Absolute Radiometry: Electrically Calibrated Thermal Detectors of Optical Radiation

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This is a nice collection of eight chapters on various aspects of absolute radiometry, which is also called electrical substitution radiometry. It deals with the measurement of flux with a thermal receiver that is calibrated by the dissipation of electrical energy. The chapters are as follows: The Absolute Measurement of Radiant Power (116 pp.), Absorbers of Optical Radiation (23 pp.), Thermal Detectors of Optical Radiation (10 pp.), Analysis of the Temperature Distribution in a Detector Element (13 pp.), Environmental Corrections in Absolute Radiometry (21 pp.), Instrumental Corrections in Absolute Radiometry (36 pp.), Alternative Optical Power Scales (12 pp.), and DC Substitution Methods Used in Other Areas of Metrology (13 pp.). Five of the eight chapters were written by the editor; the other authors were A. Ono, L. P. Boivin, and K. Motsi. Chapter one (Hengstberger), the largest by far, introduces the SI system of units, discusses the fundamentals of radiative transfer, and describes the basics and history of absolute radiometry—from Kurlbaum and Ångström to the work of today. The radiometers of the different Bureau of Standards are described, and in a single table, 47 different instruments are briefly compared in terms of NEP, responsivity, and estimated uncertainty. The latter ranges from 0.004% to 1%! The treatment is more general and descriptive than analytical, but the concepts are well described and ample references are given for those who wish the nitty gritty.

Chapter two (Motsi) describes cavity absorbers; disk absorbers, with and without reflectors; cone absorbers; cylindrical-cone absorbers; and paints (Nextel, Parson's, Eppler-Parson's, Kodak Black Baking Lacquer, Krylon, Chemglaze Z306 and Z302, Metal Blacks, Metal Films, Carbon Blacks, Electrodepositions, and 10 others that have appeared from time to time). The treatment is descriptive, with directional-hemispherical spectral curves for most of the surface coatings, a general idea of how the cones and cavities work, and some of their pitfalls. The reader can count that only about a page is devoted to each of the absorbers.

Chapter three (Hengstberger) covers NEP, NEP, responsivity, detectivity, specific detectivity, and the time constant for describing detector performance and then goes on to discuss thermopiles, bolometers, pyroelectricities, and other possibilities for thermal detection. The responsivity equation for each is given, and the use of the detector in absolute radiometry is described. The treatment is adequate for the purpose but surely does not substitute for one of the good books on infrared detectors already in print.

Chapter four (Ono) seems out of place. It is a very detailed calculation of the temperature distribution in a thermal detector. Classical techniques of heat flow and numerical computations are used for several different configurations.

Chapter five (Boivin) reminds us about and gives quantitative results on corrections needed for diffraction at the aperture, atmospheric absorption, refraction, and filters that are tilted.

Chapter six (Hengstberger) gives general descriptions and calculations of the instrument correlations, with emphasis on those related to lead heating, reflection from the absorber, case heating, diffraction (although the details of the previous chapter are not repeated), non-equivalence, nonuniformity, dual detectors, feedback, aperture area, response nonlinearity, and a few others.

Chapter seven (Hengstberger) discusses the techniques of using blackbody simulators and synchrotrons as standard sources and silicon diodes as standard receivers. The treatment is intentionally brief, but the comparison of these techniques to absolute radiometry is very welcome.

Chapter eight (Hengstberger) is a very brief excursion into calibrations in the microwave region and for particle beams. It lends a nice perspective.

This book arose from the work of a subcommittee on absolute radiometry of the International Commission on Illumination. The group published CIE Technical Report 65 (1985) entitled "Electrically calibrated thermal detectors of optical radiation (absolute radiometers)," in itself a very nice summary of the subject. They felt, however, that they had compiled some additional, valuable material that should not be lost, and they were right. The book covers the subject like a blanket. The exposition is clear, and there are abundant references for the determined reader to pursue. It is very specific in its coverage of absolute radiometry; the audience may be small, but anyone in this field should have the book. If what you want on absolute calibration is not in here, there is a reference to it.

Books Received

Introduction to Surface Roughness and Scattering, by Jean M. Bennett and Lars Mattsson. viii + 110 pp., illus. (with some color plates), subject index, references, two appendixes. ISBN 1-55752-108-5. Optical Society of America, 1816 Jefferson Pl., N.W., Washington, DC 20036 (1989) $44.95 softbound. Defines roughness and discusses how we see and measure this phenomenon. Also covers scattering theories (focusing on classical scattering) and surface statistics.


Optical Recording: A Technical Overview, by Alan B. Marchant. Part of the Addison-
Wesley Series in New Horizons in Technology. xvii + 408 pp., illus., subject index, references following each chapter, glossary of terms and acronyms. ISBN 0-201-76247-1. Addison-Wesley Publishing Co., Inc., 1 Jacob Way, Reading, MA 01867-9984 (1990) $47.50 hardbound. Discusses new applications, optical head technology, formats and codes, and media technology.


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February 1990—Santa Clara, Calif.

These courses will be offered in conjunction with the SPIE/SPIE 1990 Symposium on Electronic Imaging Science and Technology, Feb. 11-16, Santa Clara, Calif.

**Image Sensors**

Scientific Charge-Coupled Devices, James R. Janeck, Jet Propulsion Lab., Sun., 8:00 am-5:00 pm.

Advances in Solid-State Image Sensors, Walter F. Kozonocky, New Jersey Inst. of Technology and David Sarnoff Research Ctr., Wed., 8:00 am-5:00 pm.

Image Tube Technology, Illes P. Csorba, Imaging Tubes Technology, Tues., 8:00 am-noon.

**Image Processing**

Imaging in Medicine: Techniques, Systems and Information, Hans Roehrig, Univ. of Arizona, Sun., 8:00 am-5:00 pm.

Picture Archiving and Communication Systems, William J. Dallas, Univ. of Arizona, Sun., 8:00 am-noon.

Digital Image Enhancement, Majid Rabbani, Eastman Kodak Research Labs., Sun., 8:00 am-noon.

Digital Image Restoration, Majid Rabbani, Eastman Kodak Research Labs., Sun., 1:30-5:30 pm.

Digital Image Compression, Majid Rabbani, Eastman Kodak Research Labs., Mon., 8:00 am-5:00 pm.

Nonlinear Image Processing, Gonzalo R. Arce, Univ. of Delaware; Edward J. Delp, Purdue Univ.; Sun., 8:00 am-5:00 pm.

Digital Image Processing Fundamentals, Mohan M. Trivedi, Univ. of Pennsylvania, Wed., 8:00 am-5:00 pm.

**Image Storage**

Basics of Magnetic Recording, John C. Mallinson, Univ. of California/San Diego, Sun., 8:00 am-noon.

The Future of Magnetic Recording, John C. Mallinson, Univ. of California/San Diego, Sun., 1:30-5:30 pm.

Principles of Magneto-Optical Data Storage, Masud Mansuripur, Univ. of Arizona, Mon., 8:00 am-5:00 pm.

Read Only Optical Storage: Principles and Practice, David H. Davies, 3M Mountain View Lab., Sun., 1:30-5:30 pm.

Introduction to Signal Processing in Digital Recording, Dennis G. Howe, Eastman Kodak Co., Mon., 8:00 am-5:00 pm.

Design of Digital Servo Control for High Density Magnetic Recording, Hal H. Oetse, IBM Corp., Fri., 8:00 am-5:00 pm.

**Vision**

Colorimetry: A Tool for Device Independent Specification, Roy S. Bens, Rochester Inst. of Technology, Sun., 8:00 am-5:00 pm.

Models of Human Vision, Andrew B. Watson, NASA/Ames Research Ctr., Sun., 8:00 am-noon.