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Book Reviews

Inverse Source Problems in Optics

Edited by H. BALTES

Topics in Current Physics, 9

Springer-Verlag, Berlin, Heidelberg, New York 1978
(pp. i – x + 204)

This is the first book devoted exclusively to the inverse source problem that has ever appeared and only this fact is important enough to welcome this publication with the greatest interest.

The book starts with explaining the fundamental of the inverse source problem, whereby the formal definitions are completed by a short survey of important special cases which illustrate the physical range and applicability of the problem. Then the methods of solution of the phase reconstruction problem are discussed in a systematic way for different types of scattering objects (sources), available (measured) data, the special attention being given to the far field data), and the special techniques (filtering) used. Next the uniqueness of the reconstructing procedure is extensively discussed, including the specific situation occurring in the case of the so-called nonradiating sources and taking account of the role, which is played by the prior knowledge. The last three chapters are devoted to: the spatial resolution of subwavelength sources (superresolution) as recoverable from the far field data, the relationship between the correlations appearing in a variety of source types and the radiometrically measurable quantities (e.g. radiant intensity, radiant fluctuations, angular coherence of first and second orders), and, finally, the discussion of the statistical properties of the phase source from scattering data.

As it can be easily seen from the above, the concept of the book is quite original. Thus – became of its precursory character – the editor and the contributors were certainly faced with a number of more difficult than usually problems concerning the selection of material and the way of its presentation. As a result, not all the details of the book could be perfectly prepared. This is the more understandable that the book bears all symptoms of a quick publication of the modern achievements in the field in question. The presentation is very compact, but sometimes too laconic and not even stylistically, e.g. the language differing considerably from one chapter to another does not either facillitate the studying. This may render some difficulties to the readers not much familiar with the inverse source problems.

For these reasons I could not recommend this book as a first-step text book for the beginners. However, the more advanced students as well as the scientific workers involved in the problem discussed will certainly enjoy the intelectual, methodological and (the last but not least) physical content of this book, the practical value of which laying, among others, in offering a systematized review of ordered and interrelated topics (otherwise available in the literature in the "atomized" from). This gives the reader a chance of being quickly introduced into the whole complexity of the inverse source problem. A certain incompleteness of the treatment presented in this book is due to the fact that the measurable quantities (like radiant intensity) were considered in an idealized way, i.e. as being perfectly measurable without any

mention of measuremental restrictions coming from finite sizes of the realizable "point" detectors or the finite number of sampling points available in practice. The positive result of this idealization is the obvious simplification of the analysis, which, however, seems to be worth mentioning in the book of such extent.

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Matrix Theory of Photoelasticity

Springer Series in Optical Sciences, Vol. 11

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[pp. i–xi + 352]

In the development of any discipline of science it is felt from time to time that a kind of treatment summarizing its actual state of affair is needed. It is so, in particular, when there appear some new elements of essential influence on the interpretation of phenomena or on research methods including new mathematical tools applied. Such a monographic treatment offers usually several possibilities. For the experts it may serve as a starting basis for further investigations, for less advanced it offers a good chance to deepen their knowledge without tedious studying the nonordered contributory literature spread over many literature sources, finally, for teachers it may present a systematized material for the lectures (which may require, however, some deepening of certain fragments and some modification of others to adjust them to specific needs of the particular students). An intermediate reason for the authors to elaborate this monograph seemed to be the introduction of matrix calculus to describe the transformations of the polarization state of light in the anisotropic media, which happened in the course of fortees. The matrix calculus allows to avoid the unconvenient manipulations on electric field, which are troublesome and not easy in interpretation, especially in the cases of complex system containing many double-refracting and polarizing elements working in cascade, and to replace these manipulations by a product of respective matrices. The calculations are simplified by the fact that each matrix may represent not only one polarizing element but also a set of many elements. In particular case of photoelasticity the application of the matrix calculus appeared to be extraordinarily advantageous. This application is first the subject of the monograph reviewed. This book is devoted to a literature review of the application of the matrix calculus in three-dimensional photoelasticity (including the original contributions of the authors) aimed at analysis of the state of light polarization and the media of birefringence induced by the stress or strain fields. It also contains a matrix description of the measuring techniques used to determine the changes in polarization states in the stressed media (in addition to the well known methods of Poincaré sphere and the like) and to find the strain itself as the next step of analysis. It is worth to emphasizing that the form of this monograph is elegant, compact and uniform which is not easy to achieve if dealing with so rich and diversified material. The presentation is somehow typical of the applied physics. The authors do not pay much attention to explanations of the fundamental physical phenomena, putting the main emphasis on the technical applications. On the other hand they have happily avoided too detailed utilitarianism by omitting the well known details concerning the measuring technique or the analysis of the measurement results. Thus it may be said that this book is written for those, which known the principles of the subject and want to be aquainted with the applications of the modern mathe-

matical methods to the polarization study in general and to photoelasticity in particular.

What concerns the content of the book it may be shortly stated that this monograph (divided into 13 chapters and containing 352 pages, 96 figures, 46 pages of bibliography, the subject index and the list of authors) is devoted to the following topics:

– An outline of electromagnetic theory of light propagation in anisotropic media.

– Methods of light polarization description (including component of E-vector, Stokes and Jones vectors, Poincaré sphere, j-circles).

– Methods of evaluation of changes in polarizations state of light in birefringent media with the help of Mueller and Jones matrices, Poincaré sphere and the j-circle, and also respective photoelectric and visual measurements by means of polariscopes, as well as some types of compensators (described in the matrix notation).

– Description of photoelasticity phenomenon in two- and three-dimensional spaces based on Neuman–Maxwell stress-optical equations and the equivalence theorem.

– Elastooptic measurements in scattered light.

– Reflection photoelasticity.

– Matrix description in the interferometric and holographic methods in photoelasticity.

– Some graphical and numerical methods for elaboration of measurement results.

Finally I would like to add that having a many year experience in giving lectures in optics of anisotropic media being based also on the matrix calculus I have lastly written a text book on this subject it is may pleasure to state that in the part concerning the photoelectricity the both books are excelently consistent. As a physicist concerned with applied optics I have no objections to recommend this book and I believe that it will be enjoyed by many specialists in the field of photoelasticity.

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