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Optics deals with light waves, which are electromagnetic waves. Electromagnetic waves include not only light waves, but also ordinary alternating current at 60Hz, radio waves, microwaves, infrared, X-rays and γ -rays.

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Electromagnetic waves obey Maxwell's equations, which are introduced in Sect. 2.1, which also treats the electromagnetic wave equation followed by the plane-wave solution in homogeneous, linear isotropic space.

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The subject "optical signal processing" can and should include all aspects of optics and signal processing. However, that is too large a scope for a textbook that, like this

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one, is intended as an introduction to the subject at a level suitable for first year graduate students of electrical engineering, physics, and optical engineering. Therefore, the subject matter has been restricted. The book begins with basic background material on optics, signal processing, matrix algebra, ultrasound and SAWs, and CCDs. One might argue about this choice of topics. For example, there already exist very good books on matrix algebra. However, matrix algebra is so important in signal processing, especially in connection with devices such as optical

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matrix processors, that it was felt that a review was essential. Also, the matrix algebra needed for systolic arrays and parallel computing has made great advances in recent years. My original intention was to write a single-volume textbook covering most of the fundamental concepts and applications of optical signal processing. However, it soon became apparent that the large amount of material to be included would make publication in a single volume impracticable. Therefore this volume treats the "fundamentals" and a second volume will appear dealing with devices and

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Applications. This textbook was stimulated by a set of short courses that I have directed and lectured since 1976, as well as regular courses that I have taught at Rensselaer Polytechnic Institute since 1974.

1.1 Digital Optics as a Subject Improvement of the quality of optical devices has always been the central task of experimental optics. In modern terms, improvements in sensitivity and resolution have equated higher quality with greater informational throughput. For most of today's applications, optics and electronics have, in

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essence, solved the problem of generating high quality pictures with great informational capacity.

Effective use of the enormous amount of information contained in the images necessitates processing pictures, holograms, and interferograms. The manner in which information might be extracted from optical entities has become a topic of current interest. The informational aspects of optical signals and systems might serve as a basis for attacking this question by making use of information theory and signal communication theory, and by

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enlisting modern tools and methods for data processing (the most important and powerful of which are those of digital computation). Exploiting modern advances in electronics has allowed new wavelength ranges and new kinds of radiation to be used in optics. Computers have extended our knowledge of the informational essence of radiation. Thus, computerized optical devices enhance not only the optical capabilities of sight, but also its analytical capabilities as well, thus opening qualitatively new horizons to all the areas in which optical devices have found application.

Read Online Signal Processing Using Optics Fundamentals Devices

Ideal for senior-level undergraduate and first year graduate students in electrical engineering and applied physics as well as practicing engineers and scientists, this accessible text also includes problem exercises, selected hints and solutions, extensive references, and MATLAB-based modeling.

Intended for use as both a senior and graduate level textbook and as a reference for workers in the field, it combines a solid treatment of optical signal processing theory with detailed descriptions of selected

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Fundamentals Applications

With a focus on processing two-dimensional analog signals, it treats the

important new area of

acousto-optic signal processing. Beginning with

an examination of optical signal processing

fundamentals, chapters cover basic signal parameters,

geometrical optics, physical optics, spectrum analysis

and spatial filtering. Later chapters, focusing on

applications, examine heterodyne systems,

heterodyne spectrum analysis, decimated arrays

and cross-spectrum analysis, heterodyne transform and

signal excision, space

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integrating correlators, time integrating systems and two-dimensional processing.

In recent years, Moore's law has fostered the steady growth of the field of digital image processing, though the computational complexity remains a problem for most of the digital image processing applications. In parallel, the research domain of optical image processing has matured, potentially bypassing the problems digital approaches were suffering and bringing new applications. The advancement of technology calls for applications and

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knowledge at the intersection of both areas but there is a clear knowledge gap between the digital signal processing and the optical processing communities. This book covers the fundamental basis of the optical and image processing techniques by integrating contributions from both optical and digital research communities to solve current application bottlenecks, and give rise to new applications and solutions. Besides focusing on joint research, it also aims at disseminating the knowledge existing in both domains. Applications covered include image

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restoration, medical imaging, surveillance, holography, etc... "a very good book that deserves to be on the bookshelf of a serious student or scientist working in these areas."

Source: Optics and Photonics News

This cutting-edge book is a clear and thorough exposition of signal-processing fundamentals for communications and major sensing systems. Based on the author's earlier book in this area, this revised and expanded resource offers you expert guidance in the detection of optical, acoustic and radio-frequency

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signals in noise. It covers digital filtering and parameter estimation, and helps you with problems associated with radar system design, including search, tracking and measurement ambiguity."

Nonlinear Optical Systems: Principles, Phenomena, and Advanced Signal Processing is a simplified overview of the evolution of technology associated with nonlinear systems and advanced signal processing. This book's coverage ranges from fundamentals to phenomena to the most cutting-edge

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aspects of systems for next-generation biomedical monitoring and nonlinear optical transmission. The authors address how these systems are applied through photonic signal processing in contemporary optical systems for communications and/or laser systems. They include a concise but sufficient explanation of mathematical representation of nonlinear equations to provide insight into nonlinear dynamics at different phases. The book also describes advanced aspects of solitons and bound solitons for passive- and active-mode locked fiber lasers, in which higher-

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Order differential equations can be employed to represent the dynamics of amplitude evolution in the current or voltages of lightwaves in such systems. Covering a wide range of topics, this book: Introduces nonlinear systems and some mathematical representations, particularly the routes to chaos and bifurcation Describes nonlinear fiber lightwave lasing systems Covers nonlinear phenomena in fiber lasers, including both passive and active energy storage cavities Experimentally and theoretically demonstrates soliton pulses, in which

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lightwaves are the carrier under their envelopes Assembles and demonstrates sequences of both single and multiple solitons in a group and then assesses their dynamics in detail Examines the evolution of bound solitons, which are transmitted through single-mode optical fibers that compose a phase variation system This text outlines the theory and techniques used in nonlinear physics and applications for physical systems. It also illustrates the use of MATLAB® and Simulink® computer models and processing techniques for nonlinear signals. Building

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on readers' newly acquired fundamental understanding of nonlinear systems and associated signal processing, the book then demonstrates the use of such applications in real-world, practical environments.

The potential of photonic signal processing (PSP) to overcome electronic limits for processing ultra-wideband signals, provide signal conditioning that can be integrated in line with fiber optic systems, and improve signal quality makes this technology extremely attractive for improvement in receiver sensitivity performance. Spanning the

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current transitional period, Photonic Signal Processing: Techniques and Applications addresses the merging techniques of processing and manipulating signals propagating in the optical domain. The book begins with a historical perspective of PSP and introduces photonic components essential for photonic processing systems, such as optical amplification devices, optical fibers, and optical modulators. The author demonstrates the representation of photonic circuits via a signal flow graph technique adapted for photonic domain. He describes photonic signal

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processors, such as differentiators and integrators, and their applications for the generation of solitons, and then covers the application of these solitons in optically amplified fiber transmission systems. The book illustrates the compensation dispersion using a photonic processor, the design of optical filters using photonic processor techniques, and the filtering of microwave signals in the optical domain. Exploring methods for the processing of signals in the optical domain, the book includes solutions to photonic

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circuits that use signal flow techniques and significant applications in short pulse generation, the filtering of signals, differentiation, and the integration of signals. It delineates fundamental techniques on the processing of signals in the optical domain as well as their applications that lead to advanced aspects of performing generation of short pulses, integration, differentiation, and filtering for optical communications systems and networks and processing of ultra-high speed signals.

Fibre Optics Is A Very

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Phenomenal Progress, A New Class Of Ultra-Sensitive Optical Sensors And Devices Based On Fibre Optics Has Emerged, Which Are Being Developed For Large Scale Use In Industrial And Biomedical Sectors. This Book Provides Semi-Tutorial Presentations Of The Fundamentals Of This Emerging Technology As Applied To Telecommunication And Sensor Development. Each Chapter, Contributed By Leading Researchers, Is Appended With A Large Number Of References To The Original Publications. The Book Is Broadly Divided Into Three Parts. The First Part Is Devoted To Propagation

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