

# DEPARTMENTS

## BOOK REVIEWS

### Theory and Applications of Optical Remote Sensing

Edited by Ghassem Asrar, xiv + 734 pages, illus., subject index, references, list of contributors. ISBN 0-471-62895-6. John Wiley & Sons, 605 Third Ave., New York, NY 10158 (1989) \$91.95 hardbound.

Reviewed by Susan L. Ustin, University of California, Department of Land, Air, and Water Resources, Davis, CA 95616.

This book covers a broad range of practical advice, principles, and applications of remote sensing. It demonstrates how the same basic measurements, covering the 0.40- through 16- $\mu\text{m}$  spectral region, are used in diverse earth science disciplines concerned with understanding terrestrial conditions and processes. Published three years ago, the book remains a valuable and up-to-date reference for most topics other than recent innovations in high spectral resolution imaging spectrometry. This book is unique in its attempt to encompass both theoretical and applied aspects over the breadth of terrestrial remote sensing research. It is a valuable reference work directed toward the environmental scientist interested in better understanding the interdisciplinary requirements needed for interpreting remotely sensed data.

The book brings together detailed and comprehensive reviews of many diverse topics and includes extensive references and lists of symbols with their descriptions in each chapter. The book could be considered as the basis for a graduate course in remote sensing and earth system science, even though its scope is broader than what would be covered in traditional courses. The level of mathematics and the diversity of subject matter may be daunting for casual readers; however, I know of no other source that provides a comparable level of information on the underlying physical, chemical, and biological basis for spectral reflectance

and emission properties of terrestrial surfaces.

The book is organized into 18 chapters, with major topic areas that include soils and geology; plant canopy modeling; atmospheric effects; applications in ecology, hydrology, biometeorology; and future directions in ecological remote sensing. Each chapter is an individual contribution and stands independently; therefore, writing styles, depth, and treatment of subject matter varies considerably between chapters. Nonetheless, there is little duplication of discussion and the chapters generally complement each other. The subject index is not always complete and it is sometimes difficult to locate subjects discussed in several chapters.

Chapter 1 by G. Asrar provides a review of current satellites and a good explanation of radiometric calibration as well as a brief outline of the topics in other chapters. Chapter 2 by D. W. Derring provides good practical advice on field measurements and a review of sensors for measuring bidirectional reflectance.

Chapter 3 by J. R. Irons et al. reviews general soil properties and interactions of matter with electromagnetic energy to explain vibrational and electronic energy transitions and their effects on reflectance spectra. This chapter also presents examples of the types of spectral variation encountered and the factors that affect reflectance. A. R. Huete discusses the influence of soils and atmospheric effects on canopy spectra in Chap. 4. This chapter provides an excellent review and synthesis of the author's earlier work in addition to an introduction to the soil-adjusted vegetation index.

The next four chapters provide a comprehensive review of current methods for extracting biophysical information about the structure and physiological condition of plant canopies from reflectance spectra. In Chap. 5, R. B. Myneni et al. review the theory of photon transport in canopies. This chapter provides a detailed examination of radiation transport equations and

other theoretical considerations in canopy models. Chapter 6 by N. S. Goel continues this topic by examining the basis for interpreting canopy reflectance models to estimate canopy properties such as leaf area index and leaf angle distribution. G. Asrar et al. in Chap. 7 examine other methods (principally ratios) for estimating absorbed photosynthetically active radiation and canopy structural variables, and they include a discussion of the canopy hot spot. P. J. Sellers in Chap. 8 reviews the basis for extending interpretations of reflectance to canopy biophysical properties, including photosynthesis and transpiration rates along with canopy resistance to flux.

Chapter 9 is a lengthy summary of atmospheric absorption and scattering effects on remotely sensed data, and it also reviews theoretical and empirical correction methods by Y. J. Kaufman.

The next two chapters provide a more empirical approach on applications of remote sensing to ecological studies, and they emphasize spatial attributes and land cover classification to a greater extent than the earlier more theoretical chapters. Chapter 10 by D. L. Peterson and S. W. Running reviews forest management applications in remote sensing. They discuss classification methods for use in management analyses and in spatial and multitemporal change detection. They also present the use of new spectroscopy techniques to measure the biochemical constituents of leaves and their application to the imaging spectrometry of canopies. In Chap. 11, M. F. Gross et al. review the empirical bases for applying red and near infrared reflectance characteristics to determine canopy attributes in coastal wetlands.

A. F. H. Goetz in Chap. 12 reviews the basis for absorption and scattering phenomena for mineral identifications in geologic applications. This chapter includes a review of sensors for multispectral imaging, including the aircraft

scanners, TIMS and AVIRIS, and some newer image analysis techniques, such as the decorrelation stretch and other rotational transformations.

Chapter 13 by J. Dozier reviews the theory and potential for remote sensing of snow properties (grain size, depth, water content, impurities) in visible and reflected infrared wavelengths and presents detailed spectral curves of snow conditions.

In Chap. 14, S. W. Wharton provides an introduction to knowledge-based land surface classification concepts.

The next three chapters focus on remote sensing in the thermal infrared with an emphasis on its use for surface energy budget analysis. Chapter 15 by J. C. Price reviews the theory and quantitative basis for understanding temperatures, emissivity, and energy balance. In Chap. 16, W. P. Kustas et al. discuss methods for estimating energy balance parameters for remotely sensed inputs. B. J. Choudhury in Chap. 17 reviews methods for modeling and estimating carbon and water fluxes through estimates of canopy resistance using thermal infrared measures, and he discusses application of the Crop Water Stress Index.

Chapter 18 by D. E. Wickland provides a view of future directions in ecological research by focusing on issues important for understanding the forces and directions of global biospheric changes and how NASA's Earth System Science programs relate to research requirements.

This book brings together many diverse topics in a comprehensive review that is valuable for scientists working in related environmental fields. I would recommend it to any environmental scientist interested in remote sensing applications.

### Optical Signal Processing: Fundamentals

Pankaj K. Das, xi + 483 pages, illus., subject index, references, bibliography, and appendices. ISBN 0-387-51476-7. Springer-Verlag, Inc., 175 Fifth Ave., New York, NY 10010 (1991) \$59.00 hardbound.

Reviewed by David L. Flannery, University of Dayton Research Institute, Dayton, Ohio 45469-0140

As noted on the back cover, the book *Optical Signal Processing* presents the background material necessary for an understanding of modern optical methods of signal processing. Intended for graduate students in electrical engineering, physics, or optical engineering, this text covers fundamentals. In my opinion the

book does exactly that and does it well. Appropriate phases describing this book include: complete, concise, well organized, well written, broadly scoped yet remarkably detailed and rigorous, generously illustrated, and well suited as a graduate text. Note that the book is the first of two planned volumes. It covers optical and signal processing fundamentals and two devices that support optical signal processing (CCDs and SAWs), while the second volume will cover the remaining optical devices and applications.

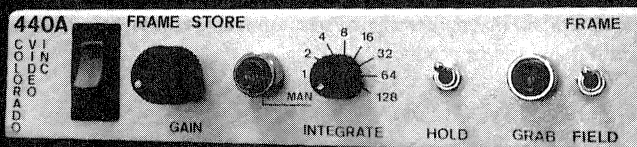
The scope of topics covered in both the optical and signal processing areas is impressive, ranging from basics such as Maxwell's equations and diffraction theory to advanced (or at least esoteric) topics such as Wigner distribution functions. This coverage in less than 500 pages demands well-organized material, heavy reliance on mathematical equations, and efficient use of good illustrations, all of which are accomplished. The book presents a clear, concise treatment of theory and concepts underlying an impressive number of topics within the subject areas, and does so while maintaining considerable mathematical rigor

considering the space available per topic. The high equation content does not tend to overwhelm because of both good writing style and good organization. Although the treatment (in a fundamentals book) is theoretical in emphasis, adequate connection to reality is made to establish context and relevance.

Five appendices (more than 40 pages) cover linear algebra, orthogonal functions, the principle of stationary phase, vectors, and the symmetry properties of crystals. A small but carefully chosen set of references is provided for each chapter as well as a bibliography for further reading. In keeping with the declared textbook orientation, homework problems are provided at the end of each chapter.

This book is highly recommended either for its stated purpose as a graduate text or as a reference covering the basic concepts and theoretical foundations of a major portion of the optics and signal processing areas (particularly for "mature" researchers such as your reviewer, whose formal background in these areas is both questionable and certainly outdated). I look forward to the appearance of the second volume.

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