

# Speckle Phenomena In Optics Theory And The Applications

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*Speckle Phenomena In Optics Theory And The Applications*

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## KIRK LONG

*Speckle Phenomena in Optics* Academic Press

Adopting a multidisciplinary approach with input from physicists, researchers and medical professionals, this is the first book to introduce many different technical approaches for the visualization of microcirculation, including laser Doppler and laser speckle, optical coherence tomography and photo-acoustic tomography. It covers everything from basic research to medical applications, providing the technical details while also outlining the respective strengths and weaknesses of each imaging technique. Edited by an international team of top experts, this is the ultimate handbook for every clinician and researcher relying on microcirculation imaging.

*Optical Wireless Communications* Lulu.com

Random Light Beams: Theory and Applications contemplates the potential in harnessing random light. This book discusses light-matter interactions, and concentrates on the various phenomena associated with beam-like fields. It explores natural and man-made light fields and gives an overview of recently introduced families of random light beams. It outlines mathematical tools for analysis, suggests schemes for realization, and discusses possible applications. The book introduces the essential concepts needed for a deeper understanding of the subject, discusses various classes of deterministic paraxial beams and examines random scalar beams. It highlights electromagnetic random beams and matters relating to generation,

propagation in free space and various media, and discusses transmission through optical systems. It includes applications that benefit from the use of random beams, as well as the interaction of beams with deterministic optical systems. • Includes detailed mathematical description of different model sources and beams • Explores a wide range of man-made and natural media for beam interaction • Contains more than 100 illustrations on beam behavior • Offers information that is based on the scientific results of the last several years • Points to general methods for dealing with random beams, on the basis of which the readers can do independent research It gives examples of light propagation through the human eye, laser resonators, and negative phase materials. It discusses in detail propagation of random beams in random media, the scattering of random beams from collections of scatterers and thin random layers as well as the possible uses for these beams in imaging, tomography, and smart illumination.

*Tissue Optical Sectioning* CRC Press

Holographic and speckle interferometry are optical techniques which use lasers to make non-contracting field view measurements at a sensitivity of the wavelength of light on optically rough (i.e. non-mirrored) surfaces. They may be used to measure static or dynamic displacements, the shape of objects, and refractive index variations of transparent media. As such, these techniques have been applied to the solution of a wide range of problems in strain and vibrational analysis, non-destructive testing (NDT), component inspection and design analysis and fluid flow visualisation. This book provides a self-contained, unified, theoretical analysis of the basic principles and associated opto-electronic techniques (for example Electronic Speckle Pattern Interferometry). In addition, a detailed discussion of experimental design and practical application to the solution of physical problems is presented. In this new edition, the authors have taken the opportunity to include a much more coherent description of more than twenty

individual case studies that are representative of the main uses to which the techniques are put. The Bibliography has also been brought up to date.

**Understanding Biophotonics** Springer

This book highlights some of the latest advances in nanotechnology and nanomaterials from leading researchers in Ukraine, Europe and beyond. It features contributions presented at the 7th International Science and Practice Conference Nanotechnology and Nanomaterials (NANO2019), which was held on August 27–30, 2019 at Lviv Polytechnic National University, and was jointly organized by the Institute of Physics of the National Academy of Sciences of Ukraine, University of Tartu (Estonia), University of Turin (Italy), and Pierre and Marie Curie University (France). Internationally recognized experts from a wide range of universities and research institutions share their knowledge and key findings on material properties, behavior, and synthesis. This book's companion volume also addresses topics such as nano-optics, energy storage, and biomedical applications.

**An Emerging Technology** Springer Science & Business Media

This book provides a cutting-edge research overview on the latest developments in the field of Optics and Photonics. All chapters are authored by the pioneers in their field and will cover the developments in Quantum Photonics, Optical properties of 2D Materials, Optical Sensors, Organic Optoelectronics, Nanophotonics, Metamaterials, Plasmonics, Quantum Cascade lasers, LEDs, Biophotonics and biomedical photonics and spectroscopy.

*Materials, Metamaterials and Device Applications* John Wiley & Sons

These proceedings comprise of invited and contributed papers presented at the 13th International Conference on X-Ray Lasers (ICXRL 2012) which was held 11–15 June 2012 in Paris, France, in the famous Quartier Latin, inside the historical Center of Cordeliers. This conference is part of a continuing series dedicated to recent developments and applications of x-ray lasers and other coherent x-ray sources with attention to supporting technologies and instrumentation. New results in the generation of intense coherent x-rays and progress towards practical devices and their applications are reported in these proceedings, including areas of research in plasma-based x-ray lasers, 4th generation accelerator-based sources and higher harmonic generation. Recent achievements related to the increase of the repetition rate up to 100 Hz and shorter wavelength collisional plasma-based soft x-ray lasers down to about 7 nm are presented. Seeding the amplifying plasma with a femtosecond high-order harmonic of infrared laser was foreseen as the required breakthrough to break the picosecond frontier. Numerical simulations based on the Maxwell-Bloch model are presented in these proceedings, transposing the chirped pulse amplification technique to the x-ray domain in order to increase the time over which the femtosecond seed can be amplified. These proceedings also include innovative applications of soft x-ray lasers based on techniques and diagnostics relevant to topical domains such as EUV lithography, inertial confinement fusion, or warm dense matter physics.

**Fundamentals, Advances, and Applications** CRC Press

If you work in optics you quickly learn that you can either fight speckle to try to get rid of it or you can take advantage of speckle for many applications. Speckle Phenomena in Optics tells it all. It gives a detailed description of speckle, explains techniques for suppressing speckle, and it gives several applications of speckle in imaging and metrology. Joseph W. Goodman has provided a clearly written technical book that will become a classic in its field. A fascinating consequence of optical coherence, speckle has become one of the major optical phenomena. Most often, but not necessarily always, associated with laser illumination, it is relevant for the basic understanding of scattering phenomena and for application to high technology alike, from the Brownian motion to integrated circuit lithography and to the imaging of the sky by large telescopes. This book broadly encompasses the conceptual and mathematical tools relevant for analyzing speckle phenomena together with all major applications. Its readers will benefit from J. W. Goodman's fine understanding of physics and his famous skills as a teacher.

*Volume 4: Light Scattering and Radiative Transfer* Springer Nature

Lithography is a field in which advances proceed at a swift pace. This book was written to address several needs, and the revisions for the second edition were made with those original objectives in mind. Many new topics have been included in this text commensurate with the progress that has taken place during the past few years, and several subjects are discussed in more detail. This book is intended to serve as an introduction to the science of microlithography for people who are unfamiliar with the subject. Topics directly related to the tools used to manufacture integrated circuits are addressed in depth, including such topics as overlay, the stages of exposure, tools, and light sources. This text also contains numerous references for students who want to investigate particular topics in more detail, and they provide the experienced lithographer with lists of references by topic as well. It is expected that the reader of this book will have a foundation in basic physics and chemistry. No topics will require knowledge of mathematics beyond elementary calculus.

*X-Ray Lasers 2012* Cambridge University Press

Gets you quickly up to speed with the theoretical and practical aspects of free space optical systems engineering design and analysis One of today's fastest growing system design and analysis disciplines is free space optical systems engineering for communications and remote sensing applications. It is concerned with creating a light signal with certain characteristics, how this signal is affected and changed by the medium it traverses, how these effects can be mitigated both pre- and post-detection, and if after detection, it can be differentiated from noise under a certain standard, e.g., receiver operating characteristic. Free space optical systems engineering is a complex process to design against and analyze. While there are several good introductory texts devoted to key aspects of optics—such as lens design, lasers, detectors, fiber and free space, optical communications, and remote sensing—until now, there were none offering comprehensive coverage of the basics needed for optical systems engineering. If you're an upper-division undergraduate, or first-year graduate student, looking to acquire a practical understanding of electro-optical engineering basics, this book is intended for you. Topics and tools are covered that will prepare you for graduate research and engineering in either an academic or commercial environment. If you are an engineer or scientist considering making the move into the opportunity rich field of optics, this all-in-one guide brings you up to speed with everything you need to know to hit the ground running, leveraging your experience and expertise acquired previously in alternate fields. Following an overview of the mathematical fundamentals, this book provides a concise, yet thorough coverage of, among other crucial topics: Maxwell Equations, Geometrical Optics, Fourier Optics, Partial Coherence theory Linear algebra, Basic probability theory, Statistics, Detection and Estimation theory, Replacement Model detection theory, LADAR/LIDAR detection theory, optical communications theory Critical aspects of atmospheric propagation in real environments, including commonly used models for characterizing beam, and spherical and

plane wave propagation through free space, turbulent and particulate channels Lasers, blackbodies/graybodies sources and photodetectors (e.g., PIN, ADP, PMT) and their inherent internal noise sources The book provides clear, detailed discussions of the basics for free space optical systems design and analysis, along with a wealth of worked examples and practice problems—found throughout the book and on a companion website. Their intent is to help you test and hone your skill set and assess your comprehension of this important area. Free Space Optical Systems Engineering is an indispensable introduction for students and professionals alike.

*Microcirculation Imaging* MDPI

Unique within the field for being written in a tutorial style, this textbook adopts a step-by-step approach to the background needed for understanding a wide range of full-field optical measurement techniques in solid mechanics. This method familiarizes readers with the essentials of imaging and full-field optical measurement techniques, helping them to identify the appropriate techniques and in assessing measurement systems. In addition, readers learn the appropriate rules of thumb as a guide to better experimental performance from the applied techniques. Rather than presenting an exhaustive overview on the subject, each chapter provides a concise introduction to the concepts and principles, integrates solved problems within the text, summarizes the essence at the end, and includes unsolved problems. With its coverage of topics also relevant for industry, this text is aimed at graduate students, researchers, and engineers involved in non-destructive testing for acoustics, mechanics, medicine, diagnosis on artwork and construction, and civil engineering.

**Lasers and Electro-optics** John Wiley & Sons

This pioneering, course-tested text is the first to combine communications theory with the physics of optical communications. Comprehensive and rigorous, it brings together an in-depth treatment of the physical characteristics of the guided lightwave channel with the study of modern methods of algorithmic-based communication in time and space. The many different levels at which a lightwave communication signal can be described are integrated to provide a unified explanation of how a commonplace bit stream is transformed into a physical lightwave, how that lightwave travels through an optical fiber, and how it is then transformed back into the bit stream. Background fundamentals such as linear systems and electromagnetics are explained in relation to modern topics such as channel models, encoding, modulation and interference, and end-of-chapter problems are provided throughout. This is an essential text for students taking courses on optical communications, as well as researchers and professionals working in the area.

**Fourier Optics and Computational Imaging** Artech House

Our intent in producing this book was to provide a text that would be comprehensive enough for an introductory course in integrated optics, yet concise enough in its mathematical derivations to be easily readable by a practicing engineer who desires an overview of the field. The response to the first edition has indeed been gratifying; unusually strong demand has caused it to be sold out during the initial year of publication, thus providing us with an early opportunity to produce this updated and improved second edition. This development is fortunate, because integrated optics is a very rapidly progressing field, with significant new research being regularly reported. Hence, a new chapter (Chap. 17) has been added to review recent progress and to provide numerous additional references to the relevant technical literature. Also, thirty-five new problems for practice have been included to supplement those at the ends of chapters in the first edition. Chapters I through 16 are essentially unchanged, except for brief updating revisions and corrections of typographical errors. Because of the time limitations imposed by the need to provide an uninterrupted supply of this book to those using it as a course text, it has been possible to include new references and to briefly describe recent developments only in Chapter 17. However, we hope to provide details of this continuing progress in a future edition.

*Frontiers in Optics and Photonics* CRC Press

Speckle Phenomena in Optics Theory and Applications Roberts and Company Publishers

**Fourier Transforms Using Mathematica** Cambridge University Press

Speckle Phenomena in Optics provides a comprehensive discussion of the statistical properties of speckle, as well as detailed coverage of its role in applications. Some of the applications discussed include speckle in astronomy, speckle in the eye, speckle in projection displays, speckle in coherence tomography, speckle in lithography, speckle in waveguides (modal noise), speckle in optical radar detection, and speckle in metrology. This book is aimed at graduate students and professionals working in a wide variety of fields.

*Principles of Scattering and Transport of Light* John Wiley & Sons

Speckle study constitutes a multidisciplinary area with inherent complexities. In order to conquer challenges such as the variability of samples and sensitive measurements, researchers must develop a theoretical and statistical understanding of both biological and non-biological metrology using dynamic speckle laser. Dynamic Laser Speckle and Applications discusses the main methodologies used to analyze biospeckle phenomena with a strong focus on experimentation. After establishing a theoretical background in both speckle and biospeckle, the book presents the main methodologies for statistical and image analysis. It then deals with the concept of frequency decomposition before moving on to a discussion of fuzzy methods to treat dynamic speckle data. The book dedicates two sections to applications, including agricultural approaches. Additional features include photo images of experiments and software to aid in easy start-up of dynamic speckle usage. A systematic approach to new dynamic speckle laser phenomena, this book provides the physical theory and statistical background needed to analyze images formed by laser illumination in biological and non-biological samples.

*Selected Proceedings of the 7th International Conference Nanotechnology and Nanomaterials (NANO2019), 27 – 30 August 2019, Lviv, Ukraine* MDPI

This book covers both the mathematics of inverse problems and optical systems design, and includes a review of the mathematical methods and Fourier optics. The first part of the book deals with the mathematical tools in detail with minimal assumption about prior knowledge on the part of the reader. The second part of the book discusses concepts in optics, particularly propagation of optical waves and coherence properties of optical fields that form the basis of the computational models used for image recovery. The third part provides a discussion of specific imaging systems that illustrate the power of the hybrid computational imaging model in enhancing imaging performance. A number of exercises are provided for readers to develop further understanding of computational imaging. While the focus of the book is largely on optical imaging systems, the key concepts are

discussed in a fairly general manner so as to provide useful background for understanding the mechanisms of a diverse range of imaging modalities. [Handbook of Neurophotonics](#) ASP / VUBPRESS / UPA

Speckle metrology includes various optical techniques that are based on the speckle fields generated by reflection from a rough surface or by transmission through a rough diffuser. These techniques have proven to be very useful in testing different materials in a non-destructive way. They have changed dramatically during the last years due to the development of modern optical components, with faster and more powerful digital computers, and novel data processing approaches. This most up-to-date overview of the topic describes new techniques developed in the field of speckle metrology over the last decade, as well as applications to experimental mechanics, material science, optical testing, and fringe analysis.

*Advances in Atomic, Molecular, and Optical Physics* Springer

The Handbook of Neurophotonics provides a dedicated overview of neurophotonics, covering the use of advanced optical technologies to record, stimulate, and control the activity of the brain, yielding new insight and advantages over conventional tools due to the adaptability and non-invasive nature of light. Including 32 colour figures, this book addresses functional studies of neurovascular signaling, metabolism, electrical excitation, and hemodynamics, as well as clinical applications for imaging and manipulating brain structure and function. The unifying theme throughout is not only to highlight the technology, but to show how these novel methods are becoming critical to breakthroughs that will lead to advances in our ability to manage and treat human diseases of the brain. Key Features: Provides the first dedicated book on state-of-the-art optical techniques for sensing and

imaging across at the cellular, molecular, network, and whole brain levels. Highlights how the methods are used for measurement, control, and tracking of molecular events in live neuronal cells, both in basic research and clinical practice. Covers the entire spectrum of approaches, from optogenetics to functional methods, photostimulation, optical dissection, multiscale imaging, microscopy, and structural imaging. Includes chapters that show use of voltage-sensitive dye imaging, hemodynamic imaging, multiphoton imaging, temporal multiplexing, multiplane microscopy, optoacoustic imaging, near-infrared spectroscopy, and miniature neuroimaging devices to track cortical brain activity.

*Nanomaterials and Nanocomposites, Nanostructure Surfaces, and Their Applications* John Wiley & Sons

With contributions by numerous experts

*Proceedings of the 2009 Annual Symposium of the IEEE Photonics Benelux Chapter* Cambridge University Press

This book presents a collection of extended contributions on the physics and application of optoelectronic materials and metamaterials. The book is divided into three parts, respectively covering materials, metamaterials and optoelectronic devices. Individual chapters cover topics including phonon-polariton interaction, semiconductor and nonlinear organic materials, metallic, dielectric and gyrotropic metamaterials, singular optics, parity-time symmetry, nonlinear plasmonics, microstructured optical fibers, passive nonlinear shaping of ultrashort pulses, and pulse-preserving supercontinuum generation. The book contains both experimental and theoretical studies, and each contribution is a self-contained exposition of a particular topic, featuring an extensive reference list. The book will be a useful resource for graduate and postgraduate students, researchers and engineers involved in optoelectronics/photonics, quantum electronics, optics, and adjacent areas of science and technology.

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