

DEPARTMENTS

BOOK REVIEWS

Optical Computing in Japan

S. Ishihara, Ed., 525 pages, illus., index, and references. ISBN 0-941743-85-3. Nova Science Publishers, Commack, NY 11725 (1990) \$85 hardbound.

Reviewed by **Mohammad A. Karim**, University of Dayton, Center for Electro-Optics, 300 College Park, Dayton, Ohio 45469-0227.

In fiscal year 1988 alone, optoelectronic products in Japan were valued at more than \$14 billion. Many of these products were related to optical communication and optical disk memories. This multibillion dollar per year surge is continuing. No wonder, therefore, that much optical computing activity is carried out in Japan. Unlike U.S. efforts, where interest in optical computing mimics a dollar-starved roller-coaster ride, Japanese researchers are more consistent and have their eyes fixed far into the future. However, not much of the Japanese effort is known abroad because many results are presented only in Japan or published in Japanese. This book is the product of a courageous effort by its editor, Satoshi Ishihara, in which he collects the optical computing work of 93 Japanese experts from both universities and industrial R&D laboratories.

The book consists of 47 chapters with the chapters, including illustrations, averaging 10.9 pages. Each of the chapters is self-contained as well as lucid. Ishihara accomplishes this feat by requiring each chapter to include as many references as possible to cover omitted material. The chapters of the book have been roughly divided into five groups: general fundamentals, systems, interconnects, devices, and materials. The first group consists of four chapters and deals with the pros, cons, and various limits of optical computers as well as prospects for quantum-controlled devices.

The second group, which is the largest, involves systems and consists of 20 chapters divided into two subgroups: digital and analog systems. The digital systems subgroup consists of five "parallel" systems related chapters, four

"logic" systems related chapters, three "neural" systems related chapters, and two "numerical" systems related chapters. These fourteen chapters cover shadow-casting based systems, array logic systems, schemes using BSO, interference techniques and wavefront synthesis, optical neural networks and their limitations, and matrix multiplication schemes. The six analog subgroup chapters are truly exceptional. They cover a wide variety of problems such as speech recognition, integrated-optic disk pick-up, three-dimensional transformation, parallel implementation of convolution, and image coupling and intensification.

The first two chapters on interconnects describe chip-to-chip data transmission and clock distributions and optical array processing using optical guided wave devices. The third chapter deals with optical exchange using cylindrical mirrors or holograms and, accordingly, describes the development of a multiprocessor system based on virtual common memory.

The fourth group consists of seventeen chapters and deals with device-related topics such as microchannel spatial light modulators, microlens arrays and array lasers, bistable devices, high-speed devices using liquid crystal light modulators, guided wave light modulators, distributed feedback lasers, and active devices. The last group deals with organic materials and their optical nonlinearities.

Although the work summarized in this book pertains only to Japanese optical computing efforts, the book offers readers a comprehensive picture of what is going on in the optical computing world. In this context, the book will prove extremely successful. *Optical Computing in Japan* should be recommended reading for anyone doing research in the field of optical computing. Students as well as those who desire a casual understanding of optical computing should examine it. The latter group of readers will be impressed with the book because it is not clogged with equations. There are ample illustrations (an average of 8.1 per chapter) and a scrupulous listing of references that should be of high value to readers.

Dye Laser Principles with Applications

Edited by F. J. Duarte and Lloyd W. Hillman, 462 pages, illus., index, references, and one appendix. ISBN 0-12-222700-X. Academic Press, 1250 Sixth Avenue, San Diego, CA 92101 (1990) \$75 hardbound.

Reviewed by **Jan M. Yarrison-Rice**, Miami University, Physics Department, Oxford, OH 45056.

As an educator and researcher who utilizes dye lasers in the laboratory, I was excited to see a book that addresses the issues surrounding dye lasers and their applications. I was further impressed with the aim of the text: to be appropriate for both students and also laser researchers. The book achieves this aim with varying success. Several chapters are indeed better-suited for instruction (2,3,5,6,8) than others. However, all of the chapters serve well as updated references describing the state-of-the-art techniques in dye laser design and applications. While the book contains a collection of chapters written by different authors, the chapters are well integrated into the book, and similar notation and terminology is used from chapter to chapter. Generally, the homework problems are interesting and not just simply "fill-in-the-blanks between equations." The problems deal with topics such as analyzing the use of a dye jet in a laser (what flow rate is necessary to prevent overheating of dye?), calculating the frequency difference between the main longitudinal mode and spatial hole burning mode, which could oscillate simultaneously in a cw laser, and designing a three-prism beam expander with a magnification of 80.

In Chap. 2, Lloyd Hillman provides an excellent introduction to laser operation in general and to dye lasers in particular. He explains terminology carefully and uses the rate-equation model to analyze a four-level system, and then he extends this into the additional levels and band structures of the dye laser system. Actual lifetime values for Rhodamine 6G dyes give students a feeling for the approximations

made in the theoretical treatment of the problem. The chapter contains a few typographical errors that could lead to some confusion if the reader is not following carefully, but they are relatively minor.

J. C. Diels writes about femtosecond dye lasers in Chap. 3. His general discussion on ring and linear femtosecond dye laser configurations addressed practical design considerations, such as astigmatism, phase modulation, and dispersion. The section concerning solitons is interesting and presents very recent numerical studies of femtosecond dye laser cavities that are compared with measurements of a ring-dye laser. The diagnostic techniques section discusses the usual autocorrelation and new ideas, such as convolutions, asymmetric correlation, and single shot detection techniques. Section 3, Theory of Operation, would be a very useful pedagogical section except that the section contains inconsistent and at times incorrect notation that would greatly confuse the uninitiated (as well as the knowledgeable) person. For example, pulse energy is defined in Eq. (3.16) using a script capital T , then in Eq. (3.25) the script capital T is designated as an energy density, which is the correct definition. Later in the text W_s is called the saturation energy density [just below Eq. (3.51)]. Anyone wishing to use this section for students will want to examine it thoroughly in advance. Such inconsistencies detract from an otherwise thought-provoking chapter on femtosecond dye lasers.

Chapter 4 by F. J. Duarte deals with narrowing the bandwidth of pulsed dye lasers. The chapter contains lots of practical information on the experimental design of narrow bandwidth dye lasers through the use of dispersive elements. The dispersion and beam divergence theory is straightforward, yet complete enough to include multiple passes in the cavity. The discussion on pulse compression due to prism dispersion could include more information on how dispersion relates to compression, rather than leaving it to the reader to find the reference. Duarte tends to give a brief overview of each subject and a list of references for further reading (sufficient for a physicist working with lasers), but does not spend as much time describing topics as one would like in a textbook. Duarte also includes a section on the use of grazing-incidence and multiple-prism grating techniques for mode selection in pulsed gas lasers.

Chapter 5, written by Leo Hollberg, is an excellent presentation on cw dye lasers. He explains the two major dye laser configurations (linear folded geometry cavity and unidirectional ring laser), while paying attention to such details as high gain for design flexibility, dye lifetimes, and dye flow rates that avoid associ-

ated heating problems. Spatial hole burning versus mode structure in linear cavities is also addressed. The section on frequency stabilization includes helpful hints for the laboratory and many references to successful optical designs. A discussion on amplitude stabilization techniques would have rounded out the chapter nicely.

Chapter 6, by F. J. Duarte, provides a good discussion on pulsed dye laser pump geometries, followed by the pros and cons of various dye cell designs. The chapter covers a broad range of concerns including amplified spontaneous emission, polarization considerations, thermal effects in dye cells, and tuning methods. Duarte provides an overview of available pulsed pump sources with the exception of high-repetition rate Nd:YAG lasers (frequencies in the 100-MHz range and pulselengths of 30 to 70 ps).

Guilford Jones writes about the Photochemistry of Laser Dyes in Chap. 7. The chapter is an informative and valuable addition to the book. Jones provides sufficient definitions of organic chemistry terms to allow the reader to understand the basics of the reactions. Topics of interest include solvent effects on dye emission, possible interactions of dye molecules that affect lifetime and emission/absorption of radiation, and photodegradation of dyes. Separate sections are devoted to various dye families to provide specific information about the dyes one might be using.

The three chapters dealing with applications of dye lasers are each as different as their titles. *Industrial Applications of Dye Lasers* (Chap. 8) by David Klick is a great pedagogical chapter. The case study of dye laser curing of pigmented coatings describes the development of a laboratory experiment into an industrial application, taking into consideration laser technology requirements, cost, safety, and ease of maintenance. Other applications Klick covers include diagnosis in electronics and combustion. Chapter 9 by M. A. Akerman is basically a bibliography. Following a very brief description on isotope separation using dye lasers (several paragraphs), the chapter has an extensive list of references for further study of isotope separation. Finally, Chap. 10 presents various medical procedures and treatments that utilize lasers, such as eye surgery, cancer diagnosis and treatment, birthmark removal, lithotripsy, and angioplasty. Leon Goldman presents problems that must be addressed to use lasers in a medical environment, in effect, spurring interested scientists to study these areas.

In summary, *Dye Laser Principles With Applications* is a fine book. The text meets most of the editors' goals. Graduate students and laser physicists will find that this publication contains an up-to-date description of current dye laser topics of interest with an excellent collection of

references. Educators will also find the book to be a helpful reference for teaching with several chapters that could be readily adopted as part of a laser physics course. I would recommend this text to laser physics teachers and anyone working with dye lasers as tools in their industrial or research laboratories.

BOOKS RECEIVED

Handbook of Optical Constants of Solids II, edited by Edward D. Palik. 1096 pp., illus. ISBN 0-12-544422-2. Academic Press Inc., 1250 Sixth Avenue, San Diego, CA 92101 (1991). \$145.00 hardbound. Contents include determination of optical constants, convention confusions, methods for determining optical parameters of thin films, optical properties of superlattices and measurements of n and k XUV by the angle-of-incidence total-external-reflectance method, plus nine other chapters.

Physical Research, edited by Gottfried Frankowski, Niels Abramson, Zoltan Fuzessy. 380 pp. illus., references. ISBN 0-05-500789-1. Akademie-Verlag Berlin, 1086 Berlin, Leipziger StraBe 3-4, Telefon 2-23-60 (1991). Includes metrological laser methods for applications machines and systems, double-pulse holography for the investigation of machines and systems, laser metrological methods for the investigation of automotive parts, geometric optical measurement techniques with laser light, holography and laser-doppler techniques for vibrations analysis.

Nonlinear Waves in Solid State Physics, edited by A. D. Boardman, M. Bertolotti, T. Twardowski. 500 pp., illus., subject index, references. ISBN 0-306-43811-9. Plenum Publishing Corp., 233 Spring Street, New York, NY 10013. (1990). \$120.00 hardbound. Contents include nonlinear surface-guided waves in self-focusing optical media, surface acoustic waves on nonlinear substrates, nonlinear waves in ferromagnetic films, the optical Kerr effect in fibers, linear and nonlinear theory of surface polarization diffraction, and an overview of nonlinear integrated optics, plus nine more chapters.

Subband Image Coding, edited by John W. Woods. 355 pp., illus., subject index, references. ISBN 0-7923-9093-8. Kluwer Academic Publishers, 101 Philip Drive, Assinipi Park, Norwell MA 02061 (1991). Covers performance bounds, multirate filter banks, IIR analysis/synthesis, transforms, coding of color images, and coding of video signals for subband coding.