Chapter 1 Geometrical Optics Spie

This book employs homogeneous coordinate notation to compute the first- and second-order derivative matrices of various optical quantities. It will be one of the important mathematical tools for automatic optical design. The traditional geometrical optics is based on raytracing only. It is very difficult, if possible, to compute the first- and second-order derivatives of a ray and optical path length with respect to system variables, since they are recursive functions. Consequently, current commercial software packages use a finite difference approximation methodology to estimate these derivatives for use in optical design and analysis. Furthermore, previous publications of geometrical optics use vector notation, which is comparatively awkward for computations for non-axially symmetrical systems.

This volume describes modern developments in reflective, refractive and diffractive optics for short wavelength radiation. It also covers recent theoretical approaches to modelling and ray-tracing the x-ray and neutron optical systems. It is based on the joint research activities of specialists in x-ray and neutron optics, working together under the framework of the European Programme for Cooperation in Science and Technology (COST, Action P7) in the period 2002-2006.

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This book gathers selected and expanded contributions presented at the 5th Symposium on Space Optical Instruments and Applications, which was held in Beijing, China, on September 5–7, 2018. This conference series is organized by the Sino-Holland Space Optical Instruments Laboratory, a cooperative platform between China and the Netherlands. The symposium focused on key technological problems regarding optical instruments and their applications in a space context. It covered the latest developments, experiments and results on the theory, instrumentation and applications of space optics. The book is split into five main sections: The first covers optical remote sensing system design, the second focuses on advanced optical system design, and the third addresses remote sensor calibration and measurement. Remote sensing data processing and information extraction are then presented, followed by a final section on remote sensing data applications.

This book provides a clear, concise, and consistent exposition of what aberrations are, how they arise in optical imaging systems, and how they affect the quality of images formed by them. The emphasis of the book is on physical insight, problem solving, and numerical results, and the text is intended for engineers and scientists who have a need and a desire for a deeper and better understanding of aberrations and their role in optical imaging and wave propagation. Some knowledge of Gaussian optics and an appreciation for aberrations would be useful but is not required.

Astronomy and Astrophysics Abstracts aims to present a comprehensive documen tation of the literature concerning all aspects of astronomy, astrophysics, and their border fields. It is devoted to the recording, summarizing, and indexing of the relevant publications throughout the world. Astronomy and Astrophysics Abstracts is prepared by a special department of the Astronomisches Rechen-Institut under the auspices of the International Astronomical Union. Volume 43 records literature published in 1987 and received before August 15, 1987. Some older documents which we received late and which are not surveyed in earlier volumes are included too. We acknowledge with thanks contributions of our colleagues all over the world. We also express our gratitude to all organiza tions, observatories, and publishers which provide us with complimentary copies of their publications. Starting with Volume 33, all the recording, correction, and data processing work was done by means of computers. The recording was done by our technical staff members Ms. Helga Ballmann, Ms. Beate Gobel, Ms. Monika Kohl, Ms. Sylvia Matyssek, Ms. Doris Schmitz-Braunstein, Ms. Utta-Barbara Stegemann. Mr. Jochen Heidt and Mr. Kristopher Polzine supported our task by careful proof reading. It is a pleasure to thank them all for their encouragement. Heidelberg, October 1987 The Editors Contents Introduction . . . . 1 Concordance Relation: PHYS-AAA 3 Abbreviations 5 Periodicals, Proceedings, Books, Activities 001 Periodicals . . . . 10 002 Bibliographical Publications, Documentation, Catalogues, Data Bases 50 003 Books ....

This special volume of Advances in Imaging and Electron Physics details the current theory, experiments, and applications of neutron and x-ray optics and microscopy for an international readership across varying backgrounds and disciplines. Edited by Dr. Ted Cremer, these volumes attempt to provide rapid assimilation of the presented topics that include neutron and x-ray scatter, refraction, diffraction, and reflection and their potential application. Contributions from leading authorities Informs and updates on all the latest developments in the field

This volume in the SPIE Tutorial Text series presents a practical approach to optical testing, with emphasis on techniques, procedures, and instrumentation rather than mathematical analysis. The author provides the reader with a basic understanding of the measurements made and the tools used to make those measurements. Detailed information is given on how to measure and characterize imaging systems, perform optical bench measurements to determine first- and third-order properties of optical systems, set up and operate a Fizeau interferometer and evaluate fringe data, conduct beam diagnostics (such as wavefront sensing), and perform radiometric calibrations.

This book provides a unified treatment of the characteristics of telescopes of all types, both those whose performance is set by geometrical aberrations and the effect of the atmosphere, and those diffraction-limited telescopes designed for observations from above the atmosphere. The emphasis throughout is on basic principles, such as Fermat's principle, and their application to optical systems specifically designed to image distant celestial sources. The book also contains thorough discussions of the principles underlying all spectroscopic instrumentation, with special emphasis on grating instruments used with telescopes. An introduction to adaptive optics provides the needed background for further inquiry into this rapidly developing area. Geometrical aberration theory based on Fermat's principle Diffraction theory and transfer function approach to near-perfect telescopes Thorough discussion of 2-mirror telescopes, including misalignments Basic principles of spectrometry; grating and echelle instruments Schmidt and other catadioptric telescopes Principles of adaptive optics Over 220 figures and nearly 90 summary tables Electromagnetic Scintillation: Volume 1, Geometrical OpticsCambridge University Press

"Astronomy and Astrophysics Abstracts" appearing twice a year has become oneof the fundamental publications in the fields of astronomy, astrophysics andneighbouring sciences. It is the most important English-language abstracting journal in the mentioned branches. The abstracts are classified under more than a hundred subject categories, thus permitting a quick survey of

the whole extended material. The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences. As such it represents a necessary ingredient of any astronomical library all over the world.

A Course in Lens Design is an instruction in the design of image-forming optical systems. It teaches how a satisfactory design can be obtained in a straightforward way. Theory is limited to a minimum, and used to support the practical design work. The book introduces geometrical optics, optical instruments and aberrations. It gives a description of the process of lens design and of the strategies used in this process. Half of its content is devoted to the design of sixteen types of lenses, described in detail from beginning to end. This book is different from most other books on lens design because it stresses the importance of the initial phases of the design process: (paraxial) lay-out and (thin-lens) pre-design. The argument for this change of accent is that in these phases much information can be obtained about the properties of the lens to be designed. This information can be used in later phases of the design. This makes A Course in Lens Design a useful self-study book and a suitable basis for an introductory course in lens design. The mathematics mainly used is college algebra, in a few sections calculus is applied. The book could be used by students of engineering and technical physics and by engineers and scientists.

This comprehensive and self-contained text for researchers and professionals presents a detailed account of optical imaging from the viewpoint of both ray and wave optics.

Astronomy and Astrophysics Abstracts aims to present a comprehensive documen tation of the literature concerning all aspects of astronomy, astrophysics, and their border fields. It is devoted to the recording, summarizing, and indexing of the relevant publications throughout the world. Astronomy and Astrophysics Abstracts is prepared by a special department of the Astronomisches Rechen-Institut under the auspices of the International Astronomical Union. Volume 33 records literature published in 1983 and received before August 1, 1983. Some older documents which we received late and which are not surveyed in earlier volumes are included too. We acknowledge with thanks contributions of our colleagues all over the world. We also express our gratitude to all organizations, observatories, and publishers which provide us with complimentary copies of their publications. Starting with Volume 33, all the recording, correction, and data processing work was done by means of computers. The recording was done by our technical staff members Ms. Helga Ballmann, Ms. Mona El-Choura, Ms. Monika Kohl, and Ms. Sylvia Matyssek. Mr. Martin Schlotelburg and Mr. Ulrich Uberall supported our task by careful proofreading. It is a pleasure to thank them all for their encouragement. Heidelberg, September 1983 The Editors Contents Introduction . . . . 1 Concordance Relation: ICSU-AB-AAA 3 Abbreviations 10 Periodicals, Proceedings, Books, Activities 001 Periodicals . . . . 15 002 Bibliographical Publications, Documentation, Catalogues, Atlases 47 003 Books .... 51 004 History of Astronomy 58 005 Biography . . 64 006 Personal Notes 65 007 Obituaries . . .

This title provides a comprehensive, unified tutorial covering the most recent advances in the emerging technology of free-space optics (FSO), a field in which interest and attention continue to grow along with the number of new challenges. This book is intended as an all-inclusive source to serve the needs of those who require information about the fundamentals of FSO, as well as up-to-date advanced knowledge of the state-of-the-art in the technologies available today. This text is intended for graduate students, and will also be useful for research scientists and engineers with an interest in the field. FSO communication is a practical solution for creating a three dimensional global broadband communications grid, offering bandwidths far beyond what is possible in the Radio Frequency (RF) range. However, the attributes of atmospheric turbulence and scattering impose perennial limitations on availability and reliability of FSO links. From a systems point-of-view, this groundbreaking book provides a thorough understanding of channel behavior, which can be used to design and evaluate optimum transmission techniques that operate under realistic atmospheric conditions. Topics addressed include: • FSO Physical and Statistical Models: Single/Multiple Inputs/Outputs • Understanding FSO: Theory and Systems Analysis • Modulation and Coding for Free-Space Optical Channels • Atmospheric Mitigation and Compensation for FSO Links • Non-line-of-sight (NLOS) Ultraviolet and Indoor FSO Communications • FSO Platforms: UAV and Mobile • Retromodulators for Free Space Data links • Hybrid Optical RF Communications • Free-space and Atmospheric Quantum Communications • Other related topics: Chaos-based and Terahertz (THz) FSO Communications

Electromagnetic Scintillation describes the phase and amplitude fluctuations imposed on signals that travel through the atmosphere. The volumes that make up Electromagnetic Scintillation will provide a modern reference and comprehensive tutorial, treating both optical and microwave propagation and integrating measurements and predictions at each step of the development. This first volume deals with phase and angle-of-arrival measurement errors, accurately described by geometrical optics. It will be followed by a further volume examining weak scattering. In this book, measured properties of tropospheric and ionospheric irregularities are reviewed first. Electromagnetic fluctuations induced by these irregularities are then estimated for a wide range of applications. The book will be of interest to those working in the resolution of astronomical interferometers and large single-aperture telescopes, as well as synthetic aperture radars and laser pointing/tracking systems. It is also directly relevant to those working in laser metrology, GPS location accuracy, and terrestrial and satellite communications.

This book provides all the essential and best elements of Kidger's many courses taught worldwide on lens and optical design. It is written in a direct style that is compact, logical, and to the point--a tutorial in the best sense of the word. "I read my copy late last year and read it straight through, cover to cover. In fact, I read it no less than three times. Its elegant expositions, valuable insights, and up-front espousal of pre-design theory make it an outstanding work. It's in the same league with Conrady and Kingslake." Warren Smith.

A practical guide for engineers and students that covers a wide range of optical design and optical metrology topics Optical Engineering Science offers a comprehensive and authoritative review of the science of optical engineering. The book bridges the gap between the basic theoretical principles of classical optics and the practical application of optics in the commercial world. Written by a noted expert in the field, the book examines a range of practical topics that are related to optical design, optical metrology and manufacturing. The book fills a void in the literature by coving all three topics in a single volume. Optical engineering science is at the foundation of the design of commercial optical systems, such as mobile phone cameras and digital cameras as well as highly sophisticated instruments for commercial and research applications. It spans the design, manufacture and testing of space or aerospace instrumentation to the optical sensor technology for environmental monitoring. Optics engineering science has a wide variety of applications, both commercial and research. This important book: Offers a comprehensive review of the topic of optical engineering Covers topics such as optical fibers, waveguides, aspheric surfaces, Zernike polynomials, polarisation, birefringence and more Targets engineering professionals and students Filled with illustrative examples and mathematical equations Written for professional practitioners, optical engineers, optical designers, optical systems engineers

and students, Optical Engineering Science offers an authoritative guide that covers the broad range of optical design and optical metrology topics and their applications.

Topics covered by this text include imaging, radiometry, source detectors and lasers, with a special emphasis on flux-transfer issues. The author takes a first-order approach so that students and professionals can quickly make the back-of-envelope calculations needed for initial setup of optical apparatus. The target is to help readers solve the practical problems frequently encountered by those new to the field of electro-optics. The text aims to enable readers to answer such questions as: where is the image, how big is it, how much light gets to the detectors, and how small an object is it possible to see?

This second volume based on Michael Kidger's popular short courses and workshops is aimed at readers already familiar with the concepts presented in Fundamental Optical Design (SPIE Press Vol. PM92). It begins with a sweeping discussion of optimization that is written with the user in mind and continues with a unique look at the role of higher-order aberrations. The book's key feature is its astounding presentation of a wide range of practical design examples, covering such problems as secondary spectrum correction, high numerical aperture designs, lasers, zoom lenses, tilted or decentered optical systems, and price and performance requirements. Each scenario is accompanied by an in-depth discussion that goes well beyond the ray aberration plot, including useful insights into an optical designer's thought processes

A fundamental problem in cell biology is the cause of aging. The solution to this problem has not yet been obtained because,(l) until recently, it was not possible to image living cells directly. The use of low-energy (soft) X rays has made such imaging possible, perhaps thereby allowing the aging process to be understood and possibly overcome (a result that may well generate further social, moral, and ethical problems). Fortun ately this is not the only aspect of cell biology amenable to soft X-ray imaging, and it is envisaged that many less controversial studies--such as investigations of the detailed differences between healthy and diseased or malignant cells (in their natural states) and processes of cell division and growth-will be made possible. The use of soft X rays is not limited to biological studies-many applications are possible in, for example, fusion research, materials science, and astronomy. Such studies have only recently begun in earnest because several difficulties had to be overcome, major among these being the lack (for some purposes) of sufficiently intense sources, and the technological difficulties associated with making efficient optical systems. As is well known, the advent of dedicated synchrotron radiation sources, in particular, has alleviated the first of these difficulties, not just for the soft X-ray region. It is the purpose of this book to consider progress in the second.

Handbook of Optical Design, Third Edition covers the fundamental principles of geometric optics and their application to lens design in one volume. It incorporates classic aspects of lens design along with important modern methods, tools, and instruments, including contemporary astronomical telescopes, Gaussian beams, and computer lens design. Written by respected researchers, the book has been extensively classroom-tested and developed in their lens design courses. This well-illustrated handbook clearly and concisely explains the intricacies of optical system design and evaluation. It also discusses component selection, optimization, and integration for the development of effective optical apparatus. The authors analyze the performance of a wide range of optical materials, components, and systems, from simple magnifiers to complex lenses used in photography, ophthalmology, telescopes, microscopes, and projection systems. Throughout, the book includes a wealth of design examples, illustrations, and equations, most of which are derived from basic principles. Appendices supply additional background information. What's New in This Edition Improved figures, including 32 now in color Updates throughout, reflecting advances in the field New material on Buchdahl high-order aberrations Expanded and improved coverage of the calculation of wavefront aberrations based on optical path An updated list of optical materials in the appendix A clearer, more detailed description of primary aberrations References to important new publications Optical system design examples updated to include newly available glasses 25 new design examples This comprehensive book combines basic theory and practical details for the design of optical systems. It is an invaluable reference for optical students as well as scientists and engineers working with optical instrumentation.

This book—unique in the literature—provides readers with the mathematical background needed to design many of the optical combinations that are used in astronomical telescopes and cameras. The results presented in the work were obtained by using a different approach to third-order aberration theory as well as the extensive use of the software package Mathematica®. Replete with workout examples and exercises, Geometric Optics is an excellent reference for advanced graduate students, researchers, and practitioners in applied mathematics, engineering, astronomy, and astronomical optics. The work may be used as a supplementary textbook for graduate-level courses in astronomical optics, optical design, optical engineering, programming with Mathematica, or geometric optics.

"Astronomy and Astrophysics Abstracts" appearing twice a year has become one of the fundamental publications in the fields of astronomy, astrophysics and neighbouring sciences. It is the most important English-language abstracting journal in the mentioned branches. The abstrats are classified under more than a hundred subject categories, thus permitting a quick survey of the whole extended material. The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences. As such it represents a necessary ingredient of any astronomical library all over the world.

The book is designed as an introduction for engineers and researchers wishing to obtain a fundamental knowledge and a snapshot in time of the cutting edge in technology research. As a natural consequence, Nano and Giga Challenges is also an essential reference for the "gurus" wishing to keep abreast of the latest directions and challenges in microelectronic technology development and future trends. The combination of viewpoints presented within the book can help to foster further research and cross-disciplinary interaction needed to surmount the barriers facing future generations of technology design. Key Features: • Quickly becoming the hottest topic of the new millennium (2.4 billion dollars funding in US alone • Current status and future trends of micro and nanoelectronics research • Written by leading experts in the corresponding research areas • Excellent tutorial for graduate students and reference for "gurus"

A beginner's introduction to Optics, Thin Films, Lasers and Crystals. Parts 1-3 cover: absorption, angle of incidence, antireflection, bandgap, birefringence, Bravais, lattice,

damage, dielectric, crystallography, grating, diode, electric field, diffraction, oscillator, electro-optic, emission, energy gap, poling, fiber optic, fluorescence, frequency, geometrical optics, glide plane, graded-index, grinding, group velocity, harmonic generation, index, interference, filters, cavity, diodes, pumping, laser, light, melting glass, Miller indices, mode-locking, molding, nonlinear, semiconductor, nucleation, optical cavity, coatings, resonator, phase shift, phase velocity, phonon, photon, p-n junction, point group, polishing, population inversion, Q-switched, saturable absorber, screw axis, semiconductor, solid state, space group, substrate, sum-frequency, tuning, temperature-bandwidth, thin films, transmission, unit cell, unstable resonator, walkoff, wave vector, waveguide, wavelength...and much more. Enjoy

From the reviews: "Astronomy and Astrophysics Abstracts has appeared in semi-annual volumes since 1969 and it has already become one of the fundamental publications in the fields of astronomy, astrophysics and neighbouring sciences. It is the most important English-language abstracting journal in the mentioned branches. ...The abstracts are classified under more than a hundred subject categories, thus permitting a quick survey of the whole extended material. The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences. As such it represents a necessary ingredient of any astronomical library all over the world." Space Science Reviews#1 "Dividing the whole field plus related subjects into 108 categories, each work is numbered and most are accompanied by brief abstracts. Fairly comprehensive cross-referencing links relevant papers to more than one category, and exhaustive author and subject indices are to be found at the back, making the catalogues easy to use. The series appears to be so complete in its coverage and always less than a year out of date that I shall certainly have to make a little more space on those shelves for future volumes." The Observatory Magazine#2

This book discusses the characteristics of a diffraction image of an incoherent or a coherent object formed by an aberrated imaging system. Numerical results in aberrated imaging have been emphasized to maximize the practical use of the material. This new, second printing includes a number of updates and corrections to the first printing. Beginning with a description of the diffraction theory of image formation, the book describes both aberration-free and aberrated imaging by optical systems with circular, annular, or Gaussian pupils. As in part I, the primary aberrations are emphasized. Their effects on Strehl, Hopkins, and Struve ratios are discussed in detail. The balanced aberrations are identified with Zernike polynomials appropriate for each type of system. Imaging in the presence of random aberrations is also discussed that includes the effects of image motion and propagation through atmospheric turbulence. Each chapter ends with a set of practical problems.

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Publishes papers reporting on research and development in optical science and engineering and the practical applications of known optical science, engineering, and technology. Covering a wide range of topics related to neutron and x-ray optics, this book explores the aspects of neutron and x-ray optics and their associated background and applications in a manner accessible to both lower-level students while retaining the detail necessary to advanced students and researchers. It is a self-contained book with detailed mathematical derivations, background, and physical concepts presented in a linear fashion. A wide variety of sources were consulted and condensed to provide detailed derivations and coverage of the topics of neutron and x-ray optics as well as the background material needed to understand the physical and mathematical reasoning directly related or indirectly related to the theory and practice of neutron and x-ray optics. The book is written in a clear and detailed manner, making it easy to follow for a range of readers from undergraduate and graduate science, engineering, and medicine. It will prove beneficial as a standalone reference or as a complement to textbooks. Supplies a historical context of covered topics. Detailed presentation makes information easy to understand for researchers within or outside the field. Incorporates reviews of all relevant literature in one convenient resource.

The content of this book covers several up-to-date topics in fluid dynamics, computational modeling and its applications, and it is intended to serve as a general reference for scientists, engineers, and graduate students. The book is comprised of 30 chapters divided into 5 parts, which include: winds, building and risk prevention; multiphase flow, structures and gases; heat transfer, combustion and energy; medical and biomechanical applications; and other important themes. This book also provides a comprehensive overview of computational fluid dynamics and applications, without excluding experimental and theoretical aspects.

Fundamentals of Photonics: A complete, thoroughly updated, full-color second edition Now in a new full-color edition, Fundamentals of Photonics, Second 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 logical 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 photons and atoms, and semiconductor optics. Presented at increasing levels of complexity, preliminary sections build toward more advanced topics, such as Fourier optics and holography, guided-wave and fiber optics, semiconductor sources and detectors, electro-optic and acousto-optic devices, nonlinear optical devices, optical interconnects and switches, and optical fiber communications. Each of the twenty-two chapters of the first edition has been thoroughly updated. The Second Edition also features entirely new chapters on photonic-crystal optics (including multilayer and periodic media, waveguides, holey fibers, and resonators) and ultrafast optics (including femtosecond optical pulses, ultrafast nonlinear optics, and optical solitons). The chapters on optical interconnects and switches and optical fiber communications have been completely rewritten to accommodate current technology. Each chapter contains summaries, highlighted equations, exercises, problems, and selected reading lists. Examples of real systems are included to emphasize the concepts governing applications of current interest.

This book addresses some of the issues in visual optics with a functional analysis of ocular aberrations, especially for the purpose of vision correction. The basis is the analytical representation of ocular aberrations with a set of orthonormal polynomials, such as Zernike polynomials or the Fourier series. Although the aim of this book is the application of wavefront optics to laser vision

correction, most of the theories discussed are equally applicable to other methods of vision correction, such as contact lenses and intraocular lenses.

From the reviews: Astronomy and Astrophysics Abstracts has appeared in semi-annual volumes since 1969 and it has already become one of the fundamental publications in the fields of astronomy, astrophysics and neighbouring sciences. It is the most important English-language abstracting journal in the mentioned branches. ... The abstracts are classified under more than hundred subject categories, thus permitting a quick survey of the whole extended material. The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences. As such it represents a necessary ingredient of any astronomical library all over the world." Space Science Reviews #1 "Dividing the whole field plus related subjects into 108 categories, each work is numbered and most are accompanied by brief abstracts. Fairly comprehensive cross-referencing links relevant papers to more than one category, and exhaustive author and subject indices are to be found at the back, making the catalogues easy to use. The series appears to be so complete in its coverage and always less than a year out of date that I shall certainly have to make a little more space on those shelves for future volumes." The Observatory Magazine #1

Astronomy and Astrophysics Abstracts is devoted to the recording, summarizing and indexing of astronomical publications throughout the world. Two volumes are scheduled to appear per year. Volume 67 records 10,903 papers covering besides the classical fields of astronomy and astrophysics such matters as space flights related to astronomy, lunar and planetary probes and satellites, meteorites and interplanetary matter, X rays and cosmic rays, quasars and pulsars. The abstracts are classified under more than one hundred subject categories thus permitting quick surveying of the bulk of material published on the same topic within six months. For instance, this volume records 119 papers on minor planets, 155 papers on supernovae, and 554 papers on cosmology.