

Bioanalysis: Advanced Materials, Methods, and Devices  
*Series Editor: Tuan Vo-Dinh*

David D. Nolte

# Optical Interferometry for Biology and Medicine

 Springer

# Optical Interferometry For Biology And Medicine Bioanalysis

**David D. Nolte**



## **Optical Interferometry For Biology And Medicine Bioanalysis:**

Optical Interferometry for Biology and Medicine David D. Nolte, 2011-12-04 This book presents the fundamental physics of optical interferometry as applied to biophysical biological and medical research Interference is at the core of many types of optical detection and is a powerful probe of cellular and tissue structure in interference microscopy and in optical coherence tomography It is also the root cause of speckle and other imaging artefacts that limit range and resolution For biosensor applications the inherent sensitivity of interferometry enables ultrasensitive detection of molecules in biological samples for medical diagnostics In this book emphasis is placed on the physics of light scattering beginning with the molecular origins of refraction as light propagates through matter and then treating the stochastic nature of random fields that ultimately dominate optical imaging in cells and tissue The physics of partial coherence plays a central role in the text with a focus on coherence detection techniques that allow information to be selectively detected out of incoherent and heterogeneous backgrounds Optical Interferometry for Biology and Medicine is divided into four sections The first covers fundamental principles and the next three move up successive scales beginning with molecular interferometry biosensors moving to cellular interferometry microscopy and ending with tissue interferometry biomedical An outstanding feature of the book is the clear presentation of the physics with easy derivations of the appropriate equations while emphasizing rules of thumb that can be applied by experimental researchers to give semi quantitative predictions *Plasmonics in Biology and Medicine* ,2007 Biomedical and Resonance Optics Leonid V. Tanin, Andrei L. Tanin, 2020-12-10 This book discusses fundamentally new biomedical imaging methods such as holography holographic and resonant interferometry and speckle optics It focuses on the development of holographic interference microscopy and its use in the study of phase objects such as nerve and muscle fibers subjected to the influence of laser radiation magnetic fields and hyperbaric conditions The book shows how the myelin sheath and even the axon itself exhibit waveguide properties enabling a fresh new look at the mechanisms of information transmission in the human body The book presents theoretically and experimentally tested holographic and speckle optical methods and devices used for investigating complex diffusely scattering surfaces such as skin and muscle tissue Additionally it gives broad discussion of the authors own original fundamental and applied research dedicated to helping physicians introduce new contact less methods of diagnosis and treatment of diseases of the cardiovascular and neuromuscular systems into medical practice The book is aimed at a broad spectrum of scientific specialists in the fields of speckle optics holography laser physics morphology and cytochemistry as well as medical professionals such as physiologists neuropathologists neurosurgeons cardiologists and dentists **Research Awards Index** ,1979 **Directory of Graduate Research** American Chemical Society. Committee on Professional Training, 2005 Faculties publications and doctoral theses in departments or divisions of chemistry chemical engineering biochemistry and pharmaceutical and or medicinal chemistry at universities in the United States and Canada American Men and Women of

Science ,1971      Optical Spectroscopy and Computational Methods in Biology and Medicine Malgorzata Baranska,2013-12-05 This multi author contributed volume gives a comprehensive overview of recent progress in various vibrational spectroscopic techniques and chemometric methods and their applications in chemistry biology and medicine In order to meet the needs of readers the book focuses on recent advances in technical development and potential exploitations of the theory as well as the new applications of vibrational methods to problems of recent general interest that were difficult or even impossible to achieve in the not so distant past Integrating vibrational spectroscopy and computational approaches serves as a handbook for people performing vibrational spectroscopy followed by chemometric analysis hence both experimental methods as well as procedures of recommended analysis are described This volume is written for individuals who develop new methodologies and extend these applications to new realms of chemical and medicinal interest      *Optics in Biomedical Sciences* G.v. Bally,P. Greguss,2013-06-05 As there recently has been increased interest in the applications of optical techniques in biomedical research and clinical diagnostics it seemed to be appropriate to organize a comprehensive international conference on optics in medicine and biology Such a broad international meeting had not been held before An international conference on Optics in Biomedical Sciences was organized and took place in Graz Austria September 7th through 11th 1981 sponsored by the International Commission for Optics ICO in co operation with the European Optical Committee the Austrian Association on Biomedical Engineering and the German Society for Applied Optics It seemed timely to establish a forum for communication among specialists on an international level This book presenting the papers given at this conference demonstrates the state of the art of this increasingly expanding field of applications of optics Furthermore the interested reader will find an extended list of references in the various contributions This book helps to overcome the difficulty inherent in all interdisciplinary research fields of gathering widely scattered literature The contributions to this book are focussed on the following topics Biomedical applications of unconventional imaging in microscopy image processing interferometry and holography speckle techniques and spectroscopy optometry and Moire methods In addition the brilliant and humorous closing remarks of Nils Abramson from the Royal Institute of Technology Stockholm have been included

**Optical Technologies for Biology and Medicine** Elina A. Genina,2022      Optics in Biomedical Sciences Gert Bally,Pál Greguss,1982      **Optical Techniques in Biological Research** Denis Rousseau,2012-12-02 Optical Techniques in Biological Research discusses the fundamentals and applications of light scattering Raman scattering Fourier transform infrared spectroscopy nanosecond fluorescence spectroscopy and circular dichroism Electron microscopy is also included owing to some of its classical similarity to optical microscopy optical structural and resonance techniques for biological research The chapters are aimed at a level such that only a general understanding of chemistry and biology is required The objective is to present material in a way that allows the research worker to assess quickly the applicability utility and significance of the specific technique to his or her problem or field of interest Together with Structural and Resonance

Techniques in Biological Research this book marks the introduction of a new series of volumes Physical Techniques in Biology and Medicine which is intended to replace a previous treatise Physical Techniques in Biological Research

**Handbook of Biophotonics, Volume 3** Jürgen Popp, Valery V. Tuchin, Arthur Chiou, Stefan H. Heinemann, 2012-05-14  
This new handbook covers the world of biophotonics not only geographically with the editors coming from different continents but also in terms of content since the authors come from the whole spectrum of biophotonic basic and applied research Designed to set the standard for the scientific community these three volumes break new ground by providing readers with the physics basics as well as the biological and medical background together with detailed reports on recent technical advances The Handbook also adopts an application related approach starting with the application and then citing the various tools to solve the scientific task making it of particular value to medical doctors Divided into several sections the first part offers introductory chapters on the different fields of research with subsequent parts focusing on the applications and techniques in various fields of industry and research The result is a handy source for scientists seeking the basics in a condensed form and equally a reference for quickly gathering the knowledge from neighboring disciplines Absolutely invaluable for biophotonic scientists in their daily work

Basics of Interferometry P. Hariharan, 2006-11 Optical interferometry is used in communications medical imaging astronomy and structural measurement With the use of an interferometer engineers and scientists are able to complete surface inspections of micromachined surfaces and semiconductors Medical technicians are able to give more concise diagnoses with the employ of interferometers in microscopy spectroscopy and coherent tomography Originating from a one day course this material was expanded to serve as an introduction to the topic for engineers and scientists that have little optical knowledge but a need for more in their daily work lives The need for interferometry knowledge has crossed the boundaries of engineering fields and Dr Hariharan has written a book that answers the questions that new practitioners to interferometry have and haven't even thought of yet This new edition includes complete updates of all material with an emphasis on applications It also has new chapters on white light microscopy and interference with single photons Outstanding introduction to the world of optical interferometry with summaries at the beginning and end of each chapter several appendices with essential information and worked numerical problems Practical details enrich understanding for readers new to this material New chapters on white light microscopy for medical imaging and interference with single photons quantum optics

*Optical Interferometry* Alexandr Banishev, Jue Wang, Mithun Bhowmick, 2017-02-15 Optical methods of measurements are the most sensitive techniques of noncontact investigations and at the same time they are fast as well as accurate which increases reproducibility of observed results In recent years the importance of optical interferometry methods for research has dramatically increased and applications range from precise surface testing to finding extrasolar planets This book covers various aspects of optical interferometry including descriptions of novel apparatuses and methods application interferometry for studying biological objects surface

qualities materials characterization and optical testing The book includes a series of chapters in which experts share recent progress in interferometry through original research and literature reviews Optical Interferometry P. Hariharan,1985

FROM THE PREFACE The aim of this book is to present a self contained treatment of the subject with particular emphasis on recent developments and their implications for the future A brief historical survey leads up to three chapters covering the classical concepts of two beam interference coherence and multiple beam interference Chapter 5 then discusses interference in thin films antireflection coatings and interference filters As mentioned at the outset lasers are now being used to an increasing extent in optical interferometry in fact this has led to the virtual demise of the classical mercury arc Accordingly Chapter 6 looks at the laser as a light source and discusses techniques for obtaining a single frequency output and for frequency stabilization Five chapters then deal with applications of interferometry such as length measurement testing optical surfaces interference spectroscopy and Fourier transform spectroscopy Emphasis is placed in these chapters on techniques which have become feasible with the development of the laser including unequal path interferometry fringe counting heterodyne and digital interferometry fibre optic interferometry and nonlinear interferometry These are followed by three chapters on holography holographic interferometry and speckle interferometry A final chapter on stellar interferometry describes the intensity interferometer and techniques such as stellar speckle interferometry and speckle holography Some useful mathematical results as well as some selected topics in optics are summarized for ready reference in five appendices I have tried to plan this book so that it can be used by people who would like to apply interferometric techniques in their work as well as those who would like to learn more about interferometry In the first instance most topics are discussed at a level accessible to people with a basic knowledge of physical optics a more detailed treatment for the serious worker then follows Finally the text is supplemented by a reference list of nearly 600 selected papers Accordingly students should find this book useful as a text while researchers can use it as a reference work

**Optical Polarization in Biomedical Applications**

Valery V. Tuchin,Lihong Wang,Dmitry A. Zimnyakov,2006-10-12 Optical Polarization in Biomedical Applications introduces key developments in optical polarization methods for quantitative studies of tissues while presenting the theory of polarization transfer in a random medium as a basis for the quantitative description of polarized light interaction with tissues This theory uses the modified transfer equation for Stokes parameters and predicts the polarization structure of multiple scattered optical fields The backscattering polarization matrices Jones matrix and Mueller matrix important for noninvasive medical diagnostic are introduced The text also describes a number of diagnostic techniques such as CW polarization imaging and spectroscopy polarization microscopy and cytometry As a new tool for medical diagnosis optical coherent polarization tomography is analyzed The monograph also covers a range of biomedical applications among them cataract and glaucoma diagnostics glucose sensing and the detection of bacteria Principles of Biophotonics, Volume 1: Linear Systems and the Fourier Transform in Optics Gabriel Popescu,2018-12-27 This book aims to teach students instructors and

professionals the basis of optical techniques for biomedical investigation It is a text for researchers active at the interface between biology medicine and optics With the format of a classical textbook this work contains the underlying theory of biological optics and applications to real laboratory problems via exercises and homework      **Biological Imaging with Low Coherence Optical Interferometry** Michael Richard Hee,1992      Optical Interferometry Maurice Françon,1966

Coherence produced by thermal luminous sources Interferences of two waves by wavefront division Interferences of two waves by amplitude division Two beam interferometers Standing waves Multiple beam interferences Polarization interferometers Interference and partial coherence Intensity interferometer Interferences with lasers Interferential study of wavefronts Interferometric measurement of the transfer function of an optical instrument noncoherent illumination Thin films Interference spectroscopy Application of interferences for the measurement of length Diverse applications of interference      Optical Sensing, Imaging, and Manipulation for Biological and Biomedical Applications Robert R. Alfano, Ping-Pei Ho, Arthur E. T. Chiou, Society of Photo-optical Instrumentation Engineers, Guo jia ke xue wei yuan hui, Photonics Industry Development Association, 2000

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