

# DEPARTMENTS

## BOOK REVIEWS

### Modern Optical Engineering: The Design of Optical Systems, Second Edition

Warren J. Smith, xiii + 524 pp., illus., subject index, bibliography and exercises following each chapter. Part of the Optical and Electro-Optical Engineering Series. ISBN 0-07-059174-1. McGraw-Hill, Inc., 11 West 19th St., New York, NY 10011 (1990) \$59.50 hardbound.

Reviewed by Robert R. Shannon, Optical Sciences Center, University of Arizona (mailing address: 7040 E. Taos Place, Tucson, AZ 85715).

This edition is an update of the well-known text by Smith that has been a "must have" for a generation of optical engineers. The book is fundamentally the same as the original volume but has new material in several areas. Smith continues to deliver the basics of optical engineering, which have not significantly altered since the original volume. Nor are the principles espoused in this book likely to change unless Snell's law is repealed.

The author calls attention to 1200 changes since the first edition. This reviewer did not attempt to check the accuracy of this statement but did observe that in some areas the text appears to be clearer and the explanations a bit crisper than in the first volume. The chapters on lens design are excellent and refer to contemporary procedures in this field. The chapter on image evaluation is good but does not cover some of the new topics in modulation transfer functions and their application to imaging detectors. Very useful updates are given in such areas as Gaussian beams and ray tracing. The author has, in this edition, accepted the inevitable convention of a right-handed coordinate system for ray tracing.

In summary, the volume is as useful and practical as the first edition, has the substance and excellent communication of the first edition, and should be purchased by anyone who has any interest in doing optical engineering correctly. Readers will not find explanations of most of the new electro-optical concepts and will find only a very terse review of such topics

as fiber optics, lasers, imaging detectors, gradient index,  $y$ -bar diagrams, matrix optics, and other such subjects. Readers will, however, find the tools, explanations, and understanding necessary for carrying out the engineering of those imaging systems that compose the vast majority of optics that are produced today and in the future.

### Quantitative Coherent Imaging: Theory, Methods and Some Applications

J. M. Blackledge. Vol. 11, Techniques of Physics, N. H. March, series editor. vii + 362 pp., illus., index, bibliography following each chapter. ISBN 0-12-103300-7. Academic Press Limited, 24-28 Oval Road, London NW1 7DX England, U.K. (1989) \$32 hardbound.

Reviewed by Steven Cartwright, ERIM, Fairborn, OH 45324-6208.

As stated in the preface, this book "is concerned with the principles of interpreting the structure and material properties of objects by the way in which they scatter electromagnetic and acoustic radiation." The book is divided into three sections. The first provides the basic mathematics to understand both electromagnetic and acoustic scattering. The next section presents several examples of scattering, which show how material parameters may be recovered from the detected fields. The final section presents several methods of digital image enhancement. It is an ambitious effort.

Chapter 1 lays out the basic premise of the book, including the restriction to problems in which the phase of the scattered field is measured. Chapter 2 introduces the basic concepts of Fourier analysis, as well as the Hilbert transform and the analytic signal representation. Also included are several sample FORTRAN programs for fast Fourier transforms and convolutions. In Chap. 3 the author covers scattering theory using Green's functions. He derives the functions separately for different dimensionalities and for the time-dependent case. He next derives the basic scattering equa-

tions (via the first Born approximation) for both electromagnetic and acoustic waves.

Chapter 4 starts the second section with a discussion of quantitative imaging of layered media for both electromagnetic and acoustic scattering. While not strictly a coherent imaging technique, projection tomography is covered in Chap. 5, both for its general interest and the foundation it lays for Chap. 6, diffraction tomography. In projection tomography the scattering wavelength is sufficiently small that the radiation may be treated like geometric rays. As the name implies, diffraction tomography takes diffraction effects into account. Chapter 7 finishes the section with a discussion of synthetic aperture radar and (to a lesser extent) sonar.

The last section starts with Chap. 8, which covers linear methods of deconvolving image data. Chapter 9 covers nonlinear methods of deconvolving image data, and Chap. 10 addresses the question of superresolution. Chapter 11 presents techniques of image enhancement, including histogram equalization, homomorphic filtering, and high-pass filtering. Chapter 12, the last chapter, is about noise reduction. All except Chap. 10 present sample FORTRAN programs of the different image processing techniques.

The level of mathematics and physics in this book is more difficult than that presented in most books on imaging. The casual reader will find it daunting, but the developments are actually straightforward and clearly explained. Unfortunately, covering this many topics at this level weighs against extensive discussions of the derivation, and so the equations are sometimes left standing as a bare framework. Occasionally, derivations pile up at the end of a chapter, rather like a professor trying to fit in just one more equation before class is over. Each chapter includes a few references labeled "Further Reading." This is appropriate since any one of these sections could fill a text in itself.

Because this book brings together so many diverse topics and does so at a comprehensive level, I would recommend it as the basis of a graduate-level course in imaging.