Imaging Systems For Medical Diagnostics Fundamentals Technical Solutions And Applications For Systems Applying Ionizing Radiation Nuclear Magnetic Resonance And Ultrasound

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Current Catalog - 1991
First multi-year cumulation covers six years: 1965-70.
Optical Engineering - 2004
Publishes papers reporting on research and development in optical science and engineering and the practical applications of known optical science, engineering, and technology.
Diagnostic Ultrasound Imaging: Inside Out - Thomas L. Szabo 2013-12-05
Diagnostic Ultrasound Imaging provides a unified description of the physical principles of ultrasound imaging, signal processing, systems and measurements. This comprehensive reference is a core resource for both graduate students and engineers in medical ultrasound research and design. With continuing rapid technological development of ultrasound in medical diagnosis, it is a critical subject for biomedical engineers, clinical and healthcare engineers and practitioners, medical physicists, and related professionals in the fields of signal and image processing. The book contains 17 new and updated chapters covering the fundamentals and latest advances in the area, and includes four appendices, 450 figures (60 available in color on the companion website), and almost 1,500 references. In addition to the continual influx of readers entering the field of ultrasound worldwide who need the broad grounding in the

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core technologies of ultrasound, this book provides those already working in these areas with clear and comprehensive expositions of these key new topics as well as introductions to state-of-the-art innovations in this field. Enables practicing engineers, students and clinical professionals to understand the essential physics and signal processing techniques behind modern imaging systems as well as introducing the latest developments that will shape medical ultrasound in the future Suitable for both newcomers and experienced readers, the practical, progressively organized applied approach is supported by hands-on MATLAB® code and worked examples that enable readers to understand the principles underlying diagnostic and therapeutic ultrasound Covers the new important developments in the use of medical ultrasound: elastography and high-intensity therapeutic ultrasound. Many new developments are comprehensively reviewed and explained, including aberration correction, acoustic measurements, acoustic radiation force imaging, alternate imaging architectures, bioeffects: diagnostic to therapeutic, Fourier transform imaging, multimode imaging, plane wave compounding, research platforms, synthetic aperture, vector Doppler, transient shear wave elastography, ultrafast imaging and Doppler, functional ultrasound and viscoelastic models

INIS Atomindeks - 1988

Medical Research Centres - Informa Healthcare 1995

Focuses on research and development centers in the areas of medical and biomedical sciences including those in anatomy, biochemistry, clinical medicine, dentistry, drugs, genetics, immunology, neoplasms, pharmaceutical technology, and surgery.

Lasers and Optical Fibers in Medicine - Abraham Katzir 1993-10-19

The increasing use of lasers and fiber optics in medicine has created a need for an

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interdisciplinary perspective on their technology and methods. Written for physicians, engineers, and biophysicists, this book presents a comprehensive examination of lasers and optical fibers in a hierarchical organization. Each chapter is divided into three basic sections: the Fundamentals section provides an overview of basic concepts and background; the Principles section offers an in-depth engineering approach; and the Advances section features specific information on systems and biophysical parameters. Extensive coverage of how lasers interact with tissue, how optical fibers are used in endoscopic imaging, and how lasers and their fiber-optic systems are utilized in various medical disciplines is included. Those interested in the fields of lasers and fiber optics will find this book fascinating and instructive reading.

Integrating Device Data Into the Electronic Medical Record - John Zaleski 2009-02-09

interfaces on your own, regulatory issues, and how to assure connectivity and access to data." --Book Jacket.

Imaging in Nuclear Medicine - Augusto Giussani 2013-03-15

This volume addresses a wide range of issues in the field of nuclear medicine imaging, with an emphasis on the latest research findings. Initial chapters set the scene by considering the role of imaging in nuclear medicine from the medical perspective and discussing the implications of novel agents and applications for imaging. The physics at the basis of the most modern imaging systems is described, and the reader is introduced to the latest advances in image reconstruction and noise correction. Various novel concepts are then discussed, including those developed within the framework of the EURATOM FP7 MADEIRA research project on the optimization of imaging procedures in order to permit a reduction in the radiation dose to healthy tissues. Advances in quality control and quality assurance are covered, and the book concludes by listing rules of thumb for imaging

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that will be of use to both beginners and experienced researchers.

Fundamentals of Medical Imaging - Paul Suetens 2017-05-11

This third edition provides a concise and generously illustrated survey of the complete field of medical imaging and image computing, explaining the mathematical and physical principles and giving the reader a clear understanding of how images are obtained and interpreted. Medical imaging and image computing are rapidly evolving fields, and this edition has been updated with the latest developments in the field, as well as new images and animations. An introductory chapter on digital image processing is followed by chapters on the imaging modalities: radiography, CT, MRI, nuclear medicine and ultrasound. Each chapter covers the basic physics and interaction with tissue, the image reconstruction process, image quality aspects, modern equipment, clinical applications, and biological effects and safety issues. Subsequent chapters review image computing and visualization for diagnosis and treatment. Engineers, physicists and clinicians at all levels will find this new edition an invaluable aid in understanding the principles of imaging and their clinical applications.

Physics and Engineering of Radiation Detection - Syed Naeem Ahmed 2014-11-20

Physics and Engineering of Radiation Detection presents an overview of the physics of radiation detection and its applications. It covers the origins and properties of different kinds of ionizing radiation, their detection and measurement, and the procedures used to protect people and the environment from their potentially harmful effects. The second edition is fully revised and provides the latest developments in detector technology and analyses software. Also, more material related to measurements in particle physics and a complete solutions manual have been added. Discusses the experimental techniques and

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instrumentation used in different detection systems in a very practical way without sacrificing the physics content Provides useful formulae and explains methodologies to solve problems related to radiation measurements Contains many worked-out examples and end-of-chapter problems Detailed discussions on different detection media, such as gases, liquids, liquefied gases, semiconductors, and scintillators Chapters on statistics, data analysis techniques, software for data analysis, and data acquisition systems

Advances in Computational Electrodynamics - Allen Taflove 1998

Finite-Difference Time-Domain (FD-TD) modeling is arguably the most popular and powerful means available to perform detailed electromagnetic engineering analyses. Edited by the pioneer and foremost authority on the subject, here is the first book to assemble in one resource the latest techniques and results of the leading theoreticians and practitioners of FD-TD computational electromagnetics modeling.

Applied Medical Image Processing - Wolfgang Birkfellner 2016-04-19

A widely used, classroom-tested text, Applied Medical Image Processing: A Basic Course delivers an ideal introduction to image processing in medicine, emphasizing the clinical relevance and special requirements of the field. Avoiding excessive mathematical formalisms, the book presents key principles by implementing algorithms from scratch and usin

Selected Papers on Gas Laser Technology - J. G. Eden 2000

SPIE Milestones are collections of seminal papers from the world literature covering important discoveries and developments in optics and photonics.

Intelligent Systems - Cornelius T. Leondes 2018-10-08

Intelligent systems, or artificial intelligence technologies, are playing an increasing role in areas ranging from medicine to the major

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manufacturing industries to financial markets. The consequences of flawed artificial intelligence systems are equally wide ranging and can be seen, for example, in the programmed trading-driven stock market crash of October 19, 1987. Intelligent Systems: Technology and Applications, Six Volume Set connects theory with proven practical applications to provide broad, multidisciplinary coverage in a single resource. In these volumes, international experts present case-study examples of successful practical techniques and solutions for diverse applications ranging from robotic systems to speech and signal processing, database management, and manufacturing.
AIAA Aerospace Sciences Meeting and Exhibit, 42nd - 2004

Diagnostic Techniques and Surgical Management of Brain Tumors - Ana Lucia Abujamra 2011-09-22
The focus of the book Diagnostic Techniques and Surgical Management of Brain Tumors is on describing the established and newly-arising techniques to diagnose central nervous system tumors, with a special focus on neuroimaging, followed by a discussion on the neurosurgical guidelines and techniques to manage and treat this disease. Each chapter in the Diagnostic Techniques and Surgical Management of Brain Tumors is authored by international experts with extensive experience in the areas covered.

Artificial Intelligence in Medical Imaging - Erik R. Ranschaert 2019-01-29
This book provides a thorough overview of the ongoing evolution in the application of artificial intelligence (AI) within healthcare and radiology, enabling readers to gain a deeper insight into the technological background of AI and the impacts of new and emerging technologies on medical imaging. After an introduction on game changers in radiology, such as deep learning technology, the technological evolution of AI in computing science and medical image

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computing is described, with explanation of basic principles and the types and subtypes of AI. Subsequent sections address the use of imaging biomarkers, the development and validation of AI applications, and various aspects and issues relating to the growing role of big data in radiology. Diverse real-life clinical applications of AI are then outlined for different body parts, demonstrating their ability to add value to daily radiology practices. The concluding section focuses on the impact of AI on radiology and the implications for radiologists, for example with respect to training. Written by radiologists and IT professionals, the book will be of high value for radiologists, medical/clinical physicists, IT specialists, and imaging informatics professionals.

Atherosclerotic Plaque Characterization Methods Based on Coronary Imaging - Lambros S Athanasiou 2017-05-04

Atherosclerotic Plaque Characterization Methods Based on Coronary Imaging provides a complete review of computer methods for atherosclerotic plaque reconstruction and characterization. The authors, with their expertise from biomedical engineering, computer science, and cardiology, offer a holistic view. The focus of the book is on the presentation of major imaging techniques, including their limitations. It includes details on the mechanical characterization and properties of plaques and appropriate constitutive models to describe the mechanical behavior of plaques. The authors explore the challenges of using multiple coronary imaging technologies, and provide the pros and cons of invasive vs. non-invasive techniques. Methods for plaque characterization and 3D reconstruction of coronary arteries using IVUS, OCT, and CT images are described. This book will help readers study new trends in image processing analysis and plaque characterization, implement automated plaque characterization

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methodologies, understand coronary imaging drawbacks, and comprehend 3 dimensional coronary artery and plaque reconstruction methods. Describes the multimodality imaging techniques that are commonly used in the diagnosis of arterial diseases, including intravascular ultrasound, optical coherence tomography, angiography, computed tomography angiography, and magnetic resonance angiography Discusses in-depth the computational methods which can be used for the detection of different plaque types Explores plaque in 3D reconstruction methods and plaque modeling approaches

Principles of Terahertz Science and Technology - Yun-Shik Lee 2010-10-29

Principles of Terahertz Science and Technology aims to elucidate the fundamentals of THz technology and science for potential new users. It surveys major techniques of generating, detecting, and manipulating THz waves and also discusses a number of essential processes where THz waves interact with physical, chemical, and biological systems. This book serves as an introduction to THz technology for new researchers in various fields. Many different disciplines, such as ultrafast spectroscopy, semiconductor device fabrication, bio-medical imaging and more, involve the recent development of THz technology. It is necessary to lay down a strong, common foundation among researchers, so that communication can proceed smoothly. Previous THz research activities have concentrated on generation and detection, but the focus has now shifted to practical applications of this technology, such as high-speed optoelectronic signal processing and molecular spectroscopy. Drawing upon years of practical experience and using numerous examples and illustrative applications Yun-Shik Lee discusses: The major techniques of generating, detecting, and manipulating THz waves Essential processes where THz waves interact with physical, chemical, and biological

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systems Medical Applications of T-Ray Imaging including, optical properties of human tissue, cancer diagnostics, reflective imaging of skin burns and detection of dental caries Principles of Terahertz Science and Technology is an ideal book for applied physicists, microwave engineers, biomedical engineers, electrical engineers, and analytical chemists interested in the fundamentals and applications of THz engineering.

The British National Bibliography - Arthur James Wells 2006

Practical Radiography - Peter Hertrich 2005-07-11

This book provides radiological technicians, radiologists, technicians, developers and sales engineers with a unique display of the methods and applications used in radiography. Building on the physical basis and the quality and effects of X-rays, the book describes X-ray systems for diagnostics and interventions, the technique behind a radiographic image, image quality, patient data management including data archiving and communication with PACS in the hospital as well as between a physician's practice and hospitals. All descriptions are in accordance with the technical and diagnostic requirements to be met by modern, frequently digital radiographic as well as image processing methods and systems.

Fundamental and Advanced Fetal Imaging - Beth Kline-Fath 2014-09-09

Effectively evaluate obstetric patients with Fundamental and Advanced Fetal Imaging: Ultrasound and MRI! Written by an impressive roster of leading fetal radiologists and maternal-fetal medicine specialists, with additional input from cardiologists, geneticists, and Doppler specialists, this state-of-the-art reference explores how to obtain the maximum information from fetal ultrasound and magnetic resonance imaging, so you can rule out pathologies with confidence – or identify them early enough to

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initiate the most appropriate interventions.

21st Century Nanoscience – A Handbook - Klaus D. Sattler 2020-04-22

This 21st Century Nanoscience Handbook will be the most comprehensive, up-to-date large reference work for the field of nanoscience. Handbook of Nanophysics by the same editor published in the fall of 2010 and was embraced as the first comprehensive reference to consider both fundamental and applied aspects of nanophysics. This follow-up project has been conceived as a necessary expansion and full update that considers the significant advances made in the field since 2010. It goes well beyond the physics as warranted by recent developments in the field. This ninth volume in a ten-volume set covers industiral applications. Key Features: Provides the most comprehensive, up-to-date large reference work for the field. Chapters written by international experts in the field. Emphasises presentation and real results and applications. This handbook distinguishes itself from other works by its breadth of coverage, readability and timely topics. The intended readership is very broad, from students and instructors to engineers, physicists, chemists, biologists, biomedical researchers, industry professionals, governmental scientists, and others whose work is impacted by nanotechnology. It will be an indispensable resource in academic, government, and industry libraries worldwide. The fields impacted by nanophysics extend from materials science and engineering to biotechnology, biomedical engineering, medicine, electrical engineering, pharmaceutical science, computer technology, aerospace engineering, mechanical engineering, food science, and beyond.

Quantitative MRI in Cancer - Thomas E. Yankeelov 2011-09-13

Propelling quantitative MRI techniques from bench to bedside, Quantitative MRI in Cancer presents a range of quantitative MRI methods for assessing tumor biology. It includes

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biophysical and theoretical explanations of the most relevant MRI techniques as well as examples of these techniques in cancer applications. The introductory part of the book covers basic cancer biology, theoretical aspects of NMR/MRI physics, and the hardware required to form MR images. Forming the core of the book, the next three parts illustrate how to characterize tissue properties with endogenous and exogenous contrast mechanisms and discuss common image processing techniques relevant for cancer. The final part explores emerging areas of MR cancer characterization, including radiation therapy planning, cellular and molecular imaging, pH imaging, and hyperpolarized MR. Each of the post-introductory chapters describes the salient qualitative and quantitative aspects of the techniques before proceeding to preclinical and clinical applications. Each chapter also contains references for further study. Leading the way toward more personalized medicine, this text brings together existing and emerging quantitative MRI techniques for assessing cancer. It provides a self-contained overview of the theoretical and experimental essentials and state of the art in cancer MRI.

Physics for Ophthalmologists - Douglas J. Coster 1994

The Physics of Diagnostic Imaging Second Edition - David Dowsett 2006-04-28

Over recent years there has been a vast expansion in the variety of imaging techniques available, and developments in machine specifications continue apace. If radiologists and radiographers are to obtain optimal image quality while minimising exposure times, a good understanding of the fundamentals of the radiological science underpinning diagnostic imaging is essential. The second edition of this well-received textbook continues to cover all technical aspects of diagnostic radiology, and remains an ideal companion during examination

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preparation and beyond. The content includes a review of basic science aspects of imaging, followed by a detailed explanation of radiological sciences, conventional x-ray image formation and other imaging techniques. The enormous technical advances in computed tomography, including multislice acquisition and 3D image reconstruction, digital imaging in the form of image plate and direct radiography, magnetic resonance imaging, colour flow imaging in ultrasound and positron radiopharmaceuticals in nuclear medicine, are all considered here. A chapter devoted to computers in radiology considers advances in radiology information systems and computer applications in image storage and communication systems. The text concludes with a series of general topics relating to diagnostic imaging. The content has been revised and updated throughout to ensure it remains in line with the Fellowship of the Royal College of Radiologists (FRCR) examination, while European and American perspectives on technology, guidelines and regulations ensure international relevance.

International Books in Print - 1995

21st Century Nanoscience - Klaus D. Sattler 2021-11-05

This 21st Century Nanoscience Handbook will be the most comprehensive, up-to-date large reference work for the field of nanoscience. Handbook of Nanophysics, by the same editor, published in the fall of 2010, was embraced as the first comprehensive reference to consider both fundamental and applied aspects of nanophysics. This follow-up project has been conceived as a necessary expansion and full update that considers the significant advances made in the field since 2010. It goes well beyond the physics as warranted by recent developments in the field. Key Features: Provides the most comprehensive, up-to-date large reference work for the field. Chapters written by international experts in the field.

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Emphasises presentation and real results and applications. This handbook distinguishes itself from other works by its breadth of coverage, readability and timely topics. The intended readership is very broad, from students and instructors to engineers, physicists, chemists, biologists, biomedical researchers, industry professionals, governmental scientists, and others whose work is impacted by nanotechnology. It will be an indispensable resource in academic, government, and industry libraries worldwide. The fields impacted by nanoscience extend from materials science and engineering to biotechnology, biomedical engineering, medicine, electrical engineering, pharmaceutical science, computer technology, aerospace engineering, mechanical engineering, food science, and beyond.

Innovative Minds - Ulrich Eberl 2007-08-13

Innovative Minds: A Look Inside Siemens' Idea Machine tells the story of 30 innovations - the large and the small, the rapid and the slow-moving, the disruptive and the evolutionary - and covers the entire spectrum of people and processes involved in their development. The book provides a unique insight into the multi-dimensional process of innovation development at Siemens. All of the innovations were shaped not only by complex organizational forces and strategies, but also by a host of factors, including bold visions, creative freedom, conflicts, internal and external networks, customer orientation, teamwork - and an ample measure of luck. Every innovation story yields many valuable lessons, for companies and for each individual involved. With this in mind, the authors offer a wealth of experiences for all readers who are involved in the process of innovation - whether in a strategic or hands-on capacity - infields such as research and development, marketing, production and sales, strategy and innovation management, organization and management.

Biomedical Imaging Instrumentation -

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Mrutyunjay Suar 2021-11-26

Biomedical Imaging Instrumentation: Applications in Tissue, Cellular and Molecular Diagnostics provides foundational information about imaging modalities, reconstruction and processing, and their applications. The book provides insights into the fundamental of the important techniques in the biomedical imaging field and also discusses the various applications in the area of human health. Each chapter summarizes the overview of the technique, the various applications, and the challenges and recent innovations occurring to further improve the technique. Chapters include Biomedical Techniques in Cellular and Molecular Diagnostics, The Role of CT Scan in Medical and Dental Imaging, Ultrasonography - Technology & Applications in Clinical Radiology, Magnetic Resonance Imaging, Instrumentation and Utilization of PET-CT Scan in Oncology, Gamma Camera and SPECT, Sentinel of Breast Cancer Screening; Hyperspectral Imaging; PA Imaging; NIR Spectroscopy, and The Advances in Optical Microscopy and its Applications in Biomedical Research. This book is ideal for supporting learning, and is a key resource for students and early career researchers in fields such as medical imaging and biomedical instrumentation. A basic, fundamental, easy to understand introduction to medical imaging techniques Each technique is accompanied with detailed discussion on the application in the biomedical field in an accessible and easy to understand way Provides insights into the limitations of each technology and innovations that are occurring related to that technology

Knowledge for Sustainable Development - Unesco 2002

This three volume set presents a multidisciplinary examination of the global life support systems on which we depend by providing a selection of articles on sustainable development issues written by international experts. Volume 1 focuses on the earth and

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atmospheric sciences, mathematical, biological and medical sciences, social sciences and humanities, physical sciences, engineering and technology resources. Volume 2 covers chemical sciences, energy science and water engineering, as well as the main issues related to environmental sciences and ecological resources. Volume 3 offers a comprehensive view of food and agricultural engineering resources, the management of human and natural resources, economic and institutional resources, information technology and systems management, as well as a regional overview of sustainable development issues. Each article includes a bibliography, a glossary and a guide to further information available as part of the on-line Encyclopedia version (http://www.eolss.net).

Fundamentals of Nuclear Science and Engineering Third Edition - J. Kenneth Shultis 2016-11-30

Fundamentals of Nuclear Science and Engineering, Third Edition, presents the nuclear science concepts needed to understand and quantify the whole range of nuclear phenomena. Noted for its accessible level and approach, the Third Edition of this long-time bestselling textbook provides overviews of nuclear physics, nuclear power, medicine, propulsion, and radiation detection. Its flexible organization allows for use with Nuclear Engineering majors and those in other disciplines. The Third Edition features updated coverage of the newest nuclear reactor designs, fusion reactors, radiation health risks, and expanded discussion of basic reactor physics with added examples. A complete Solutions Manual and figure slides for classroom projection are available for instructors adopting the text.

Diagnostic Radiology Physics - International Atomic Energy Agency 2013-03-01

This publication is aimed at students and teachers involved in programmes that train medical physicists for work in diagnostic radiology. It provides, in the form of a syllabus, a

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comprehensive overview of the basic medical physics knowledge required for the practice of modern diagnostic radiology. This makes it particularly useful for graduate students and residents in medical physics programmes. The material presented in the publication has been endorsed by the major international organisations and is the foundation for academic and clinical courses in both diagnostic radiology physics and in emerging areas such as imaging in radiotherapy.

Magnetic Resonance Tomography - Maximilian F Reiser 2007-12-05

With an incredible 2400 illustrations, and written by a multitude of international experts, this book provides a comprehensive overview of both the physics and the clinical applications of MRI, including practical guidelines for imaging. The authors define the importance of MRI in the diagnosis of several disease groups in comparison or combination with other methods. Chapters dealing with basic principles of MRI, MR spectroscopy (MRS), interventional MRI and functional MRI (fMRI) illustrate the broad range of applications for MRI. Both standard and cutting-edge applications of MRI are included. Material on molecular imaging and nanotechnology give glimpses into the future of the field.

Magnetic Resonance Elastography - Sudhakar K. Venkatesh 2014-10-01

The first book to cover the groundbreaking development and clinical applications of Magnetic Resonance Elastography, this book is essential for all practitioners interested in this revolutionary diagnostic modality. The book is divided into three sections. The first covers the history of MRE. The second covers technique and clinical applications of MRE in the liver with respect to fibrosis, liver masses, and other diseases. Case descriptions are presented to give the reader a hands-on approach. The final section presents the techniques, sequence and preliminary results of applications in other areas

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of the body including muscle, brain, lung, heart, and breast.

Medical Imaging Systems - Andreas Maier 2018-08-02

This open access book gives a complete and comprehensive introduction to the fields of medical imaging systems, as designed for a broad range of applications. The authors of the book first explain the foundations of system theory and image processing, before highlighting several modalities in a dedicated chapter. The initial focus is on modalities that are closely related to traditional camera systems such as endoscopy and microscopy. This is followed by more complex image formation processes: magnetic resonance imaging, X-ray projection imaging, computed tomography, X-ray phase-contrast imaging, nuclear imaging, ultrasound, and optical coherence tomography.

Bibliography of Agriculture - 1993

Imaging Systems for Medical Diagnosis - Erich Krestel 1990-10-19

Erick Krestel, Editor Imaging Systems for Medical Diagnostics This book provides physicians and clinical physicists with detailed information on todya's imaging modalities and assists them in selecting the optimal system for each clinical application. Physicists, engineers and computer specialists engaged in research and development and sales departments will also find this book to be of considerable use. It may also be employed at universities, training centers and in technical seminars. The physiological and physical fundamentals are explained in part 1. The technical solutions contained in part 2 illustrate the numerous possibilities available in x-ray diagnostics, computed tomography, nuclear medical diagnostics, magnetic resonance imaging, sonography and biomagnetic diagnostics. Overview of Contents Physiology of vision Image quality X-ray and gamma radiation X-ray diagnostics Computed tomography Nuclear

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medical diagnostics Magnetic resonance imaging Sonography Biomagnetic diagnostic
IEEE Circuits & Devices - 1991

Imaging Systems for Medical Diagnostics - Arnulf Oppelt 2011-02-25
The book provides a comprehensive compilation of fundamentals, technical solutions and applications for medical imaging systems. It is intended as a handbook for students in biomedical engineering, for medical physicists, and for engineers working on medical technologies, as well as for lecturers at universities and engineering schools. For qualified personnel at hospitals, and physicians working with these instruments it serves as a basic source of information. This also applies for service engineers and marketing specialists. The book starts with the representation of the physical basics of image processing, implying some knowledge of Fourier transforms. After that, experienced authors describe technical solutions and applications for imaging systems in medical diagnostics. The applications comprise the fields of X-ray diagnostics, computed tomography, nuclear medical diagnostics, magnetic resonance imaging, sonography, molecular imaging and hybrid systems. Considering the increasing importance of software based solutions, emphasis is also laid on the imaging software platform and hospital information systems.

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