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Book Review

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Optical Metrology for Fluids, Combustion and Solids

Edited by Carolyn Mercer, Kluwer Academic Publishers, Boston, 2003, 459 pp., $219.00

Optical Metrology for Fluids, Combustion and Solids is a collection of reviews addressing various advanced optical diagnostic techniques commonly implemented in the broad areas noted in the title. The methods presented in this volume vary substantially in detail and application. However, the one common theme among the reviews, and the main premise of book as espoused by the editor in the preface, is the increasingly clever use of light to study fundamental physical processes. This focus is certainly different from that of most other measurement-method books where the field of study, i.e., fluid mechanics, solid mechanics, etc., is the common linkage. This text will therefore appeal to a broader audience than most other similar collections. In addition, although optical methods have been used for many years in qualitative ways, this volume presents critical advances made in *quantitative* optical techniques. Furthermore, publication of this volume is timely since advanced optical diagnostics are rapidly becoming methods of choice for both fluid and solid mechanicians. In particular, because the contributing authors are leaders in their respective fields, this volume provides readers with insightful and comprehensive discussions of the current state of the art in advanced optical diagnostics.

The chapters of this volume represent reviews of different optical techniques, rendering each chapter essentially independent from the others. The text is loosely divided into three sections, with the first four chapters dedicated to diagnostics for studying fluid motion, including schlieren, interferometry, particle image velocimetry, and molecular Rayleigh scattering. Chapters 5–8 represent reviews of combustion-related methodologies, including spray diagnostics, imaging using fluorescence and elastic scattering, tunable laser diode sensors, and particulate measurement methods. Chapters 9–14 are then devoted to the latest optical methods associated with solid surfaces, including luminescent paints, pyrometry, shear-stress measurements, fiber-grating strain sensors, and surface deformation and damage detection methods. Clearly the spectrum of topics addressed in this collection is quite broad, although some crucial optical diagnostic methods are not included (planar laser-induced fluorescence, for example). Notwithstanding one or two questionable omissions, the deliberate breadth of this book does not detract from its quality. Rather, the number and variety of techniques presented effectively demonstrates how important the use of light as a measurement tool has become in many areas of science and engineering. This defining characteristic makes this collection a comprehensive reference for students and researchers in many different fields.

All of the reviews are well-written and replete with insightful figures. The reviews also share a common structure, consisting of ample historical perspective, adequate discussion of the basic principles of the technique considered, suitable examples of how the technique has been successfully applied in a given field, and at least some discussion of future trends. Most important, however, the reviews appear to be well balanced. That is, each review appropriately espouses the definite advantages and cleverness of the technique being presented. However, in most of the reviews, this discussion is properly balanced with sufficient discussion of errors associated with a given technique, as well as a fair accounting of the limitations of the methodology. This reasonable assessment of each method is essential in any credible review, most especially for the benefit of readers who are not at all familiar with a technique. The editor and the authors should be commended for this consistency among the reviews. In addition, a CD-ROM containing multimedia presentations of some of the techniques is included with this volume. This additional material aids in highlighting the true virtues of the presented methodologies. Unfortunately, this feature of the collection is not utilized to its full potential, with only 6 of the 14 chapters having associated supplementary material on the CD-ROM.

Since each review is written by a different set of authors, there are some obvious stylistic differences in the way the material is presented from one chapter to the next. In particular, some of the authors are able to bridge the delicate gap between basic material and advanced concepts for the average reader. In contrast, other authors have chosen to include only the very basic principles of a technique. This deficiency is overcome by the comprehensive bibliographies included at the end of nearly all of the chapters, allowing interested readers to explore these techniques in greater detail on their own. Additionally, there is some redundancy in the presentation of certain concepts in multiple chapters because similar material is germane to more than one technique. This redundancy is not excessive, does not take away from the quality of the volume, and is inevitable since the reviews are independent from one another. Despite these issues, on the whole this volume provides the reader with

a comprehensive introduction into the current state of the art in optical metrology in fluids, combustion and solids.

Optical Metrology for Fluids, Combustion and Solids might serve as an appropriate reference for a graduate-level survey course in optical methods of science and engineering where a broad variety of techniques are to be presented. However, its greatest impact will be with novice researchers who are interested in becoming active users of advanced optical diagnostics. This audience, in particular, will find at least portions of this collection, depending on their specific research interests, quite helpful in learning and understanding how to implement one or more of these methods in their own research program.

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