Joseph W. Goodman

STATISTICAL OPTICS

Second Edition

Statistical Optics

B.Roy Frieden

Statistical Optics:

Statistical Optics Joseph W. Goodman,2015-05-04 This book discusses statistical methods that are useful for treating problems in modern optics and the application of these methods to solving a variety of such problems This book covers a variety of statistical problems in optics including both theory and applications The text covers the necessary background in statistics statistical properties of light waves of various types the theory of partial coherence and its applications imaging with partially coherent light atmospheric degradations of images and noise limitations in the detection of light New topics have been introduced in the second edition including Analysis of the Vander Pol oscillator model of laser light Coverage on coherence tomography and coherence multiplexing of fiber sensors An expansion of the chapter on imaging with partially coherent light including several new examples An expanded section on speckle and its properties New sections on the cross spectrum and bispectrum techniques for obtaining images free from atmospheric distortions A new section on imaging through atmospheric turbulence using coherent light The addition of the effects of read noise to the discussions of limitations encountered in detecting very weak optical signals A number of new problems and many new references have been added Statistical Optics Second Edition is written for researchers and engineering students interested in optics physicists and chemists as well as graduate level courses in a University Engineering or Physics Department   **Statistical Optics** Joseph W. Goodman,1985-02 Good No Highlights No Markup all pages are intact Slight Shelfwear may have the corners slightly dented may have slight color changes slightly damaged spine   *Theoretical Statistical Optics* Olga Korotkova,2021-08-10 This monograph overviews classic and recent developments in theoretical statistical optics in connection with stationary and non stationary pulsed optical source characterization and modeling discusses various phenomena occurring with random light propagating in free space on its interaction with optical systems extended media and particulate collections The text includes scalar beam like and general electromagnetic treatment of light A brief statistical description of four fundamental experiments relating to random light spatial and temporal field interference intensity interferometry and phase conjugation is also included in order to relate the analytical descriptions with practical observations Rigorous mathematical methods for statistical manipulation of light sources useful for remote shaping of its various average properties enhanced image resolution optimized transmission in random media and for other applications are introduced For illustration of efficient ways for manipulation of light polarization the generalized Stokes Mueller calculus is applied for description of interaction of beam like fields with classic and currently popular devices of polarization optics including a spatial light modulator Random light plays a special role in the image formation process Three imaging modalities including the classic intensity based system with structured source correlations the polarization based imaging system and the ghost interference approach are discussed in detail Theoretical aspects of potential scattering of light from weakly scattering media are considered under a very broad range of assumptions scalar electromagnetic incident light deterministic random light media single particulate media Then

problems and methods in light characterization on interaction with extended turbulent like natural media such as the Earth s atmosphere oceans and soft bio tissues that are currently widely used for communication remote sensing and imaging purposes in these media are provided **Probability, Statistical Optics, and Data Testing** Roy Frieden,2001-07-17 Scientists in optics are increasingly confronted with problems that are of a random nature and that require a working knowledge of probability and statistics for their solution This textbook develops these subjects within the context of optics using a problem solving approach All methods are explicitly derived and can be traced back to three simple axioms given at the outset Students with some previous exposure to Fourier optics or linear theory will find the material particularly absorbing and easy to understand This third edition contains many new applications to optical and physical phenomena This includes a method of estimating probability laws exactly by regarding them as laws of physics to be determined using a new variational principle **Probability, Statistical Optics, and Data Testing** Roy Frieden,2011-04-27 Introduction to Statistical Optics Edward L. O'Neill,2003-01-01 Authoritative introduction covers the role of Green s function in mathematical physics essential differences between spatial and time filters fundamental relations of paraxial optics and effects of aberration terms on image formation An excellent book well organized and well written Journal of the Optical Society of America 80 illustrations 1963 edition Statistical Optics J.W. Goodman, Demonstrational Optics Oleg Marchenko,Sergi Kazantsev,Laurentius Windholz,2009-06-02 Demonstrational Optics presents a new didactical approach to the study of optics Emphasizing the importance of elaborate new experimental demonstrations pictorial illustrations computer simulations and models of optical phenomena in order to ensure a deeper understanding of wave and geometric optics It includes problems focused on the pragmatic needs of students secondary school teachers university professors and optical engineers Part 2 Coherent and Statistical Optics contains chapters on interference diffraction Fourier optics light quanta thermal radiation Shot noise and Gaussian light Correlation of light fields and Correlation of light intensities A substantial part of this volume is devoted to thermal radiation and its properties especially with partial coherence A detailed treatment of the photo effect with respect to statistical properties leads to the basics of statistical optics To illustrate the phenomena covered by this volume a large number of demonstration experiments are described and discussed In the chapters devoted to statistical phenomena computer simulations are described the code of all relevant programs being included **Probability, Statistical Optics, and Data Testing** B.Roy Frieden,2012-12-06 This new edition incorporates corrections of all known typographical errors in the first edition as well as some more substantive changes Chief among the latter is the addition of Chap 17 on methods of estimation As with the rest of the text most applications and examples cited in the new chapter are from the optical perspective The intention behind this new chapter is to empower the optical researcher with a yet broader range of research tools Certainly a basic knowledge of estimation methods should be among these In particular the sections on likelihood theory and Fisher information prepare readers for the problems of optical parameter

estimation and probability law estimation Physicists and optical scientists might find this material particularly useful since the subject of Fisher information is generally not covered in standard physical science curricula Since the words statistical optics are prominent in the title of this book their meaning needs to be clarified There is a general tendency to overly emphasize the statistics of photons as the sine qua non of statistical optics In view is taken which equally emphasizes the random medium this text a wider that surrounds the photon be it a photographic emulsion the turbulent atmo sphere a vibrating lens holder etc Also included are random interpretations of ostensibly deterministic phenomena such as the Hurter Driffield H and D curve of photography Such a random interpretation sometimes breaks new ground as in Chap

Statistical Optics Nathan Grier Parke,1949 **Statistical Optics : Radiation** Nathan Grier Parke III.,1949

Fundamentals of Photonics Bahaa E. A. Saleh,Malvin Carl Teich,2020-03-04 Fundamentals of Photonics A complete thoroughly updated full color third edition Fundamentals of Photonics Third Edition is a self contained and up to date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics Featuring a blend of theory and applications coverage includes detailed accounts of the primary theories of light including ray optics wave optics electromagnetic optics and photon optics as well as the interaction of light and matter Presented at increasing levels of complexity preliminary sections build toward more advanced topics such as Fourier optics and holography photonic crystal optics guided wave and fiber optics LEDs and lasers acousto optic and electro optic devices nonlinear optical devices ultrafast optics optical interconnects and switches and optical fiber communications The third edition features an entirely new chapter on the optics of metals and plasmonic devices Each chapter contains highlighted equations exercises problems summaries and selected reading lists Examples of real systems are included to emphasize the concepts governing applications of current interest Each of the twenty four chapters of the second edition has been thoroughly updated

Imaging Through Turbulence Michael C. Roggemann,Byron M. Welsh,2018-02-06 Learn how to overcome resolution limitations caused by atmospheric turbulence in Imaging Through Turbulence This hands on book thoroughly discusses the nature of turbulence effects on optical imaging systems techniques used to overcome these effects performance analysis methods and representative examples of performance Neatly pulling together widely scattered material it covers Fourier and statistical optics turbulence effects on imaging systems simulation of turbulence effects and correction techniques speckle imaging adaptive optics and hybrid imaging Imaging Through Turbulence is written in tutorial style logically guiding you through these essential topics It helps you bring down to earth the complexities of coping with turbulence **Single-Sensor Imaging** Rastislav Lukac,2018-10-03 A Decade of Extraordinary Growth The past decade has brought a surge of growth in the technologies for digital color imaging multidimensional signal processing and visual scene analysis These advances have been crucial to developing new camera driven applications and commercial products in digital photography Single Sensor Imaging Methods and Applications for Digital Cameras embraces this extraordinary progress comprehensively covering state

of the art systems processing techniques and emerging applications Experts Address Challenges and Trends Single Sensor Imaging Methods and Applications for Digital Cameras presents leading experts elucidating their own accomplishments in developing the technologies reshaping this field The editor invited renowned authorities to address specific research challenges and recent trends in their particular areas of expertise The book discusses single sensor digital color imaging fundamentals including reusable embedded software platform digital camera image processing chain optical filter and color filter array designs It also details the latest techniques and approaches in contemporary and traditional digital camera color image processing and analysis for various sophisticated applications including Demosaicking and color restoration White balancing and color transfer Color and exposure correction Image denoising and color enhancement Image compression and storage formats Red eye detection and removal Image resizing Video demosaicking and superresolution imaging Image and video stabilization A Solid Foundation of Knowledge to Solve Problems Single Sensor Imaging Methods and Applications for Digital Cameras builds a strong fundamental understanding of theory and methods for solving many of today s most interesting and challenging problems in digital color image and video acquisition analysis processing and storage A broad survey of the existing solutions and relevant literature makes this book a valuable resource both for researchers and those applying rapidly evolving digital camera technologies **Probability, Statistical Optics, and Data Testing** B.R. Frieden,1982-12-01 A basic skill in probability is practically demanded nowadays in many bran ches of optics especially in image science On the other hand there is no text presently available that develops probability and its companion fields stochastic processes and statistics from the optical perspective Short of a book a chapter was recently written for this purpose see B R Frieden ed The Computer in Optical Research Topics in Applied Physics Vol 41 Springer Berlin Heidelberg New York 1980 Chap 3 Most standard texts either use illustrative examples and problems from electrical engineering or from the life sciences The present book is meant to remedy this situation by teaching probability with the specific needs of the optical researcher in mind Virtually all the illustrative examples and applications of the theory are from image science and other fields of optics One might say that photons have replaced electrons in nearly all considera tions here We hope in this manner to make the learning of probability a pleasant and absorbing experience for optical workers Some of the remaining applications are from information theory a con cept which complements image science in particular As will be seen there are numerous tie ins between the two concepts Students will be adequately prepared for the material in this book if they have had a course in calculus and know the basics of matrix manipulation Statistical Methods in Quantum Optics 1 Howard J. Carmichael,2013-04-17 As a graduate student working in quantum optics I encountered the question that might be taken as the theme of this book The question definitely arose at that time though it was not yet very clearly defined there was simply some deep irritation caused by the work I was doing something quite fundamental I did not understand Of course so many things are not understood when one is a graduate student However my nagging question was not a technical issue not merely

a mathematical concept that was difficult to grasp It was a sense that certain elementary notions that are accepted as starting points for work in quantum optics somehow had no fundamental foundation no identifiable root My inclination was to mine physics vertically and here was a subject whose tunnels were dug horizontally There were branches certainly going up and going down Nonetheless something major in the downwards direction was missing at least in my understanding no doubt others understood the connections downwards very well In retrospect I can identify the irritation Quantum optics deals primarily with dynamics quantum dynamics and in doing so makes extensive use of words like quantum fluctuations and quantum noise The words seem harmless enough Surely the ideas behind them are quite clear after all quantum mechanics is a statistical theory and in its dynamical aspects it is therefore a theory of fluctuations But there was my problem Nothing in Schrodinger s equation fluctuates **Image Processing for Cinema** Marcelo Bertalmio,2014-02-04 Image Processing for Cinema presents a detailed overview of image processing techniques that are used in practice in digital cinema The book shows how image processing has become ubiquitous in movie making from shooting to exhibition It covers all the ways in which image processing algorithms are used to enhance restore adapt and convert movi Computational Optical Coherence and Statistical Optics Milo W. Hyde,2023 Computational Optical Coherence and Statistical Optics presents current approaches for simulating random optical fields with prescribed statistical properties The book first reviews the key theoretical concepts of statistical optics and classic optical coherence theory then demonstrates how to simulate optical fields with arbitrary states of temporal and spatial coherence in numerous detailed examples Building on the techniques developed earlier in the text the book culminates in the final two chapters with simulations of the double slit or Young s experiment a Michelson interferometer the Hanbury Brown and Twiss effect imaging with partially coherent light and non stationary or pulsed partially coherent beams All of the simulations are written in the MATLAB scripting language m files explained in detail throughout the text and included as part of the book Computational Optical Coherence and Statistical Optics will benefit students studying statistical optics as well as researchers and engineers working on applications which deal with or exploit optical coherence e g astronomy optical coherence tomography beam shaping ghost imaging speckle mitigation etc In addition this book will be of use to instructors or teachers of statistical optics Using the simulation approaches presented in the book instructors can create demonstrations of foundational statistical optics concepts which will augment the theory presented in the classic pedagogical texts by J Goodman and E Wolf **Statistical and Quantum Optics** S. Chopra,2014 Provides a clear up to date and comprehensive introduction to the recent field of modern optics dealing with coherence and fluctuations of light The first two chapters discuss the statistical frame work needed for later part of the book followed by systematic account of coherence theory with a detailed discussed on photon statistics Description of quantum theory of coherence is preceded by a introductory chapter on field quantization A detailed description of non classical light highlighted by phenomena of anti bunching Sub Poissonian statistics production and detection of squeezed light and coherent state

follows Next is the discussion on E P R paradox on reality locality and completeness of quantum mechanics bringing out clearly the importance of Bell s inequalities The concluding two chapters put forward forcefully the new fundamental concepts based on quantum superposition and entanglement leading to two photon interference quantum cryptography and teleportation **Statistics for Imaging, Optics, and Photonics** Peter Bajorski,2011-10-17 A vivid hands on discussion of the statistical methods in imaging optics and photonics applications In the field of imaging science there is a growing need for students and practitioners to be equipped with the necessary knowledge and tools to carry out quantitative analysis of data Providing a self contained approach that is not too heavily statistical in nature Statistics for Imaging Optics and Photonics presents necessary analytical techniques in the context of real examples from various areas within the field including remote sensing color science printing and astronomy Bridging the gap between imaging optics photonics and statistical data analysis the author uniquely concentrates on statistical inference providing a wide range of relevant methods Brief introductions to key probabilistic terms are provided at the beginning of the book in order to present the notation used followed by discussions on multivariate techniques such as Linear regression models vector and matrix algebra and random vectors and matrices Multivariate statistical inference including inferences about both mean vectors and covariance matrices Principal components analysis Canonical correlation analysis Discrimination and classification analysis for two or more populations and spatial smoothing Cluster analysis including similarity and dissimilarity measures and hierarchical and nonhierarchical clustering methods Intuitive and geometric understanding of concepts is emphasized and all examples are relatively simple and include background explanations Computational results and graphs are presented using the freely available R software and can be replicated by using a variety of software packages Throughout the book problem sets and solutions contain partial numerical results allowing readers to confirm the accuracy of their approach and a related website features additional resources including the book s datasets and figures Statistics for Imaging Optics and Photonics is an excellent book for courses on multivariate statistics for imaging science optics and photonics at the upper undergraduate and graduate levels The book also serves as a valuable reference for professionals working in imaging optics and photonics who carry out data analyses in their everyday work

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Table of Contents Statistical Optics

1. Understanding the eBook Statistical Optics
    - The Rise of Digital Reading Statistical Optics
    - Advantages of eBooks Over Traditional Books
2. Identifying Statistical Optics
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Statistical Optics
    - User-Friendly Interface
4. Exploring eBook Recommendations from Statistical Optics
    - Personalized Recommendations
    - Statistical Optics User Reviews and Ratings
    - Statistical Optics and Bestseller Lists

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