

## BOOK REVIEWS

**The nonlinear optics of semiconductor lasers** edited by N. G. Basov, translated by Kevin S. Hendzel (Proceedings of the Lebedev Physics Institute of the Academy of Sciences of the USSR, Vol. 166; Series Editor: N. G. Basov), Nova Science Publishers, Inc., Commack, New York, USA, pp. 281, \$85.

The book under review is volume 166 of the series entitled "Proceedings of the Lebedev Physics Institute of the Academy of Sciences of the USSR," which are being edited by N. G. Basov, a Nobel laureate. This particular volume titled *The nonlinear optics of semiconductor lasers* is edited by the series editor himself and it is in the fitness of things that he chose to do so, because the contributions of Basov to the physics of semiconductor lasers are monumental.

The phrase nonlinear optics has come into existence with the advent of laser, because the interaction of laser light with matter can result in the manifestation of nonlinear optical phenomena such as Stimulated Raman Scattering (SRS), Optical Bistability (OB). At the grassroots level the materials that can exhibit nonlinear optical phenomena can be divided into metals, semiconductors and insulators. And this book deals with the subject of nonlinear optics of semiconductors which are prepared to function as laser gain media.

The book contains ten articles (or papers). Since the institutional affiliation of the authors is not mentioned anywhere, it is to be presumed that they all belong to the Lebedev Physics Institute. The volume portrays the high quality of the Russian contributions to the area of lasers and their applications.

The first article by Basov *et al* is a sort of overview of the physics of injection lasers by paying attention to the recent developments in lasers having quantum-dimensional structures and high-emission powers. The second paper by Eliseev and Bogatov is concerned with a discussion of the phenomena associated with nonlinear refraction and the influence of current carriers on the refractive index in semiconductor lasers. Issues such as self-focusing, optical bistability, etc., are discussed in this paper. The realisation of stabilized single-frequency operation of a laser is important in applications such as coherent optical communications and laser spectroscopy. The third article by Bogatov *et al* deals with a discussion on the realisation of single-frequency operation of an injection laser based on nonlinear mode interaction. The fourth paper by Bogatov is about the analysis of laser diode as a travelling-wave amplifier. He attempts to bring out the merits of a travelling-wave amplifier over the conventional regenerative amplifier. The fifth paper by Bogatov *et al* is on the experimental aspects of a ALGaAs/GaAs laser diode functioning as a travelling-wave amplifier. The sixth paper by Popov and Skopin is

concerned with an investigation of self-modulation, nonlinear losses, mode chirping, and other aspects of lasing dynamics of several types of stripe-lasers. Man'ko and Mikaelyan have attempted to investigate the modal behaviour of semiconductor waveguides by invoking the Epstein-layer model of the distribution of the dielectric constant and the results obtained are discussed in article seven. The eighth paper by Man'ko *et al* deals with a study of the nature of wavefronts generated by planar-stripe GaAlAs/GaAs heterolasers. The ninth paper by Bessanov *et al* is concerned with an experimental investigation of the spatial and spectral characteristics of various types of double-GaAlAs heterostructure-injection lasers. In the tenth paper VuVanLyk *et al* discuss the phenomenological theory and the experimental findings in regard to voltage saturation across the injection contact in a laser diode and the phenomenon of negative photo-EMF.

The volume contains very valuable information for the specialist; but for the generalist it offers no scope of getting a cohesive picture of the nonlinear optics of semiconductor lasers. May be the series was intended for a specialist and not a generalist; as such a generalist cannot complain.

The bibliography cited at the end of each paper will definitely aid the reader in tracking the past developments. Also the subject index will be helpful to the reader. A serious omission of the volume, however, is the absence of a "foreword" or "preface" by the Editor explaining clearly the purpose behind stringing ten papers of this kind under one cover (and a hard one at that). While the printing of the book is quite attractive to the reader, the same cannot be true of the price. Therefore, the natural habitat for the volume seems to be the institutional libraries rather than the personal ones.

Optical Communications Laboratories  
Department of Electrical Communication Engineering  
Indian Institute of Science  
Bangalore 560 012.

S. V. PAPPU

**Rational approximation in systems engineering** edited by A. Bultheel and P. Dewilde. Birkhauser Verlag, CH-4010, Basel, Switzerland, 1983, pp. 495. SFr. 72. Indian orders to Springer Book (India) Private Ltd., 6, Community Centre, Panchsheel Park, New Delhi 110 017.

Approximating a physical system from its measured input-output data is an important task in system and control. Several techniques are available for the solution of this difficult problem, scattered widely in the related literature. The present book is a collection of articles contributed by a number of researchers in the field. These contributions have a strong blend of mathematical treatment in the main stream of approximation techniques.

The six-section editorial by Bultheel and Dewilde which includes 53 references is a comprehensive report on a workshop held at the Catholic University of Leuven in August 1981. It attempts to classify the articles roughly into three major schools of

thought, viz., the Padé school, the norm approximation school, and the system theory school. This is followed by 13 contributions as outlined below:

1. Chisholm's discussion on the various Padé approximants and their generalizations including a general class of Hermite-Padé approximants.
2. A presentation by Graves-Morris of a method of solution to the Polish polynomial approximation problem on the lines of modified Kronecker algorithm. The method is also applicable to the solution of Toeplitz equations.
3. Nuttal's article on the asymptotic properties of Hermite-Padé polynomials.
4. A study by Lambert and Musette on the role of Stieltjes series in the solution of the so-called KdV and MKdV equations helpful in the understanding of soliton interaction.
5. Cichoki's derivation of algorithms to represent double power series by branched continued fractions in the design of 2-D systems.
6. Cybenko's contribution on moment methods in the context of low-rank Toeplitz approximations.
7. Werner's work concerning rational Chebyshev approximation related to the generalized Remes algorithm and its connection to the generalized eigenvalue problem for symmetric Hankel matrices.
8. The work of Arsene and Ceausescu on labelling of contractive intertwining dilations and norm approximation techniques useful in computing the norm of an analytic Toeplitz matrix with application in seismic exploration and in an error-control model in Wiener prediction.
9. Rissanen's work dealing with minimum-description-length-criterion-based structure estimation for dynamical systems.
10. The work of Lin and Kung on optimal Hankel-norm approximation of continuous time-linear systems.
11. The work of Verghese *et al* also concerning construction of interpretable or physically based reduced-order models of large systems reproducing certain chosen modes of the original system with desired accuracy.
12. Jonckheere and Silverman's singular-value analysis for deformable systems relying on asymptotic SVD of the Hankel operator associated with the impulse response.
13. Geronimo's presentation on the techniques of scattering and inverse-scattering theory aimed at the study of the properties of matrix orthogonal polynomials.

This book is a welcome addition to the literature on system-approximation techniques. Mathematicians, systems and control engineers, and, in general, all those interested in the handling of models of real-world dynamical systems will find this volume of collective expertise very useful.

Department of Electrical Engineering  
Indian Institute of Technology  
Kharagpur 721 302.

GANTI PRASADA RAO

**Kinematics of robot manipulators** edited by J. M. McCarthy. The MIT Press, 55, Hayward Street, Cambridge, Massachusetts, 02142, USA, 1987, pp. 210, \$20. Indian orders to: Affiliated East-West Press, Madras 600 010.

This book is a collection of papers focusing on various aspects of the design of modern general-purpose machines from the kinematics view point. The papers in this book have appeared before in *The International Journal of Robotics Research*, Volume 5, No. 2, 1986 and Volume 6, No. 1, 1987. Thus this is not a text book as such but a compendium of research papers that appeared recently giving a fairly comprehensive survey of this field.

Kinematic analysis is considered first, presenting the problems of displacement analysis of manipulators for the purpose of control and simulation. Next the problems of identifying singularities in these displacement relations are focused. These singularities in the configurations pose problems in the design of control algorithms. Two interesting aspects dealing with the analysis of a simple manipulator using the formalism of instantaneous invariants and the influence of relaxing the rigid body assumptions in the kinematics of mechanisms are discussed in two different papers.

The rest of the papers deal with synthesis and there are five of them concerned with the work space of manipulators. These papers address to the problem of determining basic geometric principles and techniques in the study of manipulator work space to guide the design process. An interesting study on the design methodology for the closed-loop version of the general six-degree-of-freedom serial manipulator was presented, demonstrating both the relative simplicity of present manipulator designs and the challenge involved in exploring new designs. Theoretical aspects of generalized parallel-connection robot manipulators and practical considerations for building a working machine were presented in another paper. The next paper describes the design of a high-speed three-link computer-controlled planar manipulator and the modelling necessary to derive the dynamic equations of motion. The last paper suggests techniques of type synthesis based on graph theory and expert systems that will aid in proper kinematic topology. This new area will be of significant importance to robot designers.

Science Counsellor  
Embassy of India  
2107, Massachusetts Avenue, N.W.  
Washington, D.C. 20008

J. S. RAO

**A few good men from Univac** by David E. Lundstrom. The MIT Press, Cambridge, Massachusetts, 02142, USA, 1987, pp. 227, \$19.95. Indian orders to: Affiliated East-West Press Pvt. Ltd., 6 Roselyn Gardens Apartments, 20/1A, Barnaby Road, Madras 600 010.

This book is the author's personal reminiscence of the computer industry with which he was associated for over thirty years. He presents a kaleidoscopic view of the varied aspects of what goes into the engineering of computer systems and presents many interesting perspectives on people, organisations and systems.

The book unfolds a fascinating story of the computer industry as the author progresses with his career with organisations like Sperry Rand and Control Data Corporation. Having worked in various capacities and in a variety of areas in the computer industry the author provides forthright assessments of the failures and successes in the industry. Whether it is the description of the cooling system of the UNIVAC, the pranks of the engineers on unsuspecting colleagues or the interesting sidelights of the computer genius Seymour Cray, the author succeeds in maintaining the reader's interest.

At various places in the book the author graphically recounts how certain factors emphatically determine the success or failure of projects. For instance, he illustrates how vital individual brilliance is to the success of large projects. Similarly he also assesses how disastrous physical separation between groups could be in technology-transfer efforts. The entire book is spiced with industry's folk-tales, anecdotes and interesting facets of systems and people.

This book provides a graphic description of the computer industry during an important period of growth and evolution and makes you re-live very many exciting moments of that period.

SERL

Indian Institute of Science  
Bangalore 560 012.

R. KRISHNA MURTHY