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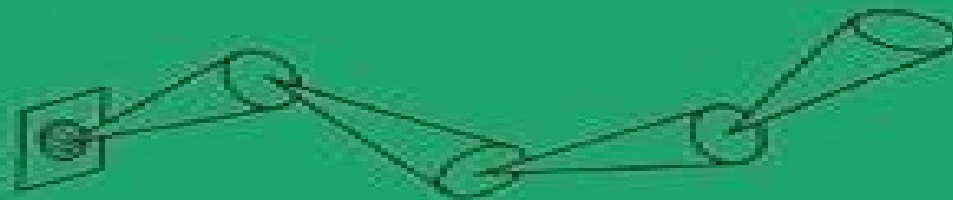## Statistical and Wave Aspects

L.A. Apresyan
Yu.A. Kravtsov

Radiation Transfer Statistical And Wave Aspects

Michael I. Mishchenko

Radiation Transfer Statistical And Wave Aspects:

Radiation Transfer Apresyan,2019-07-16 The authors expound on non traditional phenomena for transfer theory which are nevertheless of considerable interest in wave measurements and bring the advances of transfer theory as close as possible to the practical needs of those working in all areas of wave physics The book opens with a historical overview of the topic then moves on to examine the phenomenological theory of radiative transport blending traditional theory with original ideas The transport equation is derived from first principles and the ensuing discussion of the diffraction content of the transport equation and non classical radiometry is illustrated by practical examples from various fields of physics Popular techniques of solving the transport equation are discussed paying particular attention to wave physics and computing the coherence function The book also examines various problems which are no longer covered by the traditional radiative transfer theory such as enhanced backscattering and weak localization phenomena nonlinear transport problems and kinetic equations for waves This monograph bridges the gap between the simple power balance description in radiative transfer theory and modern coherence theory It will be of interest to researchers and professionals working across a wide range of fields from optics acoustics and radar theory to astrophysics radioastronomy and remote sensing as well as to students in these areas **Analytical Methods in Radiative Transfer** Alexander Kokhanovsky,Vijay Natraj,Dmitry Efremenko,2025-11-24 Provides in depth knowledge of the physics of radiative transfer In Analytical Methods in Radiative Transfer a team of distinguished researchers delivers a comprehensive exploration of solutions to practical problems of modern atmospheric optics related to solar light interaction with the terrestrial atmosphere and the remote sensing of clouds aerosols and gases The authors describe analytic methods in radiative transfer that help explain atmospheric phenomena The book includes discussions on the interaction of solar light with the atmosphere Readers will also benefit from thorough reviews of various analytical radiative transfer techniques for various turbid media including media with phase functions extended in the forward direction and also semi infinite non absorbing weakly absorbing and strongly absorbing light scattering media Analytical Methods in Radiative Transfer also includes A thorough introduction to exact solutions of the radiative transfer equation including situations of single scattering as well as isotropic and Rayleigh scattering A comprehensive exploration of approximate solutions for scalar radiative transfer including single and multiple light scattering separation and the case of semi infinite media such as snow In depth examinations of the applications of analytical methods in atmospheric radiative transfer including aerosol remote sensing cloud remote sensing and the remote sensing of trace gases Perfect for meteorologists climatologists and graduate students studying physics Analytical Methods in Radiative Transfer is also an indispensable resource for geophysicists seeking a practical exploration of modern atmospheric optics *Springer Series in Light Scattering* Alexander Kokhanovsky,2017-12-22 This book presents a survey of modern theoretical and experimental techniques in studies of light scattering phenomena and radiative transfer processes in random

media It presents reviews on light scattering by sea water and bubbles and includes a separate chapter addressing studies of the remote sensing of crystalline clouds with a focus on the shape of particles a parameter rarely studied by passive remote sensing techniques In particular it offers a comprehensive analysis of polarized radiative transfer in optically active e g chiral light scattering media and explores advances in spectro polarimetry of particulate media Lastly it discusses new developments in light scattering for combustion monitoring **Seismic Wave Propagation and Scattering in the Heterogeneous Earth : Second Edition** Haruo Sato,Michael C. Fehler,Takuto Maeda,2012-01-28 Seismic waves generated both by natural earthquakes and by man made sources have produced an enormous amount of information about the Earth s interior In classical seismology the Earth is modeled as a sequence of uniform horizontal layers or spherical shells having different elastic properties and one determines these properties from travel times and dispersion of seismic waves The Earth however is not made of horizontally uniform layers and classic seismic methods can take large scale inhomogeneities into account Smaller scale irregularities on the other hand require other methods Observations of continuous wave trains that follow classic direct S waves known as coda waves have shown that there are heterogeneities of random size scattered randomly throughout the layers of the classic seismic model This book focuses on recent developments in the area of seismic wave propagation and scattering through the randomly heterogeneous structure of the Earth with emphasis on the lithosphere The presentation combines information from many sources to present a coherent introduction to the theory of scattering in acoustic and elastic materials and includes analyses of observations using the theoretical methods developed The second edition especially includes new observational facts such as the spatial variation of medium inhomogeneities and the temporal change in scattering characteristics and recent theoretical developments in the envelope synthesis in random media for the last ten years Mathematics is thoroughly rewritten for improving the readability Written for advanced undergraduates or beginning graduate students of geophysics or planetary sciences this book should also be of interest to civil engineers seismologists acoustical engineers and others interested in wave propagation through inhomogeneous elastic media *Optical Remote Sensing of Ocean Hydrodynamics* Victor Raizer,2019-03-04 Optical Remote Sensing is one of the main technologies used in sea surface monitoring Optical Remote Sensing of Ocean Hydrodynamics investigates and demonstrates capabilities of optical remote sensing technology for enhanced observations and detection of ocean environments It provides extensive knowledge of physical principles and capabilities of optical observations of the oceans at high spatial resolution 1 4m and on the observations of surface wave hydrodynamic processes It also describes the implementation of spectral statistical and fusion algorithms for analyses of multispectral optical databases and establishes physics based criteria for detection of complex wave phenomena and hydrodynamic disturbances including assessment and management of optical databases This book explains the physical principles of high resolution optical imagery of the ocean surface discusses for the first time the capabilities of observing hydrodynamic processes and events and emphasizes the

integration of optical measurements and enhanced data analysis It also covers both the assessment and the interpretation of dynamic multispectral optical databases and includes applications for advanced studies and nonacoustic detection This book is an invaluable resource for researches industry professionals engineers and students working on cross disciplinary problems in ocean hydrodynamics optical remote sensing of the ocean and sea surface remote sensing Readers in the fields of geosciences and remote sensing applied physics oceanography satellite observation technology and optical engineering will learn the theory and practice of optical interactions with the ocean   Advances in Geophysics Haruo Sato,Michael Fehler,2009-02-26 Seismic waves generated by earthquakes have been interpreted to provide us information about the Earth s structure across a variety of scales For short periods of less than 1 second the envelope of seismograms changes significantly with increased travel distance and coda waves are excited by scattering due to randomly distributed heterogeneities in the Earth Deterministic structures such as horizontally uniform velocity layer models in traditional seismology cannot explain these phenomena This book focuses on the Earth heterogeneity and scattering effects on seismic waves Topics covered are recent developments in wave theory and observation including coda wave analysis for mapping medium heterogeneity and monitoring temporal variation of physical properties radiation of short period seismic waves from an earthquake fault weak localization of seismic waves attenuation of seismic waves in randomly porous media synthesis of seismic wave envelopes in short periods and laboratory investigations of ultrasonic wave propagation in rock samples Understanding new methods for the analysis of short period seismic waves to characterize the random heterogeneity of the Earth on many scales Observations of seismic wave scattering Discussion of techniques for mapping medium heterogeneity and for monitoring temporal change in medium characteristics Up to date techniques for the synthesis of wave envelopes in random media   **Principles of Scattering and Transport of Light** Rémi Carminati,John C. Schotland,2021-07-29 Light scattering is one of the most well studied phenomena in nature It occupies a central place in optical physics and plays a key role in multiple fields of science and engineering This volume presents a comprehensive introduction to the subject For the first time the authors bring together in a self contained and systematic manner the physical concepts and mathematical tools that are used in the modern theory of light scattering and transport presenting them in a clear accessible style The power of these tools is demonstrated by a framework that links various aspects of the subject scattering theory to radiative transport radiative transport to diffusion and field correlations to the statistics of speckle patterns For graduate students and researchers in optical physics and optical engineering this book is an invaluable resource on the interaction of light with complex media and the theory of light scattering in disordered and complex systems   **Advances in Passive Microwave Remote Sensing of Oceans** Victor Raizer,2024-09-05 This new edition introduces the fundamentals of passive microwave remote sensing of oceans including the physical principles of microwave radiometry novel observational data their interpretation and applications It not only demonstrates and examines the recent advantages and state of the art of

microwave data but also provides guidance for explaining complex ocean studies and advanced applications All chapters are thoroughly updated with detailed analysis of space based microwave missions and a new chapter on space based microwave radiometer experiments has been added This book discusses the power of microwave remote sensing as an efficient tool for diagnostics of ocean phenomena in research and education Features New to this Edition Includes a new chapter and additional data images illustrations and references Uses ocean microwave data acquired from different platforms to illustrate different methods of analysis and interpretation Updates information on recent and important satellite missions dedicated to microwave remote sensing of oceans Offers more detailed analysis of multiband microwave data and images Provides examples of microwave data that cover different ocean environmental phenomena and hydro physical fields including global and local ocean features Presents additional material on advanced applications including detection capabilities This book is intended for postgraduate students and professionals working in fields related to remote sensing geography oceanography civil environmental and geotechnical engineering **Foundations of Atmospheric Remote Sensing** Dmitry Efremenko,Alexander Kokhanovsky,2021-05-18 Theoretical foundations of atmospheric remote sensing are electromagnetic theory radiative transfer and inversion theory This book provides an overview of these topics in a common context compile the results of recent research as well as fill the gaps where needed The following aspects are covered principles of remote sensing the atmospheric physics foundations of the radiative transfer theory electromagnetic absorption scattering and propagation review of computational techniques in radiative transfer retrieval techniques as well as regularization principles of inversion theory As such the book provides a valuable resource for those who work with remote sensing data and want to get a broad view of theoretical foundations of atmospheric remote sensing The book will be also useful for students and researchers working in such diverse fields like inverse problems atmospheric physics electromagnetic theory and radiative transfer *Remote Sensing of Turbulence* Victor Raizer,2021-10-04 This book offers a unique multidisciplinary integration of the physics of turbulence and remote sensing technology Remote Sensing of Turbulence provides a new vision on the research of turbulence and summarizes the current and future challenges of monitoring turbulence remotely The book emphasizes sophisticated geophysical applications detection and recognition of complex turbulent flows in oceans and the atmosphere Through several techniques based on microwave and optical IR observations the text explores the technological capabilities and tools for the detection of turbulence their signatures and variability FEATURES Covers the fundamental aspects of turbulence problems with a broad geophysical scope for a wide audience of readers Provides a complete description of remote sensing capabilities for observing turbulence in the earth s environment Establishes the state of the art remote sensing techniques and methods of data analysis for turbulence detection Investigates and evaluates turbulence detection signatures their properties and variability Provides cutting edge remote sensing applications for space based monitoring and forecasts of turbulence in oceans and the atmosphere This book is a great resource for applied physicists the

professional remote sensing community ecologists geophysicists and earth scientists **Electromagnetic Scattering by Particles and Particle Groups** Michael I. Mishchenko,2014-04-24 This self contained and accessible book provides a thorough introduction to the basic physical and mathematical principles required in studying the scattering and absorption of light and other electromagnetic radiation by particles and particle groups For the first time the theories of electromagnetic scattering radiative transfer and weak localization are combined into a unified consistent branch of physical optics directly based on the Maxwell equations A particular focus is given to key aspects such as time and ensemble averaging at different scales ergodicity and the physical nature of measurements afforded by actual photopolarimeters Featuring over 120 end of chapter exercises with hints and solutions provided this clear one stop resource is ideal for self study or classroom use and will be invaluable to both graduate students and researchers in remote sensing physical and biomedical optics optical communications optical particle characterization atmospheric physics and astrophysics **New Directions in Linear Acoustics and Vibration** Matthew Wright,Richard Weaver,2010-07-26 Linear acoustics was thought to be fully encapsulated in physics texts of the 1950s but this view has been changed by developments in physics during the last four decades There is a significant new amount of theory that can be used to address problems in linear acoustics and vibration but only a small amount of reported work does so This book is an attempt to bridge the gap between theoreticians and practitioners as well as the gap between quantum and acoustic Tutorial chapters provide introductions to each of the major aspects of the physical theory and are written using the appropriate terminology of the acoustical community The book will act as a quick start guide to the new methods while providing a wide ranging introduction to the physical concepts

Scattering, Absorption, and Emission of Light by Small Particles Michael I. Mishchenko,Larry D. Travis,Andrew A. Lacis,2002-06-06 A thorough and up to date treatment of electromagnetic scattering by small particles **Passive Microwave Remote Sensing of the Earth** Eugene A. Sharkov,2003-12-16 This book represents the most comprehensive description of the physical foundations of methods and instruments in the fields of passive remote sensing applied to investigations of the Earth Solar system bodies and space Emphasis is placed on the physical aspects necessary to judge the possibilities and limitations of passive remote sensing methods in specific observation cases Numerous practical applications and illustrations are given referring to airspace up to date experiments Due to the lack in traditional separation on methods and instruments of remote sensing of the Earth and outerterrestrial space this book aims to supply more information in this field Optical Thin Films and Coatings Angela Piegari,François Flory,2018-06-19 Optical Thin Films and Coatings From Materials to Applications Second Edition provides an overview of thin film materials and their properties design and manufacture across a wide variety of application areas Sections explore their design and manufacture and their unconventional features including the scattering properties of random structures in thin films optical properties at short wavelengths thermal properties and color effects Other chapters focus on novel materials including organic optical coatings

surface multiplasmonics optical thin films containing quantum dots and optical coatings including laser components solar cells displays and lighting and architectural and automotive glass The book presents a technical resource for researchers and engineers working with optical thin films and coatings It is also ideal for professionals in the security automotive space and other industries who need an understanding of the topic Provides thorough review of applications of optical coatings including laser components solar cells glazing displays and lighting One stop reference that addresses deposition techniques properties and applications of optical thin films and coatings Novel methods suggestions for analysis and applications makes this a valuable resource for experts in the field as well **Sound-Flow Interactions** Y. Auregan,A. Maurel,V. Pagneux,J.-F. Pinton,2007-06-18 The coupling between acoustic waves and fluid flow motion is basically nonlinear with the result that flow and sound modify themselves reciprocally with respect to generation and propagation properties As a result this problem is investigated by many different communities such as applied mathematics acoustics and fluid mechanics This book is the result of an international school which was held to discuss the foundation of sound flow interactions to share expertise and methodologies and to promote cross fertilization between the different disciplines involved It consists essentially of a set of pedagogical lectures and is meant to serve not only as a compact source of reference for the experienced researcher but also as an advanced textbook for postgraduate students and nonspecialists wishing to familiarize themselves in depth at a research level with this fascinating subject **Stochastic Equations through the Eye of the Physicist** Valery I. Klyatskin,2005-05-20 Fluctuating parameters appear in a variety of physical systems and phenomena They typically come either as random forces sources or advecting velocities or media material parameters like refraction index conductivity diffusivity etc The well known example of Brownian particle suspended in fluid and subjected to random molecular bombardment laid the foundation for modern stochastic calculus and statistical physics Other important examples include turbulent transport and diffusion of particle tracers pollutants or continuous densities oil slicks wave propagation and scattering in randomly inhomogeneous media for instance light or sound propagating in the turbulent atmosphere Such models naturally render to statistical description where the input parameters and solutions are expressed by random processes and fields The fundamental problem of stochastic dynamics is to identify the essential characteristics of system its state and evolution and relate those to the input parameters of the system and initial data This raises a host of challenging mathematical issues One could rarely solve such systems exactly or approximately in a closed analytic form and their solutions depend in a complicated implicit manner on the initial boundary data forcing and system s media parameters In mathematical terms such solution becomes a complicated nonlinear functional of random fields and processes Part I gives mathematical formulation for the basic physical models of transport diffusion propagation and develops some analytic tools Part II and III sets up and applies the techniques of variational calculus and stochastic analysis like Fokker Plank equation to those models to produce exact or approximate solutions or in worst case numeric procedures The exposition is motivated and

demonstrated with numerous examples Part IV takes up issues for the coherent phenomena in stochastic dynamical systems described by ordinary and partial differential equations like wave propagation in randomly layered media localization turbulent advection of passive tracers clustering wave propagation in disordered 2D and 3D media For the sake of reader I provide several appendixes Part V that give many technical mathematical details needed in the book For scientists dealing with stochastic dynamic systems in different areas such as hydrodynamics acoustics radio wave physics theoretical and mathematical physics and applied mathematics The theory of stochastic in terms of the functional analysis Referencing those papers which are used or discussed in this book and also recent review papers with extensive bibliography on the subject

Encyclopedia of Optical Engineering: Las-Pho, pages 1025-2048 Ronald G. Driggers,2003 Compiled by 330 of the most widely respected names in the electro optical sciences the Encyclopedia is destined to serve as the premiere guide in the field with nearly 2000 figures 560 photographs 260 tables and 3800 equations From astronomy to x ray optics this reference contains more than 230 vivid entries examining the most intriguing technological advances and perspectives from distinguished professionals around the globe The contributors have selected topics of utmost importance in areas including digital image enhancement biological modeling biomedical spectroscopy and ocean optics providing thorough coverage of recent applications in this continually expanding field **Light Scattering Reviews 5** Alexander A. Kokhanovsky,2010-08-05 Light scattering by densely packed inhomogeneous media is a particularly ch lenging optics problem In most cases only approximate methods are used for the calculations However in the case where only a small number of macroscopic sc tering particles are in contact clusters or aggregates it is possible to obtain exact results solving Maxwell s equations Simulations are possible however only for a relativelysmallnumberofparticles especiallyiftheirsizesarelargerthanthewa length of incident light The rst review chapter in PartI of this volume prepared by Yasuhiko Okada presents modern numerical techniques used for the simulation of optical characteristics of densely packed groups of spherical particles In this case Mie theory cannot provide accurate results because particles are located in the near eld of each other and strongly interact As a matter of fact Maxwell s equations must be solved not for each particle separately but for the ensemble as a whole in this case The author describes techniques for the generation of shapes of aggregates The orientation averaging is performed by a numerical integration with respect to Euler angles The numerical aspects of various techniques such as the T matrix method discrete dipole approximation the nite di erence time domain method e ective medium theory and generalized multi particle Mie so tion are presented Recent advances in numerical techniques such as the grouping and adding method and also numerical orientation averaging using a Monte Carlo method are discussed in great depth *Journal of the Optical Society of America* ,2005

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