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Medical Image Reconstruction Medical Image Reconstruction Iterative-Interpolation Super-Resolution Image Reconstruction Minimax Theory of Image Reconstruction Image Reconstruction in Radiology Machine Learning for Medical Image Reconstruction Image Reconstruction from Projections Fundamentals of Computerized Tomography Magnetic Resonance Image Reconstruction Image Reconstruction Magnetic Resonance Image Reconstruction Machine Learning for Medical Image Reconstruction MRI Regularized Image Reconstruction in Parallel MRI with MATLAB Mathematical Methods in Image Reconstruction Machine Learning for Medical Image Reconstruction Machine Learning for Medical Image Reconstruction Compressed Sensing Magnetic Resonance Image Reconstruction Algorithms Astronomical Image Reconstruction Biomedical Image Reconstruction Emission Tomography Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine Machine Learning for Medical Image Reconstruction Image Reconstruction from Incomplete Data 3D Image Reconstruction for CT and PET Photon Counting Computed Tomography 3D Image Reconstruction for CT and PET Image Reconstruction of a Manufacturing Process Bilevel Methods for Image Reconstruction Breast Image Reconstruction and Cancer Detection Using Microwave Imaging Magnetic Resonance Imaging with Nonlinear Gradient Fields High Dynamic Range Image Reconstruction The Effects of Finite Sampling and Additive Noise on Image Reconstruction from the Radon Transform Image Reconstruction and Restoration II Medical Image Processing, Reconstruction and Analysis Image Processing X-Ray Computed Tomography in Biomedical Engineering Hard X-ray Microscopy Enhanced by Coherent Image Reconstruction Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine CT of the Heart

Biomedical imaging is a vast and diverse field. There are a plethora of imaging devices using light, X-rays, sound waves, magnetic fields, electrons, or protons, to measure structures ranging from nano to macroscale. In many cases, computer software is needed to turn the signals collected by the hardware into a meaningful image. These computer algorithms are similarly diverse and numerous. This survey presents a wide swath of biomedical image reconstruction algorithms under a single framework. It is a coherent, yet brief survey of some six decades of research. The underpinning theory of the techniques are described and practical considerations for designing reconstruction algorithms for use in biomedical systems form the central theme of each chapter. The unifying framework deployed throughout the monograph models imaging modalities as combinations of a small set of building blocks, which identify connections between modalities Thus, the user can quickly port ideas and computer code from one to the next. Furthermore, reconstruction algorithms can treat the imaging model as a black. box, meaning that one algorithm can work for many modalities. This provides a pragmatic approach to designing effective reconstruction algorithms. This monograph is written in a tutorial style that concisely introduces students, researchers and practitioners to the development and design of effective biomedical image reconstruction algorithms. This reference text explores cutting edge research into the detection of breast cancer using Microwave Imaging. Early breast cancer detection is vital for reducing mortality rates. Within this book Microwave scattering and microwave imaging based cancer detection are analysed as well as breast anatomy and breast cancer types. The book discusses 3-D level set based optimization as well as the Finite difference time domain (FDTD) technique. Advanced methods in image reconstruction techniques and Group Theory are explained with application to computation reduction. Machine learning-based advanced methods are also described for breast cancer detection. This book is highly useful for the academic community working in biomedical imaging, electromagnetic and microwave imaging, breast cancer imaging, inverse scattering and optimization. Key Features: Breast cancer screening techniques are described and with advantages and disadvantages Multiple frequency inverse scattering is discussed Microwave imaging basics with detection analysis are explained in detail Includes 3-D level set based optimization Presents advanced methods on image-based reconstruction techniques This book is a comprehensive and richly-illustrated guide to cardiac CT, its current state, applications, and future directions. While the first edition of this text focused on what was then a novel instrument looking for application, this edition comes at a time where a wealth of guideline-driven, robust, and beneficial clinical applications have evolved that are enabled by an enormous and ever growing field of technology. Accordingly, the focus of the text has shifted from a technology-centric to a more patient-centric appraisal. While the specifications and capabilities of the CT system itself remain front and center as the basis for diagnostic success, much of the benefit derived from cardiac CT today comes from avant-garde technologies enabling enhanced visualization, quantitative imaging, and functional assessment, along with exciting deep learning, and artificial intelligence applications. Cardiac CT is no longer a mere tool for non-invasive coronary artery stenosis detection in the chest pain diagnostic algorithms; cardiac CT has proven its value for uses as diverse as personalized cardiovascular risk stratification, prediction, and management, diagnosing lesion-specific ischemia, guiding minimally invasive structural heart disease therapy, and planning cardiovascular surgery, among many others. This second edition is an authoritative guide and reference for both novices and experts in the medical imaging sciences who have an interest in cardiac CT. Regularization becomes an integral part of the reconstruction process in accelerated parallel magnetic resonance imaging (pMRI) due to the need for utilizing the most discriminative information in the form of parsimonious models to generate high quality images with reduced noise and artifacts. Apart from providing a detailed overview and implementation details of various pMRI reconstruction methods, Regularized image reconstruction in parallel MRI with MATLAB examples interprets regularized image reconstruction in pMRI as a means to effectively control the balance between two specific types of error signals to either improve the accuracy in estimation of missing samples, or speed up the estimation process. The first type corresponds to the modeling error between acquired and their estimated values. The second type arises due to the perturbation of k-space values in autocalibration methods or sparse approximation in the compressed sensing based reconstruction model. Features: Provides details for optimizing regularization parameters in each type of reconstruction. Presents comparison of regularization approaches for each type of pMRI reconstruction. Includes discussion of case studies using clinically acquired data. MATLAB codes are provided for each reconstruction type. Contains method-wise description of adapting regularization to optimize speed and accuracy. This book serves as a reference material for researchers and students involved in development of pMRI reconstruction methods. Industry practitioners concerned with how to apply regularization in pMRI reconstruction will find this book most useful. This is a practical guide to tomographic image reconstruction with projection data, with strong focus on Computed Tomography (CT) and Positron Emission Tomography (PET). It will be invaluable for graduate students and scientists in medical physics and biomedical engineering who are beginners in the field of image reconstruction. X-ray microscopy is used to study the structure, dynamics and bulk properties of matter with high spatial resolutions. It is widely applied, from physics and chemistry to material and life sciences. In the past two decades, progress in X-ray microscopy was driven either by improvements in X-ray optics or by improvements in the image reconstruction by using algorithms as computational lenses. In this work both approaches are combined to exploit the advantages of X-ray imaging with a large numerical aperture and the advantages of coherent image reconstruction. It is shown that a combined X-ray microscope using both, advanced optics and algorithms, is neither limited by flawed optics nor by constraints imposed by reconstruction algorithms, which enables to go beyond current limits in resolution and applications. The thesis is structured in four parts. In the first part hard X-ray lenses, so called multilayer zone plates, are simulated to investigate volume diffraction effects within the multilayer structure, and to study the potential for smaller focus sizes and higher efficiencies. In the second part, the multilayer zone plates are characterized and implemented in an X-ray microscope. In the third part, a new imaging scheme is presented, which combines in-line holography and coherent diffractive imaging. This method overcomes the current resolution limit of in-line holography and can achieve super-resolution with respect to the numerical aperture of the illuminating beam. Finally, in the fourth part a multilayer zone plate is used as an objective lens with a known transfer function in a novel coherent full-field imaging experiment based on iterative phase retrieval, for high resolution and quantitative contrast. This one-of-a-kind resource provides a very readable description of the methods used for image reconstruction in magnetic resonance imaging, X-ray computed tomography, and single photon emission computed tomography. The goal of this fascinating work is to provide radiologists with a practical introduction to mathematical methods so that they may better understand the potentials and limitations of the images used to make diagnoses. Presented in four parts, this state-of-the-art text covers (1) an introduction to the models used in reconstruction, (2) an explanation of the Fourier transform, (3) a brief description of filtering, and (4) the application of these methods to reconstruction. In order to provide a better understanding of the reconstruction process, this comprehensive volume draws analogies between several different reconstruction methods. This informative reference is an absolute must for all radiology residents, as well as graduate students and professionals in the fields of physics, nuclear medicine, and computer-assisted tomography. Magnetic Resonance Image Reconstruction: Theory, Methods and Applications presents the fundamental concepts of MR image reconstruction, including its formulation as an inverse problem, as well as the most common models and optimization methods for reconstructing MR images. The book discusses approaches for specific applications such as non-Cartesian imaging, under sampled reconstruction, motion correction, dynamic imaging and quantitative MRI. This unique resource is suitable for physicists, engineers, technologists and clinicians with an interest in medical image reconstruction and MRI. Explains the underlying principles of MRI reconstruction, along with the latest research/li> Gives example codes for some of the methods presented Includes updates on the latest developments, including compressed sensing, tensor-based reconstruction and machine learning based reconstruction This book contains twenty-one selected papers based on communications presented at the Third International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine, held July 4-6, 1995 at Domaine d'Aix- Marlioz, Aix-les-Bains, France. 3D tomographic imaging systems based on ionising radiations tend to use 2D detectors in order to improve the radiation detection efficiency. Then, fully 3D image reconstruction algorithms are required to recover the 3D image of the region of interest. These systems include 3D radiology, 3D X-ray computerised tomography, single photon emission computerised tomography (SPECT), and positron emission tomography (PET). The material is divided into four parts covering the following topics: cone-beam and new geometries reconstruction, SPECT quantitation, patient motion and gated SPECT, and PET quantitation and reconstruction. Audience:This work will be of interest to scientists, physicists and physicians seeking new information and insight in the on-going research work in this expanding field. Computed Tomography gives a detailed overview of various aspects of computed tomography. It discusses X-ray CT tomography from a historical point of view, the design and physical operating principles of computed tomography apparatus, the algorithms of image reconstruction and the quality assessment criteria of tomography scanners. Algorithms of image reconstruction from projections, a crucial problem in medical imaging, are considered in depth. The author gives descriptions of the reconstruction methods related to tomography scanners with a parallel X-ray beam, trough solutions with fan-shaped beam and successive modifications of spiral scanners. Computed Tomography contains a dedicated chapter for those readers who are interested in computer simulations based on studies of reconstruction algorithms. The information included in this chapter will enable readers to create a simulation environment in which virtual tomography projections can be obtained in all basic projection systems. This monograph is a valuable study on computed tomography that will be of interest to advanced students and researchers in the fields of biomedical engineering, medical electronics, computer science and medicine. This book introduces the classical and modern image reconstruction technologies. It covers topics in two-dimensional (2D) parallel-beam and fan-beam imaging, three-dimensional (3D) parallel ray, parallel plane, and cone-beam imaging. Both analytical and iterative methods are presented. The applications in X-ray CT, SPECT (single photon emission computed tomography), PET (positron emission tomography), and MRI (magnetic resonance imaging) are discussed. Contemporary research results in exact region-of-interest (ROI) reconstruction with truncated projections, Katsevich's cone-beam filtered backprojection algorithm, and reconstruction with highly under-sampled data are included. The last chapter of the book is devoted to the techniques of using a fast analytical algorithm to reconstruct an image that is equivalent to an iterative reconstruction. These techniques are the author's most recent research results. This book is intended for students, engineers, and researchers who are interested in medical image reconstruction. Written in a non-mathematical way, this book provides an easy access to modern mathematical methods in medical imaging. Table of Content: Chapter 1 Basic Principles of Tomography 1.1 Tomography 1.2 Projection 1.3 Image Reconstruction 1.4 Backprojection 1.5 Mathematical Expressions Problems References Chapter 2 Parallel-Beam Image Reconstruction 2.1 Fourier Transform 2.2 Central Slice Theorem 2.3 Reconstruction Algorithms 2.4 A Computer Simulation 2.5 ROI Reconstruction with Truncated Projections 2.6 Mathematical Expressions (The Fourier Transform and Convolution , The Hilbert Transform and the Finite Hilbert Transform , Proof of the Central Slice Theorem, Derivation of the Filtered Backprojection Algorithm , Expression of the Convolution Backprojection Algorithm, Expression of the Radon Inversion Formula ,Derivation of the Backprojection-then-Filtering Algorithm Problems References Chapter 3 Fan-Beam Image Reconstruction 3.1 Fan-Beam Geometry and Point Spread Function 3.2 Parallel-Beam to Fan-Beam Algorithm Conversion 3.3 Short Scan 3.4 Mathematical Expressions

 This is a practical guide to tomographic image reconstruction with projection data, with strong focus on Computed Tomography (CT) and Positron Emission Tomography (PET). Classic methods such as FBP, ART, SIRT, MLEM and OSEM are presented with modern and compact notation, with the main goal of guiding the reader from the comprehension of the mathematical background through a fast-route to real practice and computer implementation of the algorithms. Accompanied by example data sets, real ready-to-run Python toolsets and scripts and an overview the latest research in the field, this guide will be invaluable for graduate students and early-career researchers and scientists in medical physics and biomedical engineering who are beginners in the field of image reconstruction. A top-down guide from theory to practical implementation of PET and CT reconstruction methods, without sacrificing the rigor of mathematical background Accompanied by Python source code snippets, suggested exercises, and supplementary ready-to-run examples for readers to download from the CRC Press website Ideal for those willing to move their first steps on the real practice of image reconstruction, with modern scientific programming language and toolsets Daniele Panetta is a researcher at the Institute of Clinical Physiology of the Italian National Research Council (CNR-IFC) in Pisa. He earned his MSc degree in Physics in 2004 and specialisation diploma in Health Physics in 2008, both at the University of Pisa. From 2005 to 2007, he worked at the Department of Physics "E. Fermi" of the University of Pisa in the field of tomographic image reconstruction for small animal imaging micro-CT instrumentation. His current research at CNR-IFC has as its goal the identification of novel PET/CT imaging biomarkers for cardiovascular and metabolic diseases. In the field micro-CT imaging, his interests cover applications of three-dimensional morphometry of biosamples and scaffolds for regenerative medicine. He acts as reviewer for scientific journals in the field of Medical Imaging: Physics in Medicine and Biology, Medical Physics, Physica Medica, and others. Since 2012, he is adjunct professor in Medical Physics at the University of Pisa. Niccolò Camarlinghi is a researcher at the University of Pisa. He obtained his MSc in Physics in 2007 and his PhD in Applied Physics in 2012. He has been working in the field of Medical Physics since 2008 and his main research fields are medical image analysis and image reconstruction. He is involved in the development of clinical, pre-clinical PET and hadron therapy monitoring scanners. At the time of writing this book he was a lecturer at University of Pisa, teaching courses of life-sciences and medical physics laboratory. He regularly acts as a referee for the following journals: Medical Physics, Physics in Medicine and Biology, Transactions on Medical Imaging, Computers in Biology and Medicine, Physica Medica, EURASIP Journal on Image and Video Processing, Journal of Biomedical and Health Informatics. Within the past few decades MRI has become one of the most important imaging modalities in medicine. For a reliable diagnosis of pathologies further technological improvements are of primary importance. This study deals with a radically new approach of image encoding. Gradient linearity has ever since been an unquestioned technological design criterion. With the advent of parallel imaging, this approach may be questioned, making way of much a more flexible gradient hardware that uses encoding fields with an arbitrary geometry. The theoretical basis of this new imaging modality PatLoc imaging are comprehensively presented, suitable image reconstruction algorithms are developed for a variety of imaging sequences and imaging results including in vivo data are explored based on novel hardware designs. This book constitutes the refereed proceedings of the Third International Workshop on Machine Learning for Medical Reconstruction, MLMIR 2020, held in conjunction with MICCAI 2020, in Lima, Peru, in October 2020. The workshop was held virtually. The 15 papers presented were carefully reviewed and selected from 18 submissions. The papers are organized in the following topical sections: deep learning for magnetic resonance imaging and deep learning for general image reconstruction. Focusing on mathematical methods in computer tomography, Image Processing: Tensor Transform and Discrete Tomography with MATLAB® introduces novel approaches to help in solving the problem of image reconstruction on the Cartesian lattice. Specifically, it discusses methods of image processing along parallel rays to more quickly and accurately reconstruct images from a finite number of projections, thereby avoiding overradiation of the body during a computed tomography (CT) scan. The book presents several new ideas, concepts, and methods, many of which have not been published elsewhere. New concepts include methods of transferring the geometry of rays from the plane to the Cartesian lattice, the point map of projections, the particle and its field function, and the statistical model of averaging. The authors supply numerous examples, MATLAB®-based programs, end-of-chapter problems, and experimental results of implementation. The main approach for image reconstruction proposed by the authors differs from existing methods of back-projection, iterative reconstruction, and Fourier and Radon filtering. In this book, the authors explain how to process each projection by a system of linear equations, or linear convolutions, to calculate the corresponding part of the 2-D tensor or paired transform of the discrete image. They then describe how to calculate the inverse transform to obtain the reconstruction. The proposed models for image reconstruction from projections are simple and result in more accurate reconstructions. Introducing a new theory and methods of image reconstruction, this book provides a solid grounding for those interested in further research and in obtaining new results. It encourages readers to develop effective applications of these methods in CT. PET and SPECT are two of trodays most important medical-imaging methods, providing images that reveal subtle information about physiological processes in humans and animals. Emission Tomography: The Fundamentals of PET and SPECT explains the physics and engineering principles of these important functional-imaging methods. The technology of emission tomography is covered in detail, including historical origins, scientific and mathematical foundations, imaging systems and their components, image reconstruction and analysis, simulation techniques, and clinical and laboratory applications. The book describes the state of the art of emission tomography, including all facets of conventional SPECT and PET, as well as contemporary topics such as iterative image reconstruction, small-animal imaging, and PET/CT systems. This book is intended as a textbook and reference resource for graduate students, researchers, medical physicists, biomedical engineers, and professional engineers and physicists in the medical-imaging industry. Thorough tutorials of fundamental and advanced topics are presented by dozens of the leading researchers in PET and SPECT. SPECT has long been a mainstay of clinical imaging, and PET is now one of the world's fastest growing medical imaging techniques, owing to its dramatic contributions to cancer imaging and other applications. Emission Tomography: The Fundamentals of PET and SPECT is an essential resource for understanding the technology of SPECT and PET, the most widely used forms of molecular imaging. *Contains thorough tutorial treatments, coupled with coverage of advanced topics *Three of the four holders of the prestigious Institute of Electrical and Electronics Engineers Medical Imaging Scientist Award are chapter contributors *Include color artwork There exists a large variety of image reconstruction methods proposed by different authors (see e. g. Pratt (1978), Rosenfeld and Kak (1982), Marr (1982)). Selection of an appropriate method for a specific problem in image analysis has been always considered as an art. How to find the image reconstruction method which is optimal in some sense? In this book we give an answer to this question using the asymptotic minimax approach in the spirit of Ibragimov and Khasminskii (1980a,b, 1981, 1982), Bretagnolle and Huber (1979), Stone (1980, 1982). We assume that the image belongs to a certain functional class and we find the image estimators that achieve the best order of accuracy for the worst images in the class. This concept of optimality is rather rough since only the order of accuracy is optimized. However, it is useful for comparing various image reconstruction methods. For example, we show that some popular methods such as simple linewise processing and linear estimation are not optimal for images with sharp edges. Note that discontinuity of images is an important specific feature appearing in most practical situations where one has to distinguish between the "image domain" and the "background" . The approach of this book is based on generalization of nonparametric regression and nonparametric change-point techniques. We discuss these two basic problems in Chapter 1. Chapter 2 is devoted to minimax lower bounds for arbitrary estimators in general statistical models. This book constitutes the refereed proceedings of the 4th International Workshop on Machine Learning for Medical Reconstruction, MLMIR 2021, held in conjunction with MICCAI 2021, in October 2021. The workshop was planned to take place in Strasbourg, France, but was held virtually due to the COVID-19 pandemic. The 13 papers presented were carefully reviewed and selected from 20 submissions. The papers are organized in the following topical sections: deep learning for magnetic resonance imaging and deep learning for general image reconstruction. This book presents a comprehensive review of the recent developments in fast L1-norm regularization-based compressed sensing (CS) magnetic resonance image reconstruction algorithms. Compressed sensing magnetic resonance imaging (CS-MRI) is able to reduce the scan time of MRI considerably as it is possible to reconstruct MR images from only a few measurements in the k-space; far below the requirements of the Nyquist sampling rate. L1-norm-based regularization problems can be solved efficiently using the state-of-the-art convex optimization techniques, which in general outperform the greedy techniques in terms of quality of reconstructions. Recently, fast convex optimization based reconstruction algorithms have been developed which are also able to achieve the benchmarks for the use of CS-MRI in clinical practice. This book enables graduate students, researchers, and medical practitioners working in the field of medical image processing, particularly in MRI to understand the need for the CS in MRI, and thereby how it could revolutionize the soft tissue imaging to benefit healthcare technology without making major changes in the existing scanner hardware. It would be particularly useful for researchers who have just entered into the exciting field of CS-MRI and would like to quickly go through the developments to date without diving into the detailed mathematical analysis. Finally, it also discusses recent trends and future research directions for implementation of CS-MRI in clinical practice, particularly in Bio- and Neuro-informatics applications. "Medical Image Reconstruction: A Conceptual Tutorial" introduces the classical and modern image reconstruction technologies, such as two-dimensional (2D) parallel-beam and fan-beam imaging, three-dimensional (3D) parallel ray, parallel plane, and cone-beam imaging. This book presents both analytical and iterative methods of these technologies and their applications in X-ray CT (computed tomography), SPECT (single photon emission computed tomography), PET (positron emission tomography), and MRI (magnetic resonance imaging). Contemporary research results in exact region-of-interest (ROI) reconstruction with truncated projections, Katsevich's cone-beam filtered backprojection algorithm, and reconstruction with highly undersampled data with l0-minimization are also included. This book is written for engineers and researchers in the field of biomedical engineering specializing in medical imaging and image processing with image reconstruction. Gengsheng Lawrence Zeng is an expert in the development of medical image reconstruction algorithms and is a professor at the Department of Radiology, University of Utah, Salt Lake City, Utah, USA. This book constitutes the refereed proceedings of the Second International Workshop on Machine Learning for Medical Reconstruction, MLMIR 2019, held in conjunction with MICCAI 2019, in Shenzhen, China, in October 2019. The 24 full papers presented were carefully reviewed and selected from 32 submissions. The papers are organized in the following topical sections: deep learning for magnetic resonance imaging; deep learning for computed tomography; and deep learning for general image reconstruction. This book provides readers with a superior understanding of the mathematical principles behind imaging. Evolutionary Computation (EC) is one of the most attractive techniques in the area of Computer Science. EC includes Genetic Algorithms (GAs), Genetic Programming (GP), Evolutionary Strategy (ES) and Evolutionary Programming (EP). GP have been widely used to solve a variety of problems in image enhancement, analysis and segmentation. This book explores the use of GP as a powerful approach to solve the image reconstruction problem for Lost Foam Casting (LFC) manufacturing process. The data set was collected using the Electrical Capacitance Tomography (ECT) technique. ECT is one of the most attractive technique for industrial process imaging because of its low construction cost, safety, non-invasiveness, non-intrusiveness, fast data acquisition, simple structure, wide application field and suitability for most kinds of flask and vessels. GP found to be a very efficient algorithm in producing a mathematical model of image pixels in a form of Lisp expression. A Graphical User Interface (GUI) Toolbox based Matlab was developed to help analyzing and visualizing the reconstructed images based GP problem. The reported results are promising. The field of magnetic resonance imaging (MRI) has developed rapidly over the past decade, benefiting greatly from the newly developed framework of compressed sensing and its ability to drastically reduce MRI scan times. MRI: Physics, Image Reconstruction, and Analysis presents the latest research in MRI technology, emphasizing compressed sensing-based image reconstruction techniques. The book begins with a succinct introduction to the principles of MRI and then: Discusses the technology and applications of T1rho MRI Details the recovery of highly sampled functional MRIs Explains sparsity-based techniques for quantitative MRIs Describes multi-coil parallel MRI reconstruction techniques Examines off-line techniques in dynamic MRI reconstruction Explores advances in brain connectivity analysis using diffusion and functional MRIs Featuring chapters authored by field experts, MRI: Physics, Image Reconstruction, and Analysis delivers an authoritative and cutting-edge treatment of MRI reconstruction techniques. The book provides engineers, physicists, and graduate students with a comprehensive look at the state of the art of MRI. High dynamic range imaging (HDRI) is an emerging field that has the potential to cause a great scientific and technological impact in the near future. Although new, this field is large and complex, with non-trivial relations to many different areas, such as image synthesis, computer vision, video and image processing, digital photography, special effects among others. For the above reasons,HDRI has been extensively researched over the past years and, consequently, the related scientific literature is vast. As an indication that the field is reaching maturity, tutorials and books on HDRI appeared. Moreover, this new resource has already reached interested practitioners in various application areas. In this book, we do not aim at covering the whole field of high dynamic range imaging and its applications, since it is a broad subject that is still evolving. Instead, our intent is to cover the basic principles behind HDRI and focus on one of the currently most important problems, both theoretically and practically. That is, the reconstruction of high dynamic range images from regular low dynamic range pictures. Table of Contents: Introduction / Digital Image / Imaging Devices and Calibration / HDR Reconstruction / HDRI Acquisition and Visualization / Tone Enhancement / References / Biography This book constitutes the refereed proceedings of the 5th International Workshop on Machine Learning for Medical Reconstruction, MLMIR 2022, held in conjunction with MICCAI 2022, in September 2022, held in Singapore. The 15 papers presented were carefully reviewed and selected from 19 submissions. The papers are organized in the following topical sections: deep learning for magnetic resonance imaging and deep learning for general image reconstruction. Magnetic Resonance Image Reconstruction: Theory, Methods and Applications presents the fundamental concepts of MR image reconstruction, including its formulation as an inverse problem, as well as the most common models and optimization methods for reconstructing MR images. The book discusses approaches for specific applications such as non-Cartesian imaging, under sampled reconstruction, motion correction, dynamic imaging and quantitative MRI. This unique resource is suitable for physicists, engineers, technologists and clinicians with an interest in medical image reconstruction and MRI. Explains the underlying principles of MRI reconstruction, along with the latest research/li> Gives example codes for some of the methods presented Includes updates on the latest developments, including compressed sensing, tensor-based reconstruction and machine learning based reconstruction "Medical Image Reconstruction: A Conceptual Tutorial" introduces the classical and modern image reconstruction technologies, such as two-dimensional (2D) parallel-beam and fan-beam imaging, three-dimensional (3D) parallel ray, parallel plane, and cone-beam imaging. This book presents both analytical and iterative methods of these technologies and their applications in X-ray CT (computed tomography), SPECT (single photon emission computed tomography), PET (positron emission tomography), and MRI (magnetic resonance imaging).

Contemporary research results in exact region-of-interest (ROI) reconstruction with truncated projections, Katsevich's cone-beam filtered backprojection algorithm, and reconstruction with highly undersampled data with l0-minimization are also included. This book is written for engineers and researchers in the field of biomedical engineering specializing in medical imaging and image processing with image reconstruction. Gengsheng Lawrence Zeng is an expert in the development of medical image reconstruction algorithms and is a professor at the Department of Radiology, University of Utah, Salt Lake City, Utah, USA. This book contains a selection of communications presented at the Third International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine, held 4-6 July 1995 at Domaine d' Aix-Marlioz, Aix-les-Bains, France. This nice resort provided an inspiring environment to hold discussions and presentations on new and developing issues. Roentgen discovered X-ray radiation in 1895 and Becquerel found natural radioactivity in 1896 : a hundred years later, this conference was focused on the applications of such radiations to explore the human body. If the physics is now fully understood, 3D imaging techniques based on ionising radiations are still progressing. These techniques include 3D Radiology, 3D X-ray Computed Tomography (3D-CT), Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET). Radiology is dedicated to morphological imaging, using transmitted radiations from an external X-ray source, and nuclear medicine to functional imaging, using radiations emitted from an internal radioactive tracer. In both cases, new 3D tomographic systems will tend to use 2D detectors in order to improve the radiation detection efficiency. Taking a set of 2D acquisitions around the patient, 3D acquisitions are obtained. Then, fully 3D image reconstruction algorithms are required to recover the 3D image of the body from these projection measurements. This book constitutes the refereed proceedings of the First International Workshop on Machine Learning for Medical Reconstruction, MLMIR 2018, held in conjunction with MICCAI 2018, in Granada, Spain, in September 2018. The 17 full papers presented were carefully reviewed and selected from 21 submissions. The papers are organized in the following topical sections: deep learning for magnetic resonance imaging; deep learning for computed tomography, and deep learning for general image reconstruction. Image reconstruction from projections. Probability and random variables. An overview of the process of CT. Physical problems associated with data collection in CT. Computer simulation of data collection in CT. Data collection and reconstruction of the head phantom under various assumptions. Basic concepts of reconstruction algorithms. Backprojection. Convolution method for parallel beams. Other transform methods for parallel beams. Convolution methods for divergent beams. The algebraic reconstruction techniques. Quadratic optimization methods. Noniterative series expansion methods. Truly three-dimensional reconstruction. Three-dimensional display of organs. Mathematical background. This review discusses methods for learning parameters for image reconstruction problems using bilevel formulations, and it lies at the intersection of a specific machine learning method, bilevel, and a specific application, filter learning for image reconstruction. This revised and updated second edition now with two new chapters - is the only book to give a comprehensive overview of computer algorithms for image reconstruction. It covers the fundamentals of computerized tomography, including all the computational and mathematical procedures underlying data collection, image reconstruction and image display. Among the new topics covered are: spiral CT, fully 3D positron emission tomography, the linogram mode of backprojection, and state of the art 3D imaging results. It also includes two new chapters on comparative statistical evaluation of the 2D reconstruction algorithms and alternative approaches to image reconstruction. Recently proposed methods for reconstructing large telescope astronomical images free from atmospheric perturbation are reviewed and discussed. (Author). This book will provide readers with a good overview of some of most recent advances in the field of Photon Counting CT technology for X-ray medical imaging, especially as it pertains to new detectors. There will be a good mixture of general chapters in both technology and applications in CT medical imaging. The book will have an in-depth review of the research topics from world-leading specialists in the field. The conversion of the X-ray signal into analogue/digital value will be covered in some chapters. The authors also provide a review of CMOS chips for X-ray image sensors, methods of material discrimination and image reconstruction techniques. Covers a broad range of topics, including an introduction to novel spectral Computed Tomography; Includes in-depth analysis on how to optimize X-ray detection; Discusses analysis of electronics for X-ray detection. Differently oriented specialists and students involved in image processing and analysis need to have a firm grasp of concepts and methods used in this now widely utilized area. This book aims at being a single-source reference providing such foundations in the form of theoretical yet clear and easy to follow explanations of underlying generic concepts. Medical Image Processing, Reconstruction and Analysis □ Concepts and Methods explains the general principles and methods of image processing and analysis, focusing namely on applications used in medical imaging. The content of this book is divided into three parts: Part I □ Images as Multidimensional Signals provides the introduction to basic image processing theory, explaining it for both analogue and digital image representations. Part II □ Imaging Systems as Data Sources offers a non-traditional view on imaging modalities, explaining their principles influencing properties of the obtained images that are to be subsequently processed by methods described in this book. Newly, principles of novel modalities, as spectral CT, functional MRI, ultrafast planar-wave ultrasonography and optical coherence tomography are included. Part III □ Image Processing and Analysis focuses on tomographic image reconstruction, image fusion and methods of image enhancement and restoration; further it explains concepts of low-level image analysis as texture analysis, image segmentation and morphological transforms. A new chapter deals with selected areas of higher-level analysis, as principal and independent component analysis and particularly the novel analytic approach based on deep learning. Briefly, also the medical image-processing environment is treated, including processes for image archiving and communication. Features Presents a theoretically exact yet understandable explanation of image processing and analysis concepts and methods Offers practical interpretations of all theoretical conclusions, as derived in the consistent explanation Provides a concise treatment of a wide variety of medical imaging modalities including novel ones, with respect to properties of provided image data To my wife, Mitu - Vivek Bannore Preface Preface In many imaging systems, under-sampling and aliasing occurs frequently leading to degradation of image quality. Due to the limited number of sensors available on the digital cameras, the quality of images captured is also limited. Factors such as optical or atmospheric blur and sensor noise can also contribute further to the d- radation of image quality. Super-Resolution is an image reconstruction technique that enhances a sequence of low-resolution images or video frames by increasing the spatial resolution of the images. Each of these low-resolution images contain only incomplete scene information and are geometrically warped, aliased, and - der-sampled. Super-resolution technique intelligently fuses the incomplete scene information from several consecutive low-resolution frames to reconstruct a hi- resolution representation of the original scene. In the last decade, with the advent of new technologies in both civil and mi- tary domain, more computer vision applications are being developed with a demand for high-quality high-resolution images. In fact, the demand for high- resolution images is exponentially increasing and the camera manufacturing te- nology is unable to cope up due to cost efficiency and other practical reasons.

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