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In Magnetic Resonance Imaging

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imaging method, which produces
cross-sectional tomographic and three-
dimensional images similar to those of
x-ray computed tomography (CT).

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Magnetic Resonance Imaging (MRI) is
based on radio frequency (RF)
interrogation of the human body at
frequencies between 40 MHz to 300
MHz. An RF transmitter excites proton
spin precession and then, in a manner
analogous to an RF ID tag, the proton

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is precessional ring down reports back local information about its environment.

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MRIs employ powerful magnets which produce a strong magnetic field that forces protons in the body to align with that field. When a radiofrequency current is then pulsed through the patient, the protons are stimulated, and spin out of equilibrium, straining against the pull of the magnetic field. When the radiofrequency field is

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turned off, the MRI sensors are able to detect the energy released as the protons realign with the magnetic field.

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Electromagnetics in Magnetic Resonance Imaging: Physical ...

Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body. MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to generate images of the organs in the body.

Magnetic resonance imaging - Wikipedia

Electromagnetic Analysis and Design

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in Magnetic Resonance Imaging is unique in its detailed examination of the analysis and design of the hardware for an MRI system. It takes an engineering...

In the past few decades, Magnetic Resonance Imaging (MRI) has become an indispensable tool in modern medicine, with MRI systems now available at every major hospital in the developed world. But for all its utility and prevalence, it is much less commonly understood and less readily explained than other common medical imaging techniques. Unlike optical, ultrasonic, X-ray (including CT), and nuclear medicine-based imaging, MRI does not rely primarily on simple transmission and/or

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reflection of energy, and the highest achievable resolution in MRI is orders of magnitude smaller than the smallest wavelength involved. In this book, MRI will be explained with emphasis on the magnetic fields required, their generation, their concomitant electric fields, the various interactions of all these fields with the subject being imaged, and the implications of these interactions to image quality and patient safety. Classical electromagnetics will be used to describe aspects from the fundamental phenomenon of nuclear precession through signal detection and MRI safety. Simple explanations and illustrations combined with pertinent equations are designed to help the reader rapidly gain a fundamental understanding and an appreciation of this technology as it is

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used today, as well as ongoing advances that will increase its value in the future. Numerous references are included to facilitate further study with an emphasis on areas most directly related to electromagnetics.

This book presents a comprehensive treatment of electromagnetic analysis and design of three critical devices for an MRI system - the magnet, gradient coils, and radiofrequency (RF) coils. Electromagnetic Analysis and Design in Magnetic Resonance Imaging is unique in its detailed examination of the analysis and design of the hardware for an MRI system. It takes an engineering perspective to serve the many scientists and engineers in this rapidly expanding field. Chapters present: an introduction to MRI basic concepts of electromagnetics,

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including Helmholtz and Maxwell coils, inductance calculation, and magnetic fields produced by special cylindrical and spherical surface currents principles for the analysis and design of gradient coils, including discrete wires and the target field method analysis of RF coils based on the equivalent lumped-circuit model as well as an analysis based on the integral equation formulation survey of special purpose RF coils analytical and numerical methods for the analysis of electromagnetic fields in biological objects With the continued, active development of MRI instrumentation, *Electromagnetic Analysis and Design in Magnetic Resonance Imaging* presents an excellent, logically organized text - an indispensable resource for engineers, physicists, and graduate students

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Related Applications And
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In the past few decades, Magnetic Resonance Imaging (MRI) has become

an indispensable tool in modern medicine, with MRI systems now available at every major hospital in the developed world. But for all its utility and prevalence, it is much less commonly understood and less readily explained than other common medical imaging techniques. Unlike optical, ultrasonic, X-ray (including CT), and nuclear medicine-based imaging, MRI does not rely primarily on simple transmission and/or reflection of energy, and the highest achievable resolution in MRI is orders of magnitude smaller than the smallest wavelength involved. In this book, MRI will be explained with emphasis on the magnetic fields required, their

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generation, their concomitant electric fields, the various interactions of all these fields with the subject being imaged, and the implications of these interactions to image quality and patient safety. Classical electromagnetics will be used to describe aspects from the fundamental phenomenon of nuclear precession through signal detection and MRI safety. Simple explanations and Illustrations combined with pertinent equations are designed to help the reader rapidly gain a fundamental understanding and an appreciation of this technology as it is used today, as well as ongoing advances that will increase its value in the future. Numerous references are included to facilitate further study with an emphasis on areas most directly related to electromagnetics.

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With the continued, active development of MRI instrumentation, Electromagnetic Analysis and Design in Magnetic Resonance Imaging presents an excellent, logically organized text - an indispensable resource for engineers, physicists, and graduate students working in the field of MRI as well as electrical engineers seeking a better understanding of the hardware for an MRI system.

Magnetic Resonance Imaging is a very important clinical imaging tool. It combines different fields of physics and engineering in a uniquely

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complex way. MRI is also surprisingly versatile, 'pulse sequences' can be designed to yield many different types of contrast. This versatility is unique to MRI. This short book gives both an in depth account of the methods used for the operation and construction of modern MRI systems and also the principles of sequence design and many examples of applications. An important additional feature of this book is the detailed discussion of the mathematical principles used in building optimal MRI systems and for sequence design. The mathematical discussion is very suitable for undergraduates attending medical physics courses. It is also more complete than usually found in alternative books for physical scientists or more clinically orientated works.

Get Free Electromagnetics In Magnetic Resonance Imaging Physical Principles

Magnetic Resonance Procedures: Health Effects and Safety is the first authoritative text on MR procedures and its associated health and safety concerns written by noted radiologists, physicists, and scientists with expertise in the field. It contains both theoretical and practical information. This timely text discusses emergent issues related to MR imaging and concerns such as shielding, the safe use of contrast agents, and management of patients with claustrophobia, anxiety, and emotional stress. It also contains a sample pre-MR screening form; comprehensive safety information for over 700 implants, devices, and materials; a list of medical devices and products for interventional MR procedures; and a summary of peer-

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reviewed MR safety studies. In the wake of recent government demands for increased patient safety in hospitals, along with the rapidly expanding use of MRI, this book is particularly important. It is the definitive resource for information on the safety aspects of magnetic resonance procedures.

Magnetic resonance systems are used in almost every academic and industrial chemistry, physics and biochemistry department, as well as being one of the most important imaging modalities in clinical radiology. The design of such systems has become increasingly sophisticated over the years. Static magnetic fields increase continuously, large-scale

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arrays of receive elements are now ubiquitous in clinical MRI, cryogenic technology has become commonplace in high resolution NMR and is expanding rapidly in preclinical MRI, specialized high strength magnetic field gradients have been designed for studying the human connectome, and the commercial advent of ultra-high field human imaging has required new types of RF coils and static shim coils together with extensive electromagnetic simulations to ensure patient safety. This book covers the hardware and engineering that constitutes a magnetic resonance system, whether that be a high-resolution liquid or solid state system for NMR spectroscopy, a preclinical system for imaging animals or a clinical system used for human imaging. Written by a team of experts

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in the field, this book provides a comprehensive and instructional look at all aspects of current magnetic resonance technology, as well as outlooks for future developments.

This book is intended as a text/reference for students, researchers, and professors interested in physical and biomedical applications of Magnetic Resonance Imaging (MRI). Both the theoretical and practical aspects of MRI are emphasized. The book begins with a comprehensive discussion of the Nuclear Magnetic Resonance (NMR) phenomenon based on quantum mechanics and the classical theory of electromagnetism. The first three chapters of this book provide the foundation needed to understand the basic characteristics of MR images,

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e.g., image contrast, spatial resolution, signal-to-noise ratio, common image artifacts. Then MRI applications are considered in the following five chapters. Both the theoretical and practical aspects of MRI are emphasized. The book ends with a discussion of instrumentation and the principles of signal detection in MRI. Clear progression from fundamental physical principles of NMR to MRI and its applications Extensive discussion of image acquisition and reconstruction of MRI Discussion of different mechanisms of MR image contrast Mathematical derivation of the signal-to-noise dependence on basic MR imaging parameters as well as field strength In-depth consideration of artifacts in MR images Comprehensive discussion of several techniques used for rapid MR

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imaging including rapid gradient-echo
imaging, echo-planar imaging, fast
spin-echo imaging and spiral imaging
Qualitative discussion combined with
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techniques for imaging flow

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