Optical And Digital Image Processing Fundamentals And Applications | 28731c7fa501baadb85fa7fdb5323fb7

Digital Image Processing


This unique reference presents in-depth coverage of the latest methods and applications of digital image processing describing various computer architectures ideal for satisfying specific image processing demands. This long-established and well-received monograph offers an integral view of image processing - from image acquisition to the extraction of the data of interest – written by a physical scientists for other scientists. Supplements discussion of the general concepts is supplemented with examples from applications on PC-based image processing systems and ready-to-use implementations of important algorithms. Completely revised and extended, the most notable extensions being a detailed discussion on random variables and fields, 3-D imaging techniques and a unified approach to regularized parameter estimation. Complete text of the book is now available on the accompanying CD-ROM. It is hyperlinked so that it can be used in a very flexible way. CD-ROM contains a full set of exercises to all topics covered by this book and a runtime version of the image processing software heurisko. A large collection of images, image sequences, and volumetric images is available for practice exercises. Digital image processing has experienced explosive growth over the past two decades. Public awareness has increased by way of video games, digital video special effects used in the entertainment industry, as well as articles in the mainstream press. However, the most significant impact of digital image processing in the 90s will be in the area of applications to real-world problems. To help readers keep pace, author Kenneth R. Castleman concentrates on those techniques that have proven most useful in practice. Part I presents several important concepts that can be developed without detailed mathematical analysis for a basic understanding. Part II addresses techniques that rely more on mathematics and elaborates analytically on certain concepts introduced in Part I. Part III covers specific application areas that are particularly important in industry, science, and medicine. This book is directed to engineers and scientists who need to understand the fundamentals of image processing theory and algorithms to perform specific image processing tasks. It is intended to fill the gap between existing high-level texts and the need for a more practical and fundamental text on image processing. Throughout, the author has included a large number of examples to give the reader a better understanding of how particular image processing algorithms work. The influence and impact of digital images on modern society, science, technology and art are tremendous. Image processing has become such a critical component in contemporary science and technology that tasks would be unsolvable without it. It is used in medical diagnosis, microscopy, radio astronomy, computer vision, geology and many other fields. With a few exceptions, the topics of optical information processing and digital information processing are usually covered in different books, written by experts in one field or the other. It is rare that the two topics are both covered in the same volume. This book is an exception to this trend, and is notable in several different aspects, but especially in its breadth of coverage of both topics. It seems very appropriate to have both general topics covered in the same book, for optical processing systems (defined broadly) commonly include digital systems to drive the optical system and to post-process the data (example: adaptive-optic systems), while digital processing systems most commonly operate on data that has been gathered by an optical system. As a consequence, sophisticated image-gathering and handling systems today include both types of technology, a merger that grows more complete as time progresses. Indeed, even consumer-oriented devices such as digital cameras are sophisticated systems with optical and digital parts. This is a text for use in a first practical course in image processing and analysis, for final-year undergraduate or first-year graduate students with a background in biomedical engineering, computer science, physics, or related disciplines. Designed for computer scientists and engineers as well as on University textbook level. In this book, the author aims to provide an insight into the fundamental and the effective use of image processing tools and uses mathematics as a tool, minimizing the advanced mathematical development of other textbooks. A unique collection of algorithms and lab experiments for practitioners and researchers of digital image processing technology. With the field of digital image processing rapidly expanding, there is a growing need for a book that would go beyond theory and techniques to address the underlying algorithms. Digital Image Processing Algorithms and Applications fills the gap in the field, providing scientists and engineers with a complete library of algorithms for digital image processing, coding, and analysis. Digital image transform algorithms, edge detection algorithms, and image segmentation algorithms are clearly gleaned from the literature for compatibility and a track record of acceptance in the scientific community. The author guides readers through all facets of the technology, supplementing the discussion with detailed lab exercises in EIKONA, his own digital image processing software, as well as useful PDF transparencies. He covers in depth filtering and enhancement, transforms, compression, edge detection, region segmentation, and shape analysis, explaining at every step the relevant theory, algorithm structure, and its use for problem solving in various applications. The availability of the lab exercises and the source code (all algorithms are presented in C-code) over the Internet makes the book an invaluable self-study guide. It also lets interested readers implement the algorithms on their own image processing applications on ordinary desktop computers as well as on Unix-based research machines. He also presents various aspects. Human beings perceive most of the information about their environment through their visual sense. While for a long time images could only be captured by photography, we are now at the edge of another technological revolution which allows image data to be captured, manipulated, and evaluated electronically with computers. With breathtaking pace, computers are becoming more powerful and at the same time less expensive, so that widespread applications for digital image processing emerge. In this way, image processing is becoming a tremendous tool to analyze image data in all areas of natural science. For more and more scientists digital image processing will be the key to study complex scientific problems they could not have dreamed to tackle only a few years ago. A door is opening for new interdisciplinary cooperations merging computer science with the corresponding research areas. Many students, engineers, and researchers in all natural sciences are faced with the problem of needing to know more about digital image processing. This book is written to meet this need. The author himself educated in physics-describes digital image processing as a new tool for scientific research. The book starts with the essentials of image processing and leads - in selected areas - to the state-of-the-art. This approach gives an insight as to how image processing really works. This long-established and well-received monograph offers an integral view of image processing - from image acquisition to the extraction of the data of interest – written by a physical scientists for other scientists. Supplementary discussion of the general concepts is supplemented with examples from applications on PC-based image processing systems and ready-to-use implementations of important algorithms. Completely revised and extended, the most notable extensions being a detailed discussion on random variables and fields, 3-D imaging techniques and a unified approach to regularized parameter estimation. This book covers the technology of digital image processing in various fields with big data and their applications. Readers will understand various technologies and strategies used in
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digital image processing as well as handling big data, using machine-learning techniques. This book will help to improve the skills of students and researchers in such fields as engineering, agriculture, and medical imaging. There is a need to be able to understand and analyse the latest developments of digital image technology. As such, this book will cover: • Applications such as biomedical science and biometric image processing, content-based image retrieval, remote sensing, pattern recognition, shape and texture analysis • New concepts in color interpolation to produce the full color from the sub-pattern bare pattern color prevalent in today's digital cameras and other imaging devices • Image compression standards that are needed and used to serve diverse applications • Applications of remote sensing, medical science, traffic management, education, innovation, and analysis in agricultural design and image processing • Both soft and hard computing approaches at great length in relation to major image processing tasks • The direction and development of current and future research in many areas of image processing • A comprehensive bibliography for additional research (integrated within the framework of the book) This book focuses not only on theoretical and practical knowledge in the field but also on the traditional and latest tools and techniques adopted in image processing and data science. It also provides an indispensable guide to a wide range of basic and advanced techniques in the fields of image processing and data science.

The funds received under Grant AFOSR-84-0295 for Research Instrumentation for Optical Signal Processing, Optical Materials and Devices, and Digital Image processing went for the purchase of equipment in support of several current AFOSR funded research projects at USC. The projects include: Nonlinear Real-Time Optical Signal Processing; Devices and Systems for Nonlinear Optical Information Processing; Processing of Images with Signal-Dependent Noise Using Nonstationary Models; and Image Processing, Image Understanding and Computer Vision. The equipment purchased consists of the following components: interactive image/graphics processor/display; DEC Vax 11/750 and Microvax II dedicated host computers; image processing software; and softcopy and hardcopy graphics peripherals. The equipment acquired has greatly improved research productivity in the projects listed by providing up-to-date hardware and software capable of performing advanced experimental projects which could not be done on previously available equipment. From the beginning, the equipment has met and beyond all requirements. This equipment has encouraged some researchers to stretch institutional and personal funds to further stimulate research for others. This is not just another image processing book; it is a book worth owning and a book worth reading several times " J.U. Electronic Imaging# This practical guidebook uses the concepts and mathematics familiar to students of the natural sciences to provide them with a working knowledge of modern techniques of digital image processing. It takes readers from basic concepts to current research topics and demonstrates how digital image processing can be used for data gathering in research. Detailed examples of applications on PC-based systems and ready-to-use algorithms enhance the text, as do nearly 200 illustrations (16 in color). The book also includes the most exciting recent advances such as reconstruction of 3-D objects from projections and the analysis of stereos images and image sequences. This book presents several recent advances that are related or fall under the umbrella of 'digital image processing', with the purpose of providing an insight into the possibilities offered by digital image processing algorithms in various fields. The presented mathematical algorithms are accompanied by graphical representations and illustrative examples for an enhanced readability. The chapters are written in a manner that allows even a reader with basic experience and knowledge in the digital image processing field to properly understand the presented algorithms. Concurrently, the structure of the information in this book is such that fellow scientists will be able to use it to push the development of the presented subjects even further. This unique reference presents in-depth coverage of the latest methods and applications of digital image processing describing various computer-aided and digital architectures ideal for satisfying specific image processing demands.

This book serves two purposes: first to introduce readers to the concepts of geometrical optics, physical optics and techniques of optical imaging and image processing, and secondly to provide them with experience in modeling the theory and applications using the commonly used software tool MATLAB®. A comprehensively revised version of the authors’ earlier book Principles of Applied Optics, Contemporary Optical Image Processing with MATLAB brings out the systems aspect of optics. This includes ray optics, Fourier Optics, Gaussian beam propagation, the step-step beam propagation method, holography and complex spatial filtering, ray theory of holograms, optical scanning holography, acousto-optic image processing, edge enhancement and correlation using photorefractive materials, holographic phase distortion correction, to name a few. MATLAB examples are given throughout the text. MATLAB is emphasized since it is now a widely accepted software tool very routinely used in signal processing. A sizeable portion of this book is based on the authors’ own in-class presentations, as well as research in the area. Instructive problems and MATLAB assignments are given at the end of each chapter to enhance and reinforce the material. The MathWorks’ proprietary software MATLAB® is indispensable in the area of image analysis, optics, fluorescence, and imaging devices in biomedical laboratories, this timely and invaluable volume focuses on the theory and applications of detection, morphology, and motility measurement techniques applied to bacteria, fungi, yeasts and protozoa. Digital holography and digital image processing are twins born by computer era. They share origin, theoretical base, methods and algorithms. The present book describes these common fundamentals principles, methods and algorithms including image and hologram digitization, data compression, digital transforms and efficient computational algorithms, statistical and Monte-Carlo methods, image restoration and enhancement, image reconstruction in tomography and digital holography, discrete signal resampling and image geometrical transformations, accurate measurement techniques or focal localization in images, recording and reconstruction of computer generated holograms, adaptive and non-linear filters for sensor signal perfecting and image restoration and enhancement. The book combines theory, heavily illustrated practical methods and efficient computational algorithms and is written for senior-level undergraduate and graduate students, researchers and engineers in optics, photonics, opto-electronics and electronic engineering. This introduction to the fundamental concepts and methodologies of image processing is suitable for first-year postgraduate and senior undergraduate students in almost every engineering discipline, and in particular meets the requirements of the prescribed ‘Course on the Basics of Electronics and Communication’ in Computer Science and Engineering, Information Technology, and Computer Applications.

The book, now in its second edition, continues to offer a balanced exposition of the basic principles and applications of image processing. It lays considerable emphasis on the algorithmic approach in order to teach students how to write good practical programs for problem solving. Major topics covered in the book include Image fundamentals, Different image transforms, Image enhancement in the spatial and frequency domains, Restoration, Image analysis, Image description, Image compression, Image reconstruction from projections, and Applications of image processing in the areas of biometrics, speaker recognition, satellite imaging, medical imaging, and many more. The style of presentation is comprehensive and application oriented, comprising examples, diagrams, image results, case studies of applications, and review questions—making it easy for students to understand key ideas, their practical relevance and applications.

NEW TO THIS EDITION • Object representation, recognition and classification • MATLAB programs for image processing • OpenCV programs for image processingIn 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 approaches 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 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 unique reference presents in-depth coverage of the latest methods and applications of digital image processing describing various computer-aided and digital architectures ideal for satisfying specific image processing demands. There are wide-ranging implications in information security beyond national defense. Securing our information has implications for virtually all aspects of our lives, including protecting the privacy of our financial transactions and medical records, facilitating all operations of government, maintaining the integrity of national borders, securing important facilities, ensuring the safety of our food and commercial products, protecting the safety of our aviation system—ever safeguarding the integrity of our very identity against theft. Information security is a vital element in all of these activities, as well as information collection and distribution become ever more connected through electronic information.
delivery systems and commerce. This book encompasses results of research investigation and technologies that can be used to secure, protect, verify, and authenticate objects and information from theft, counterfeiting, and manipulation by unauthorized persons and agencies. The book has drawn on the diverse expertise in optical sciences and engineering, digital image processing, imaging systems, information processing, mathematical algorithms, quantum optics, computer-based information systems, sensors, detectors, and biometrics to report novel technologies that can be applied to information-security issues. The book is unique because it has diverse contributions from the field of optics, which is a new emerging technology for security, and digital techniques that are portable and can be interfaced with optics to produce highly effective security systems. This authoritative text (the second part of a complete MSc course) provides mathematical methods required to describe images, image formation and different imaging systems, coupled with the principle techniques used for processing digital images. It is based on a course for postgraduates reading physics, electronic engineering, telecommunications engineering, information technology and computer science. This book relates the methods of processing and interpreting digital images to the physics of imaging systems. Case studies reinforce the methods discussed, with examples of current research themes. Provides mathematical methods required to describe images, image formation and different imaging systems Outline the principle techniques used for processing digital images Relates the methods of processing and interpreting digital images to the physics of imaging systems. Advances in Electronics and Electron Physics An introduction to color in three-dimensional image processing and the emerging area of multi-spectral image processing. The importance of color information in digital image processing is greater than ever. However, the transition from scalar to vector-valued image functions has not yet been generally covered in most textbooks. Now, Digital Color Image Processing fills this pressing need with a detailed introduction to this important topic. In four comprehensive sections, this book covers: The fundamentals and requirements for color image processing and optical systems. Preprocessing color images Three-dimensional scene analysis using color information, as well as the emerging area of multi-spectral imaging. Applications of color image processing, presented via the examination of two case studies. In addition to introducing readers to important new technologies in the field, Digital Color Image Processing also contains novel topics such as: Techniques for improving three-dimensional reconstruction, three-dimensional computer vision, and emerging areas of safety and security applications in surveillance and forensics. Complete with full-color illustrations and two applications chapters, Digital Color Image Processing is the only book that covers the breadth of the subject under one convenient cover. It is written at a level that is accessible for first- and second-year graduate students in electrical and computer engineering and computer science courses, and that is also appropriate for researchers who wish to extend their knowledge in the area of color image processing. This revised and expanded new edition of an internationally successful classic presents an accessible introduction to the key methods in digital image processing for both practitioners and teachers. Emphasis is placed on practical application, presenting precise algorithmic descriptions in an unusually high level of detail, while highlighting direct connections between the mathematical foundations and concrete implementation. The text is supported by practical examples and carefully constructed chapter-ending exercises drawn from the authors' years of teaching experience, including easily adaptable Java code and completely worked out examples. Source code, test images and additional instructor materials are also provided at an associated website. Digital Image Processing is the definitive textbook for students, researchers, and professionals in search of critical analysis and modern implementations of the most important algorithms in the field, and is also eminently suitable for self-study. Digital Color Image Processing is a state-of-the-art review of digital image processing techniques, with emphasis on the processing approaches and their associated algorithms. A canonical set of image processing problems that represent the class of functions typically required in image processing applications is presented. Each chapter broadly addresses the problem being considered; the best techniques for this particular problem and how they work; their strengths and limitations; and how the techniques are actually implemented as well as their computational aspects. Comprised of eight chapters, this volume begins with a discussion on processing techniques associated with the following tasks: image enhancement, restoration, detection and estimation, reconstruction, and analysis, along with image data compression and image spectral estimation. The second section describes hardware and software systems for digital image processing. Aspects of commercially available systems that combine both processing and display functions are considered, as are future prospects for their technological and architectural evolution. The specifics of system design trade-offs are explicitly presented in detail. This book will be of interest to students, practitioners, and researchers in various disciplines including digital signal processing, computer science, statistical communications theory, control systems, and applied physics. 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 Standard specifies the terms and definitions of photogrammetry and remote sensing, with English and Chinese indexes. This Standard is applicable to the establishment of photogrammetry and remote sensing standards, the preparation of technical documents, the compilation of teaching materials, books and literature.