to illustrate the use of these scanners with a new set of applications, and this serves to differentiate the material from the earlier book. While the underlying basis is a repeat, I was intrigued going through the chapter and reviewing new areas the author discusses.

Chapters 11 and 12 present the latest state-of-the-art electro-optic scanner technologies. Chapter 11, Acoustooptic Scanners and Modulators (Milton Gottlieb), describes the theory and application of acousto-optic devices. The scanners described in the earlier chapters were mechanical constructs that rotated reflector surfaces to redirect laser beams. In this new class of deflector, the phase-front of the beam is modified and the beam diffracts into a new direction. There are no moving mechanical parts, and response time is dramatically reduced. The speed is so high that these devices are used to dynamically correct for facet misalignment in polygon scanners. Because the operating principle is based upon diffraction, there are a variety of new applications for which traditional scanners cannot be used. The beamfront can be modified in detail to accomplish many operations in addition to deflection. The author provides a strong overview of the operating mode and some of the new applications opened by these scanner/modulators.

Electro-optical scanners (described in Chap. 12 by Clive L. M. Ireland and John Martin Ley) are most often two-part scanners. The electro-optic device rotates the polarization of the laser transmitted through it. The degree of rotation is controlled by the electric field applied to the device and the physical properties of the device (i.e., the coupling coefficient between the electric field and the particular physical phenomena giving rise to rotation). The beam is then passed through a birefringent material where optical properties are polarization dependent. As a result, the beam path is altered or deflected according to the polarization direction. Some electro-optic scanners that are single entity devices are also described.

The final chapter, Optical Disk Scanning Technology (Tetsuo Saimi), presents the most widely used technology in the scanner field: the system needed for reading optical disks. To a great extent, developments in this field are driven by a large consumer market, principally compact disk players. This type of mass market use by relatively unsophisticated operators is an excellent driver for the development of robust, self-controlling units. Closed-loop feedback control ensures proper operation of these systems, which are miniaturized and represent substantial engineering innovation. The author provides a concise review of the technology with sufficient detail to appreciate the effort required to develop these systems.

In summary, this book presents an excellent compilation of the current status of optical scanners. If you use these devices, teach about their operation, or simply appreciate fine engineering innovation and analysis, this book will provide much enjoyable reading. The text is also a good starting point for in-depth study. The book is quite expensive, which may be a drawback, but I recommend you not bypass the book because of cost alone.

BOOKS RECEIVED

The Photographic Lens, by Sidney F. Ray. 355 pp., illus., refs., index. ISBN 0-2405-1329-0. Butterworth, 80 Montvale Avenue, Stoneham, MA 02180-2422 (1979) $45.00 hardbound. Covers spatial properties of the eye, lens aberrations, types of projection by a lens, depth of field, measuring transmittance, wide-angle lens designs, inverted telephoto lenses, beamsplitters and stereoscopy, panoramic and periphery cameras, optics of lighting equipment, stereoscopic projection, optics of multiplexing, viewfinder systems, reflex mirror systems, optical rangefinder errors and accuracy, screen focusing, and opto-electronic devices.

Useful Optics, by Walter T. Welford. 150 pp., illus., index, refs. ISBN 0-226-89036. The University of Chicago Press, 5801 S. Ellis Avenue, Chicago, Illinois, 60637 (1991) $29.95 softbound. From the Chicago Lectures in Physics Series. Covers useful models of optics, geometrical optics, symmetrical optical systems, plane mirrors and prisms, optical materials, aberrations, physical optics and the limits of image formation, illumination for image-forming systems, laser beams, thin-film multilayers, interference and interferometry, detectors and light sources, image scanning and beam deflection, diffraction gratings, some applications of holography, and assembling an experimental optical system.

Optical Waveguide Analysis, by Masanori Koshiba. 183 pp., illus., index, bibliography. ISBN 0-07-035368-9. McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, NY 10020 (1990) $45.00 hardbound. Covers types of optical waveguides and analytical techniques, basics of optical waveguide analysis, optical waveguide modes, analytical approximation solutions for 3-D optical waveguides, finite-element analysis of 2-D optical waveguides, finite-element analysis of 3-D optical waveguides, finite-element analysis of axisymmetrical optical fibers, finite-element analysis of non-axisymmetrical optical fibers, and finite-element analysis of nonlinear optical waveguides.