

Digital Holographic Microscopy

Principles, Techniques, and Applications



Springer

Myung K. Kim

Digital Holographic Microscopy Myung K. Kim, 2011-08-09 Digital holography is an emerging field of new paradigm in general imaging applications. The book presents an introduction to the theoretical and numerical principles and reviews the research and development activities in digital holography with emphasis on the microscopy techniques and applications Topics covered include the general theory of diffraction and holography formations and practical instrumentation and experimentation of digital holography Various numerical techniques are described that give rise to the unique and versatile capabilities of digital holography Representative special techniques and applications of digital holography are discussed The book is intended for researchers interested in developing new techniques and exploring new applications of digital holography Digital Holographic Microscopy Myung K. Kim, 2011-08-09 Digital holography is an emerging field of new paradigm in general imaging applications The book presents an introduction to the theoretical and numerical principles and reviews the research and development activities in digital holography with emphasis on the microscopy techniques and applications Topics covered include the general theory of diffraction and holography formations and practical instrumentation and experimentation of digital holography Various numerical techniques are described that give rise to the unique and versatile capabilities of digital holography Representative special techniques and applications of digital holography are discussed The book is intended for researchers interested in developing new techniques and exploring new applications of digital holography Springer Series in Light Scattering Alexander Kokhanovsky, 2019-06-29 This book describes recent advances in radiative transfer atmospheric remote sensing polarization optics of random media and light scattering It is a valuable resource for anyone involved in light scattering research Providing numerous step by step tutorials it allows readers to guickly learn about various aspects of theoretical and experimental light scattering media optics. The book features among others a chapter on aerosol remote sensing that helps readers to define and solve various aerosol remote sensing problems A Practical Guide to Optical Microscopy John Girkin, 2019-06-14 Choice Recommended Title March 2020 Optical microscopy is used in a vast range of applications ranging from materials engineering to in vivo observations and clinical diagnosis and thanks to the latest advances in technology there has been a rapid growth in the number of methods available This book is aimed at providing users with a practical guide to help them select and then use the most suitable method for their application It explores the principles behind the different forms of optical microscopy without the use of complex maths to provide an understanding to help the reader utilise a specific method and then interpret the results Detailed physics is provided in boxed sections which can be bypassed by the non specialist It is an invaluable tool for use within research groups and laboratories in the life and physical sciences acting as a first source for practical information to guide less experienced users or those new to a particular methodology on the range of techniques available Features The first book to cover all current optical microscopy methods for practical applications Written to be understood

by a non optical expert with inserts to provide the physical science background Brings together conventional widefield and confocal microscopy with advanced non linear and super resolution methods in one book To learn more about the author please visit here

Digitale Holographie in der Werkzeugmaschine Tobias Seyler,2021-01-06 Dynamische Produktionsprozesse und kontinuierlich steigende Qualit tsanforderungen in der zerspanenden Fertigung stellen hohe Anforderungen an die Messtechnik Die digitale Holographie erlaubt als interferometrisches Messverfahren eine schnelle und gleichzeitig sub mikrometergenaue H henmessung von Oberfl chen ihr Einsatz in Produktionsumgebungen wird jedoch durch den Einfluss von Schwingungen als besonders kritisch bewertet In dieser Arbeit wird das erste kabellose 3D Messsysteme f r die Werkzeugmaschine vorgestellt sowie die M glichkeiten einer Inline Pr fung bewertet Die Analyse dynamischer Einflussfaktoren auf die Messdatenqualit t best tigt die Funktionsf higkeit des Messsystems im Fr szentrum und zeigt die Grenzen und Chancen der Technologie auf Mittels neu entwickelter Algorithmen k nnen softwareseitig St reinfl sse erkannt und kompensiert werden Das Messfeld des vorgestellten Systems betr gt 20 20 mm2 mit 9 Mio 3D Punkten die in weniger als 0 5 s aufgezeichnet werden k nnen Ein neu entwickeltes Fokuskriterium erm glicht dabei selbst H henunterschiede von einigen Millimetern au erhalb der geometrischen Sch rfentiefe des optischen Systems eindeutig aufzul sen Neben der vollst ndigen internen Auswertung der Daten wird zus tzlich die kabellose bertragung an eine externe Recheneinheit erm glicht

Micro- and Nanophotonic Technologies Patrick Meyrueis, Kazuaki Sakoda, Marcel Van de Voorde, 2017-03-20 Edited and authored by leading experts from top institutions in Europe the US and Asia this comprehensive overview of micro and nanophotonics covers the physical and chemical fundamentals while clearly focusing on the technologies and applications in industrial R light conversion and energy generation light based fabrication of materials and micro and nanophotonic devices in metrology and control Principles of Light Microscopy: From Basic to Advanced Volodymyr Nechyporuk-Zloy, 2022-11-29 This textbook is an excellent guide to microscopy for students and scientists who use microscopy as one of their primary research and analysis tool in the laboratory The book covers key microscopy principles and explains the various techniques such as epifluorescence microscopy confocal live cell imaging SIM light sheet microscopy and many more Easy to understand protocols provide helpful guidance for practical implementation in various commercially available imaging systems The reader is introduced to histology and further be guided through advanced image acquisition classification and analysis The book is written by experienced imaging specialists from the UK other EU countries the US and Asia and is based on advanced training courses for master students and PhD students Readers are not expected to be familiar with imaging and microscopy technologies but are introduced to the subject step by step This textbook is indented for biomedical and medical students as well as scientists and postdocs who want to acquire a thorough knowledge of microscopy or gain a comprehensive overview of modern microscopy techniques used in various research laboratories and imaging facilities Chapter 4 is available open access under a Creative Commons Attribution 4 0 International License via link

springer com **Holoscopy** Dierck Hillmann,2014-07-08 Holoscopy is a new tomographic imaging modality that combines techniques of digital holography with Fourier domain optical coherence tomography FD OCT Dierck Hillmann gives a theoretical introduction to the mathematics and physics of holoscopy and develops an efficient numerical reconstruction procedure Compared to FD OCT holoscopy provides unique advantages by enabling tomographic imaging without a limited depth of focus but results in an increased numerical cost for reconstruction In further chapters the author introduces techniques for FD OCT that are relevant to holoscopy as well He demonstrates and compares numerical reconstruction methods for FD OCT and shows how motion and dispersion artifacts in FD OCT can be numerically compensated

Biomedical Optical Phase Microscopy and Nanoscopy Natan T. Shaked, Zeev Zalevsky, Lisa L Satterwhite, 2012-11-05 Written by leading optical phase microscopy experts this book is a comprehensive reference to phase microscopy and nanoscopy techniques for biomedical applications including differential interference contrast DIC microscopy phase contrast microscopy digital holographic microscopy optical coherence tomography tomographic phase microscopy spectral domain phase detection and nanoparticle usage for phase nanoscopy The Editors show biomedical and optical engineers how to use phase microscopy for visualizing unstained specimens and support the theoretical coverage with applied content and examples on designing systems and interpreting results in bio and nanoscience applications Provides a comprehensive overview of the principles and techniques of optical phase microscopy and nanoscopy with biomedical applications Tips advice on building systems and working with advanced imaging biomedical techniques including interpretation of phase images and techniques for quantitative analysis based on phase microscopy Interdisciplinary approach that combines optical engineering nanotechnology biology and medical aspects of this topic Each chapter includes practical implementations and worked examples Advancement of Optical Methods & Digital Image Correlation in Experimental Mechanics, Volume 3 Luciano Lamberti, Ming-Tzer Lin, Cosme Furlong, Cesar Sciammarella, 2025-08-07 Advancement of Optical Methods DIC Applications for Challenging Environments Optical Methods in SEM History Mechanical Characterization of Materials Digital Holography and Wavefront Sensing Ulf Schnars, Claas Falldorf, John Watson, Werner Bioengineering Jüptner, 2014-09-19 This highly practical and self contained guidebook explains the principles and major applications of digital hologram recording and numerical reconstruction Digital Holography A special chapter is designated to digital holographic interferometry with applications in deformation and shape measurement and refractive index determination Applications in imaging and microscopy are also described Spcial techniques such as digital light in flight holography holographic endoscopy information encrypting comparative holography and related techniques of speckle metrology are also <u>Digital Holographic Methods</u> Stephan Stuerwald, 2018-10-12 This book presents not only the simultaneous treated combination of optical methods based on holographic principles for marker free imaging real time trapping identification and tracking of micro objects but also the application of substantial low coherent light sources and non diffractive beams It first

provides an overview of digital holographic microscopy DHM and holographic optical tweezers as well as non diffracting beam types for minimal invasive real time and marker free imaging as well as manipulation of micro and nano objects It then investigates the design concepts for the optical layout of holographic optical tweezers HOTs and their optimization using optical simulations and experimental methods In a further part the book characterizes the corresponding system modules that allow the addition of HOTs to commercial microscopes with regard to stability and diffraction efficiency Further based on experiments and microfluidic applications it demonstrates the functionality of the combined setup and discusses several types of non diffracting beams and their application in optical manipulation. The book shows that holographic optical tweezers including several non diffracting beam types like Mathieu beams combined parabolic and Airy beams not only open up the possibility of generating efficient multiple dynamic traps for micro and nano particles with forces in the pico and nano newton range but also the opportunity to exert optical torque with special beams like Bessel beams which can facilitate the movement and rotation of particles by generating microfluidic flows The last part discusses the potential use of a slightly modified DHM HOT system to explore the functionality of direct laser writing based on a two photon absorption process in a negative photoresist with a continuous wave laser Digital Holography Ulf Schnars, Werner Jüptner, 2005-12-08 Sag ich zum Augenblicke verweile doch Du bist so sch n J W v Goethe Faust An old dream of mankind and a sign of culture is the conservation of moments by taking an image of the world around Pictures accompany the development of mankind However a picture is the two dimensional projection of the thr dimensional world The perspective recognized in Europe in the Middle Ages was a first approach to overcome the difficulties of imaging close to reality It took up to the twentieth century to develop a real three dimensional imaging bor invented in 1948 holography Yet still one thing was missing the phase of the object wave could be reconstructed optically but not be measured directly The last huge step to the complete access of the object wave was Digital Holography By Digital Holography the intensity and the phase of electromagnetical wave fields can be measured stored transmitted applied to simulations and mani lated in the computer An exciting new tool for the handling of light We started our work in the field of Digital Holography in 1990 Our motivation mainly came from Holographic Interferometry a method used with success for precise measurement of deformation and shape of opaque bodies or refractive dex variations within transparent media A major drawback of classical HI using photographic plates was the costly process of film development Optical Holography Pierre-Alexandre Blanche, 2019-10-23 Optical Holography Materials Theory and Applications provides researchers the fundamentals of holography through diffraction optics and an overview of the most relevant materials and applications ranging from computer holograms to holographic data storage Dr Pierre Blanche leads a team of thought leaders in academia and industry in this practical reference for researchers and engineers in the field of holography This book presents all the information readers need in order to understand how holographic techniques can be applied to a variety of applications the benefits of those techniques and the materials that enable these technologies

Researchers and engineers will gain comprehensive knowledge on how to select the best holographic techniques for their needs Covers current applications of holographic techniques in areas such as 3D television solar concentration non destructive testing and data storage Describes holographic recording materials and their most relevant applications Provides the fundamentals of holography and diffraction optics **Label-Free Super-Resolution Microscopy** Vasily Astratov, 2019-08-31 This book presents the advances in super resolution microscopy in physics and biomedical optics for nanoscale imaging In the last decade super resolved fluorescence imaging has opened new horizons in improving the resolution of optical microscopes far beyond the classical diffraction limit leading to the Nobel Prize in Chemistry in 2014 This book represents the first comprehensive review of a different type of super resolved microscopy which does not rely on using fluorescent markers Such label free super resolution microscopy enables potentially even broader applications in life sciences and nanoscale imaging but is much more challenging and it is based on different physical concepts and approaches A unique feature of this book is that it combines insights into mechanisms of label free super resolution with a vast range of applications from fast imaging of living cells to inorganic nanostructures This book can be used by researchers in biological and medical physics Due to its logically organizational structure it can be also used as a teaching tool in graduate and upper division undergraduate level courses devoted to super resolved microscopy nanoscale imaging microscopy instrumentation and biomedical imaging Progress in Optics, 2014-05-08 In the 50 years since the first volume of Progress in Optics was published optics has become one of the most dynamic fields of science The volumes in this series that have appeared up to now contain more than 300 review articles by distinguished research workers which have become permanent records for many important developments helping optical scientists and optical engineers stay abreast of their fields Comprehensive in depth reviews Edited by the leading authority in the field **Introduction to Optical Metrology** Rajpal S. Sirohi,2017-07-12 Introduction to Optical Metrology examines the theory and practice of various measurement methodologies utilizing the wave nature of light The book begins by introducing the subject of optics and then addresses the propagation of laser beams through free space and optical systems After explaining how a Gaussian beam propagates how to set up a collimator to get a collimated beam for experimentation and how to detect and record optical signals the text Discusses interferometry speckle metrology moir phenomenon photoelasticity and microscopy Describes the different principles used to measure the refractive indices of solids liquids and gases Presents methods for measuring curvature focal length angle thickness velocity pressure and length Details techniques for optical testing as well as for making fiber optic and MEMS based measurements Depicts a wave propagating in the positive z direction by eitk z as opposed to eikzt Featuring exercise problems at the end of each chapter Introduction to Optical Metrology provides an applied understanding of essential optical measurement concepts techniques and procedures **Grundlagen der Photonik** Bahaa E. A. Saleh, Malvin Carl Teich, 2008-05-05 Schon die erste Auflage des englischen Lehrbuchs Fundamentals of Photonics zeichnete

sich durch seine ausgewogene Mischung von Theorie und Praxis aus und deckte in detaillierter Darstellung die grundlegenden Theorien des Lichts ab Es umfasste sowohl die Themen Strahlenoptik Wellenoptik elektromagnetische Optik Photonenoptik sowie die Wechselwirkung von Licht und Materie als auch die Theorie der optischen Eigenschaften von Halbleitern Die Photonik Technologie hat eine rasante Entwicklung genommen seit der Publikation der ersten Ausgabe von Fundamentals of Photonics vor 15 Jahren Die nun vorliegende Zweite Auflage des Marksteins auf dem Gebiet der Photonik tr gt mit zwei neuen und zus tzlichen Kapiteln den neuesten technologischen Fortschritten Rechnung Photonische Kristalle sowie Ultrakurzpuls Optik Zudem wurden alle Kapitel gr ndlich berarbeitet und viele Abschnitte hinzugef gt so z B ber Laguerre Gauss Strahlen die Sellmeier Gleichung Photonenkristall Wellenleiter photonische Kristallfasern Mikrosph ren Resonatoren Optische Koh renz Tomographie Bahndrehimpuls des Photons Bohrsche Theorie Raman Verst rker rauscharme Avalanche Photodioden Abstimmkurven und Dispersions Management Digital Holography Pascal Picart, Jun-chang Li,2013-01-24 This book presents a substantial description of the principles and applications of digital holography The first part of the book deals with mathematical basics and the linear filtering theory necessary to approach the topic The next part describes the fundamentals of diffraction theory and exhaustively details the numerical computation of diffracted fields using FFT algorithms A thorough presentation of the principles of holography and digital holography including digital color holography is proposed in the third part A special section is devoted to the algorithms and methods for the numerical reconstruction of holograms There is also a chapter devoted to digital holographic interferometry with applications in holographic microscopy quantitative phase contrast imaging multidimensional deformation investigations surface shape measurements fluid mechanics refractive index investigations synthetic aperture imaging and information encrypting Keys so as to understand the differences between digital holography and speckle interferometry and examples of software for hologram reconstructions are also treated in brief Advanced Optical Instruments and Techniques Daniel Malacara Hernández, 2017-11-22 Advanced Optical Instruments and Techniques includes twenty three chapters providing processes methods and procedures of cutting edge optics engineering design and instrumentation Topics include biomedical instrumentation and basic and advanced interferometry Optical metrology is discussed including point and full field methods Active and adaptive optics holography radiometry the human eye and visible light are covered as well as materials including photonics nanophotonics anisotropic materials and metamaterials

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