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Evolutionary computation is one of the fastest growing areas of computer science, partly because of its broad applicability to engineering problems. The methods can be applied to problems as diverse as supply-chain optimization, routing and planning, task assignment, pharmaceutical design, interactive gaming, and many others within the signal processing domain. The text is an outgrowth of a series of SPIE short courses taught by the author. The examples span a range of applications and should be useful to a variety of readers of mixed backgrounds and expertise.

This tutorial text provides the reader with an understanding of artificial neural networks (ANNs), and their application, beginning with the biological systems which inspired them, through the learning methods that have been developed, and the data collection processes, to the many ways ANNs are being used today. The material is presented with a minimum of math (although the mathematical details are included in the appendices for interested readers), and with a maximum of hands-on experience. All specialized terms are included in a glossary. The result is a highly readable text that will teach the engineer the guiding principles necessary to use and apply artificial neural

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A broad variety of techniques described in this book, as applied to a number of tasks in robotics, provide the reader with a feel for the potential of lasers and fiber optics in this area of increasing relevance. The many examples of devices and systems that are included here are of interest to the nonspecialist as well as to the researcher and industrial practitioner.

This tutorial explains performance and quality considerations in medical imaging displays. After defining performance requirements for high-fidelity displays, the book introduces the display technologies that are likely to be used in medical imaging workstations.

This text explains the mutual influences between the physical and dynamic processes in solids and their lasing properties. It provides insight into the physics and engineering of solid state lasers by integrating information from several disciplines, including solid state physics, materials science, photophysics, and dynamic processes in solids. The text discusses approaches to developing new laser materials and includes data tables of basic parameters that can be applied to laser design. Novel materials and techniques used in recent developments are also covered.

This Tutorial Text provides a comprehensive introduction to the subject of contamination control, with specific applications to the aerospace industry. The author draws upon his many years as a practicing contamination control engineer, researcher,

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and teacher. The book examines methods to quantify the cleanliness level required by various contamination-sensitive surfaces and to predict the end-of-life contamination level for those surfaces, and it identifies contamination control techniques required to ensure mission success.

Annotation There is a maximum power and energy that you can put into or transmit through your optical system; in many cases, this maximum is well below the laser-induced damage threshold. This tutorial explains the factors and constraints that limit the power- and energy-handling capability of optical materials, components, and/or systems. Because the lasers coming off the production lines are much more stable, efficient, and controlled than in the past, today's engineers often do not have the insight into the technology as was required of first-generation laser engineers. However, important insights into the use and performance of the laser and optical systems can be lost unless we remind ourselves at periodic intervals of the problems our predecessors had to face.

This tutorial explains the human eye, its function, and performance limits from the perspective of an experienced optical engineer and lens designer. It is concise and readable, with examples and data, and is intended for students, practicing engineers, and technology users.

This book supplies the optical component and systems designer, and quality assurance engineers and managers with the definitions, measurement principles, and standard metrics

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used to characterize high-quality specular surfaces. The author covers both the traditional visual methods as well as newer (but not necessarily better) computer-aided techniques and describes the metrics adopted by the new ISO standards, including the setting of form and finish tolerances. Key issues of industry are raised, to help stimulate research and development of new methods and standards that blend the best of the old and new approaches to surface assessment.

This book provides the reader with the broad range of materials that were discussed in a series of short courses presented at Georgia Tech on the design, fabrication, and testing of diffractive optical elements (DOEs). Although there are not long derivations or detailed methods for specific engineering calculations, the reader should be familiar and comfortable with basic computational techniques. This text is not a 'cookbook' for producing DOEs, but it should provide readers with sufficient information to assess whether this technology would benefit their work, and to understand the requirements for using the concepts and techniques presented by the authors.

The increased interest in imaging spectroscopy has arisen largely for technical reasons. This Tutorial Text first reviews the required background in optics, radiometry, imaging, spectral sensing and focal plane arrays. Then the principles of these subjects are applied to several specific problems to illustrate the way in which such instruments can be designed.

As electromagnetics, photonics, and materials science evolve, it is increasingly important for students and practitioners in the physical sciences and engineering to understand vector calculus and tensor analysis. This book provides a review of vector calculus. This review includes necessary excursions into tensor analysis intended as the reader's first exposure to

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tensors, making aspects of tensors understandable to advanced undergraduate students. This book will also prepare the reader for more advanced studies in vector calculus and tensor analysis.

This text provides insight into the design of optimal image processing operators for implementation directly into digital hardware. Starting with simple restoration examples and using the minimum of statistics, the book provides a design strategy for a wide range of image processing applications. The text is aimed principally at electronics engineers and computer scientists, but will also be of interest to anyone working with digital images.

From a strict semantic point of view, nonlinear image processing encompasses all image processing that is not based on linear operators; however, from a practical, evolutionary point of view, the name itself is usually associated with the study of nonlinear filters, mainly the deterministic and nondeterministic analysis and design of logic-based operators. This Tutorial Text volume explores logic-based operators with emphasis on representation, design, and statistical optimization of nonlinear filters.

Radiometry is an essential part of the optical design of virtually every optical instrument, and key to many applications. It is also used to measure the radiation of various objects. This tutorial examines both the techniques of calculating radiative transfer and the measurement of fluxes and radiometric properties of various sorts.

Ten years after the publication of *Infrared Optics and Zoom Lenses*, this text is still the only current publication devoted exclusively to infrared zoom lenses. This updated second edition includes 18 new refractive and reflective infrared zoom systems, bringing the total number of infrared zoom optical systems to 41 systems. Other additions include a section on focal plane

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arrays and a new closing chapter specifically devoted to applications of infrared zoom lenses. Coverage of wavelength region has been expanded to include the near infrared. Additional topics include an examination of the importance of principal planes, methods for athermalization by means of computer glass substitution, and global optimization techniques for zoom lens design.

In order to utilize digital images effectively, specific techniques are needed to reduce the number of bits required for their representation. This Tutorial Text provides the groundwork for understanding these image compression techniques and presents a number of different schemes that have proven useful. The algorithms discussed in this book are concerned mainly with the compression of still-frame, continuous-tone, monochrome and color images, but some of the techniques, such as arithmetic coding, have found widespread use in the compression of bilevel images. Both lossless (bit-preserving) and lossy techniques are considered. A detailed description of the compression algorithm proposed as the world standard (the JPEG baseline algorithm) is provided. The book contains approximately 30 pages of reconstructed and error images illustrating the effect of each compression technique on a consistent image set, thus allowing for a direct comparison of bit rates and reconstructed image quality. For each algorithm, issues such as quality vs. bit rate, implementation

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complexity, and susceptibility to channel errors are considered.

The authors have designed a tutorial text to provide scientists with a technical understanding of computer-based imaging systems and how these systems interact with digital image processing algorithms. Contents include Boolean logic, image processing, image compression, basic computer architecture, advanced architectures, image processors, operating systems, error detection and correction, local area networks, object-oriented design paradigms, and software engineering. Contains numerous figures and case studies. Annotation copyrighted by Book News, Inc., Portland, OR

The image analysis community has put much effort into developing systems for the automatic reading of various types of documents containing text, graphic information, and pictures. A closely related but much more problematic task is the reading and interpretation of line drawings such as maps, engineering drawings, and diagrams. This book considers the problem in detail, analyzes its theoretical foundations, and analyzes existing approaches and systems.

\- Preface - List of Figures - List of Tables - List of Acronyms and Abbreviations - Preface - Introduction - Basics of Noncontact Thermal Measurement - Matching the Instrument to the Application - Instruments Overview - Using IR Sensing and Imaging Instruments - Introduction to Applications - Plant Condition Monitoring

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and Predictive Maintenance - Buildings and Infrastructure - Materials Testing - Product and Process Monitoring Control - Night Vision, Security, and Surveillance - Life Sciences Thermography - Appendix A: Commercial Instrument Performance Characteristics - Appendix B: Manufacturers of IR Sensing and Imaging Instruments - Appendix C: Table of Generic Normal Emissivities of Materials - Appendix D: A Glossary of Terms for the Infrared Thermographer

This book is intended to familiarize the reader with the method of Gaussian matrices and some related tools of optical design. The matrix method provides a means to study an optical system in the paraxial approximation. This text contains new results such as theorems on the design of variable optics, on integrating rods, on the optical layout of prism devices, etc. The results are derived in a step-by-step way so that the reader might apply the methods presented here to resolve design problems with ease.

This tutorial will help technical professionals in optics determine whether their technologies have potential application in the life sciences. It also is useful as a 'prep class' for more detailed books on biology and biotechnology, filling the gap between fundamental and high-level approaches.

This text covers lithography process control at several levels, from fundamental through advanced topics. The book is a self-contained tutorial that works both as

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an introduction to the technology and as a reference for the experienced lithographer. It reviews the foundations of statistical process control as background for advanced topics such as complex processes and feedback. In addition, it presents control methodologies that may be applied to process development pilot lines.

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 tutorial presents optomechanical modeling techniques to effectively design and analyze high-performance optical systems. It discusses thermal and structural modeling methods that use finite-element analysis to predict the integrity and performance of optical elements and optical support structures. Includes accompanying CD-ROM with examples.

This book provides a comprehensive account of the theory of image formation in

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a confocal fluorescence microscope as well as a practical guideline to the operation of the instrument, its limitations, and the interpretation of confocal microscopy data. The appendices provide a quick reference to optical theory, microscopy-related formulas and definitions, and Fourier theory.

This tutorial text focuses on the optics and detector aspects of infrared system design. It introduces the terminology, processes, and instrument design techniques available. Design examples are based on real problems investigated by the author.

This text examines the various ways in which prisms and small mirrors typically are designed and mounted in optical instruments. It provides analytical tools for evaluating different designs, and discusses the advantages and disadvantages of various techniques. The book, in part, is an outgrowth of SPIE short courses taught by the author and is a companion to his 1995 volume "Mounting Lenses in Optical Instruments". The work should be useful for engineers and other practitioners in the fields of optical engineering and optomechanical design.

This is a practical book on wavefront sensing. Emphasis is on principles and techniques, rather than detailed mathematical analysis of such systems. The goal is to provide the reader with a qualitative understanding of wavefront sensor operation.

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Annotation This tutorial fully explains cathode ray tube (CRT) based displays in a single, easy-to-understand narrative. Detailed explanations and insights into performance properties and safety limits of the various glass melts follow a discussion of the fundamentals. In addition, other topics covered include the architectural differences between color and monochrome, the cathode (electron beam source) as a failure mode for all CRTs, types of cathodes available and their life expectancy. Phosphors, the metrics involved in defining a pixel and how distortions can influence the net results, defining CRT compliance with the DICOM Grayscale Standard Display Function (GSDF), test patterns and how they provide information about display performance, and video cards round out this informative work.

Polarimetric remote sensing offers the potential to provide a new dimension for observations of the Earth. This book takes a systems approach to the physical processes involved with formation, collection, and analysis of polarimetric remote sensing data in the visible through longwave infrared. The emphasis is on Earth observation at human scales (ground sample distances of fractions of a meter to tens of meters) where the contrast between manmade objects and natural backgrounds are typical subjects of interest. This text is targeted at individuals with a sound quantitative understanding of remote sensing who need an

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introduction to polarimetric signals as they relate to remote sensing. It includes a brief review of the polarized nature of electromagnetic energy and radiometry and introduces ways to characterize a beam of polarized energy (Stokes vectors) and polarized energy matter interactions (Mueller matrices). The polarized bidirectional reflectance distribution function (pBRDF) is introduced as a way to characterize the reflective and emissive polarimetric behavior of materials. The goal is to provide the reader with an introduction to the topic, an appreciation of the issues, and the tools to begin to work in this field.

The practical, popular 1995 tutorial has been thoroughly revised and updated, reflecting developments in technology and applications during the past decade. New chapters address wave aberrations, thermal effects, design examples, and diamond turning.

Morphological image processing, a standard part of the imaging scientist's toolbox, can be applied to a wide range of industrial applications. Concentrating on applications, this text shows how to analyse the problems and then develop successful algorithms to solve them.

Many applications today require the Fourier-transform (FT) spectrometer to perform close to its limitations, such as taking many quantitative measurements in the visible and in the near infrared wavelength regions. In such cases, the instrument should not

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be considered as a perfect "black box." Knowing where the limitations of performance arise and which components must be improved are crucial to obtaining repeatable and accurate results. One of the objectives of this book is to help the user identify the instrument's bottleneck.

A textbook designed to accompany The Society of Photo-Optical Instrumentation Engineers' short course on improving interconnect performance for increased speed in overall circuit performance authored by Steinbrnchel (materials science and engineering, Renselaer Polytechnic Institute) and Chin (senio

This text aims to expose students to the science of optics and optical engineering without the complications of advanced physics and mathematical theory.

This Tutorial Text is intended for practitioners in the fields of optical engineering and optomechanical design. It provides a comprehensive examination of the different ways in which lenses typically are mounted in optical instruments, of the advantages and disadvantages of various mounting arrangements, and of the analytical tools that can be used to evaluate and compare different designs. Each section contains an illustrated discussion of the technology involved and one or more practical examples, where feasible.

This tutorial introduces the theory and applications of MTF, used to specify the image quality achieved by an imaging system. It covers basic linear systems theory and the relationship between impulse response, resolution, MTF, OTF, PTF, and CTF. Practical

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measurement and testing issues are discussed.

This introduction to uncooled infrared focal plane arrays and their applications is aimed at professionals, students, and end users. Topics include principal uncooled thermal detection mechanisms; fundamental performance limits and theoretical performance; the state of the art; and applications, technical trends, and systems employing uncooled arrays.

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