Inverse Scattering In Microwave Imaging For Detection Of

When, in the spring of 1979, H.P. Baltes presented me with the precursor of this vo 1 ume, the book on "Inverse Source Problems in Opti cs", I expressed my gratitude in a short note, 11hich in translation, reads: "Dear Dr. Ba ltes, the mere titl e of your unexpected gift evokes memori es of a period, which, in the terminology of your own contribution, would be described as the Stone Age of the Inverse Problem. Those were pleasant times. Walter Kohn and I lived in a cave by ourselves, drew pictures on the walls, and nobody seemed to care. Now, however, Inversion has become an Industry, which I contemplate with as much bewilderment as a surviving Tasmanian aborigine gazing at a modern oil refinery with its towers, its fl ares, and the confus i ng maze of its tubes." The present volume makes me feel even more aboriginal - impossible for me to fathom its content. What I can point out, however, is one of the forgotten origins of the Inverse Scattering Problem of Quantum Mechanics: Werner Heisenberg's "S-Matrix Theory" of 1943. This grandiose scheme had the purpose of eliminating the notion of the Hamiltonian in favour of the scattering operator. If Successful, it would have done away once and for all with any kind of inverse problem.

A description of the state of the art in electromagnetic nondestructive evaluation (NDE) techniques. Topics covered range from magnetostatic to eddy current and microwave NDE methods. Advances in materials characterization, forward/simulation models, sensor design and inverse methodologies are discussed. The book also includes contributions on benchmark problems and solutions.

These Proceedings, consisting of Parts A and B, contain the edited versions of most of the papers presented at the annual Review of Progress in Quantitative Nondestructive Evaluation held at Bowdoin College, Brunswick, Maine on July 28 to August 2, 1996. The Review was organized by the Center for NDE at Iowa State University, in cooperation with the American Society of Nondestructive Testing, the Ames Laboratory of the USDOE, the Federal Aviation Administration, the National Institute of Standardsand Technology, and the National Science Foundation Industry!University Cooperative Research Centers pro gram. This year's Review of Progress in QNDE was attended by approximately 400 participants from the U.S. and many foreign countries who presented over 350 papers. As usual, the meetingwas divided into 36 sessions, with as many as four sessions running concurrently. The Review covered all phases of NDE research and development from fundamental investigations to engineering applications or inspection systems, and it included many important methods of inspection techniques from acoustics to x-rays. In the last eight to ten years, the Review has stabilized at about its current size, which most participants seem to agree is large enough to permit a full-scale overview of the latest developments, but still small enough to retain the collegial atmosphere which has marked the Review since its inception.

More and more researchers engage into investigation of electromagnetic applications, especially these connected with mechatronics, information technologies, medicine, biology and material sciences. It is readily seen when looking at the content of the book that computational techniques, which were under development during the last three decades and are still being developed, serve as good tools for discovering new electromagnetic phenomena. It means that the field of computational electromagnetics belongs to an application area rather than to a research area. This publication aims at joining theory and practice, thus the majority of papers are deeply rooted in engineering problems, being simultaneously of high theoretical level. The editors hope to touch the heart of the matter in electromagnetism. The book focuses on the following issues: Computational Electromagnetics; Electromagnetic Engineering; Coupled Field and Special Applications; Micro- and Special Devices; Bioelectromagnetics and Electromagnetic Hazard; and Magnetic Material Modeling.

Applications of Fractal Theory on Medical Data Processing -- Novel Surface Reconstruction Techniques for Visualization of Medical Data -- Automatic Medical Image Registration Schemes using Global Optimization Techniques -- Wavelet Medical Signal Processing -- Multiresolutional Distributed Filtering: A Novel Technique that Reduces the Amount of Data Required in High Resolution Electrocardiography -- Arterial Motion Estimation from Sequences of Images -- Author Index

We overview the research trend on microwave imaging for early breast cancer detection. The technologies have two categories: ultra-wide band (UWB) radar that reconstructs the scattering power distribution in the breast and inverse scattering problem that reconstructs the dielectric properties distribution. We have developed a clinical equipment using UWB radar and carried out clinical test 4 years ago. Through the experiments, we concluded that the UWB radar was insufficient for the clinical equipment, because the UWB radar cannot discriminate cancerous tumor and other lesions. Therefore, we have been studying inverse scattering. It is a challenging task to develop an equipment using inverse scattering technologies. We have proposed a microwave mammography that has four features: (1) sensor with breast fixing by absorption, (2) small sensor with multipolarization, (3) image reconstruction program linking the commercial EM simulator, and (4) hybrid imaging method using UWB radar and inverse scattering.

Microwave Imaging Methods and Applications provides practitioners and researchers with a complete overview of the latest and most important noninvasive and nondestructive techniques for inspecting structures and bodies by using microwaves. Placing emphasis on applications, the book considers many areas, from medical imaging and security… to industrial engineering and subsurface prospection. For each application, readers are presented with the objectives of the inspection and related challenges. Moreover, this groundbreaking resource details computational methods that can be used to solve inverse problems related to specific applications. Including clear examples or the most significant practical results, this forward-looking reference focuses on systems that have been recently developed. Professionals gain the knowledge needed to compare imaging methods used in different applications and develop new uses of imaging apparatuses and systems.

This book collates past and current research on one of the most promising emerging modalities for breast cancer detection. Readers will discover how, as a standalone technology or in conjunction with another modality, microwave imaging has the potential to provide reliable, safe and comfortable breast exams at low cost. Current breast imaging modalities include X- ray, Ultrasound, Magnetic Resonance Imaging, and Positron Emission Tomography. Each of these methods suffers from limitations, including poor sensitivity or specificity, high cost, patient discomfort, and exposure to potentially harmful ionising radiation. Microwave breast imaging is based on a contrast in the dielectric properties of breast tissue that exists at microwave frequencies. The book begins by considering the anatomy and dielectric properties of the breast, contrasting historical and recent studies. Next, radar-based breast imaging algorithms are discussed, encompassing both early-stage artefact removal, and data independent and adaptive beamforming algorithms. In a similar fashion, microwave tomographic reconstruction algorithms are reviewed in the following chapter, introducing the reader to both the fundamental and more advanced algorithms. Apart from imaging, the book also reviews research efforts in extracting clinically useful information from the Radar Target Signature of breast tumours, which is used to classify tumours as either benign or malignant. Finally, the book concludes by describing the current state of the art in terms of prototype microwave breast imaging systems, with a particular emphasis on those which have progressed to the clinical evaluation stage. This work is motivated by the fact that breast cancer is one of the leading causes of death amongst women in Europe and the US, and the second most common cancer in the world today. Such an important area of research will appeal to many scholars and practitioners.p>

Level set methods are numerical techniques which offer remarkably powerful tools for understanding, analyzing, and computing interface motion in a host of settings. When used for medical imaging analysis and segmentation, the function assigns a label to each pixel or voxel and optimality is defined based on desired imaging properties. This often includes a detection step to extract specific objects via segmentation. This allows for the segmentation and analysis problem to be formulated and solved in a principled way based on well-established mathematical theories. Level set method is a great tool for modeling time varying medical images and enhancement of numerical computations.

Proceedings of Sessions from the First Congress of the International Society for Analysis, Applications, and Computind held in Newark, Delaware, June 2-6, 1997

Microwave imaging techniques allow for the development of systems that are able to inspect, identify, and characterize in a noninvasive fashion under different scenarios, ranging from biomedical to subsurface diagnostics as well as from surveillance and security applications to nondestructive evaluation. Such great opportunities, though, are actually severely limited by difficulties arising from the solution of the underlying inverse scattering problem. As a result, ongoing research efforts in this area are devoted to developing inversion strategies and experimental apparatus so that they are as reliable and accurate as possible with respect to reconstruction capabilities and resolution performance, respectively. The intent of this Special Issue is to present the experiences of leading scientists in the electromagnetic inverse scattering community, as well as to serve as an assessment tool for people who are new to the area of microwave imaging and electromagnetic inverse scattering problems.

Iterative methods are suitable for solving large-size problems in the electromagnetic and acoustic wave scattering. Both the conjugate gradient and bi-conjugate gradient methods combined with the fast Fourier transform (CGFFT and BiCGFFT) are employed as efficient solvers in forward and inverse scattering problems for penetrable bodies. In microwave imaging, material permittivity is the parameter to retrieve. The distorted Born iterative method (DBIM), a nonlinear inverse scattering algorithm that accounts for multiple scattering, can retrieve the permittivity of high contrast. The computational cost for each iteration is $O(Nsp{1.5} log N)$ as the number of transmitters is $O(Nsp{0.5}),$ where N is the number of cells. Real experimental data has been processed by the algorithm under a full-view system to obtain images in real and imaginary parts of permittivity. With the aid of the frequency-hopping scheme, large-size objects can be reconstructed with higher fidelity. The nested equivalence principle algorithm (NEPAL) has been developed to implement the matrix-vector multiply in an O(N log N) fashion. NEPAL can also be applied in the cases of nonuniform grids. With the fast multipole method (FMM) incorporated in NEPAL, an O(N) algorithm can be achieved to perform the matrix-vector multiply. The T-matrix method is used to formulate the three-dimensional electromagnetic scattering problems. Exploiting the Toeplitz structure of the translation matrix, BiCGFFT is invoked as the solver, which requires only O(N log N) operations at each iteration and O(N) memory storage. Efficiency in computation and storage enables the algorithm to solve large problems in real practice. Acoustic wave equations possess the same features as the electromagnetic wave equations for $Hsb{z}$ polarization in two dimensions. The local shape function method (LSF) developed for inverse electromagnetic scattering is adapted to reconstructing both the density and compressibility of soft tissues in ultrasonic imaging. CGFFT is utilized as the forward solver as required to implement inverse operators. The capability of the algorithm has been demonstrated in the reconstructions from the experimental data as well as the synthetic data, and its complexity can be $O(Nsp{1.5} {rm log} N)$ at each iteration. A multiple-frequency scheme, such as the frequency-hopping method, provides better reconstruction than a single-frequency scheme.

This book provides a detailed overview on the use of global optimization and parallel computing in microwave tomography techniques. The book focuses on techniques that are based on global optimization and electromagnetic numerical methods. The authors provide parallelization techniques on homogeneous and heterogeneous computing architectures on high performance and general purpose futuristic computers. The book also discusses the multi-level optimization technique, hybrid genetic algorithm and its application in breast cancer imaging.

A comprehensive, step-by-step reference to the Nyström Method for solving Electromagnetic problems using integral equations Computational electromagnetics studies the numerical methods or techniques that solve electromagnetic problems by computer programming. Currently, there are mainly three numerical methods for electromagnetic problems: the finite-difference time-domain (FDTD), finite element method (FEM), and integral equation methods (IEMs). In the IEMs, the method of moments (MoM) is the most widely used method, but much attention is being paid to the Nyström method as another IEM, because it possesses some unique merits which the MoM lacks. This book focuses on that method—providing information on everything that students and professionals working in the field need to know. Written by the top researchers in electromagnetics, this complete reference book is a consolidation of advances made in the use of the Nyström method for solving electromagnetic integral equations. It begins by introducing the fundamentals of the electromagnetic theory and computational electromagnetics, before proceeding to illustrate the advantages unique to the Nyström method through rigorous worked out examples and equations. Key topics include quadrature rules, singularity treatment techniques, applications to conducting and penetrable media, multiphysics electromagnetic problems, time-domain integral equations, inverse scattering problems and incorporation with multilevel fast multiple algorithm. Systematically introduces the fundamental principles, equations, and advantages of the Nyström method for solving electromagnetic problems Features the unique benefits of using the Nyström method through numerical comparisons with other numerical and analytical methods Covers a broad range of application examples that will point the way for future research The Nystrom Method in Electromagnetics is ideal for graduate students, senior undergraduates, and researchers studying engineering electromagnetics, computational methods, and applied mathematics. Practicing engineers and other industry professionals working in engineering electromagnetics and engineering mathematics will also find it to be incredibly helpful.

This book constitutes the refereed proceedings of the 7th International Conference on High-Performance Computing and Networking, HPCN Europe 1999, held in Amsterdam, The Netherlands in April 1999. The 115 revised full papers presented were carefully selected from a total of close to 200 conference submissions as well as from submissions for various topical workshops. Also included are 40 selected poster presentations. The conference papers are organized in three tracks: end-user applications of HPCN, computational science, and computer science; additionally there are six sections corresponding to topical workshops.

This book, based on Transport and Urban Development COST Action TU1208, presents the most advanced applications of ground penetrating radar (GPR) in a civil engineering context, with documentation of instrumentation, methods and results. It explains clearly how GPR can be employed for the surveying of critical transport infrastructure, such as roads, pavements, bridges and tunnels and for the sensing and mapping of underground utilities and voids. Detailed attention is also devoted to use of GPR in the inspection of geological structures and of construction materials and structures, including reinforced concrete, steel reinforcing bars and pre/post-tensioned stressing ducts. Advanced methods for solution of electromagnetic scattering problems and new data processing techniques are also presented. Readers will come to appreciate that GPR is a safe, advanced, non destructive and noninvasive imaging technique that can be effectively used for the inspection of composite structures and the performance of diagnostics relevant to the entire life cycle of civil engineering works.

Radar-related technology is mainly processed within the time and frequency domains but, at the same time, is a multi-dimensional integrated system including a spatial domain for transmitting and receiving electromagnetic waves. As a result of the enormous technological advancements of the pioneers actively discussed in this book, research and development in multi-dimensional undeveloped areas is expected to continue. This book contains state-of-the-art work that should guide your research.

This book watches out for the issues on making moves for chest radiology in carcinoma of the chest. It focuses on all parts of radiological approaches to manage the breast illness, be it light (optical), sound (ultrasound), interest, microwave, electrical impedance, blend of these modalities, and a section of the incredibly intense issues on computer-aided detection. The dedication of the eminent analysts in this book has incorporated a lot of energy for the people who are adequately drawn in with the clinical organization of this ailment and also for the students of radiology and surgery alike. This book will definitely be appreciated and well taken by the surgeons, radiologists, and other professionals involved in this field. The contributions are excellent in terms of diagnostic approach by radiological means and would certainly be a step forward in making it possible to reach to a conclusive diagnosis of breast cancer much before it becomes inoperable. The chapters included will further our knowledge and to the best of my belief will make things easier and definable in terms of diagnosis of breast cancer.

Through-the-wall radar imaging (TWRI) allows police, fire and rescue personnel, first responders, and defense forces to detect, identify, classify, and track the whereabouts of humans and moving objects. Electromagnetic waves are considered the most effective at achieving this objective, yet advances in this multi-faceted and multi-disciplinary technology require taking phenomenological issues into consideration and must be based on a solid understanding of the intricacies of EM wave interactions with interior and exterior objects and structures. Providing a broad overview of the myriad factors involved, namely size, weight, mobility, acquisition time, aperture distribution, power, bandwidth, standoff distance, and, most importantly, reliable performance and delivery of accurate information, Through-the-Wall Radar Imaging examines this technology from the algorithmic, modeling, experimentation, and system design perspectives. It begins with coverage of the electromagnetic properties of walls and building materials, and discusses techniques in the design of antenna elements and array configurations, beamforming concepts and issues, and the use of antenna array with collocated and distributed apertures. Detailed chapters discuss several suitable waveforms inverse scattering approaches and revolve around the relevance of physical-based model approaches in TWRI along with theoretical and experimental research in 3D building tomography using microwave remote sensing, high-frequency asymptotic modeling methods, synthetic aperture radar (SAR) techniques, impulse radars, airborne radar imaging of multi-floor buildings strategies for target detection, and detection of concealed targets. The book concludes with a discussion of how the Doppler principle can be used to measure motion at a very fine level of detail. The book provides a deep understanding of the challenges of TWRI, stressing its multidisciplinary and phenomenological nature. The breadth and depth of topics covered presents a highly detailed treatment of this potentially life-saving technology.

14 contributions present mathematical models for different imaging techniques in medicine and nondestructive testing. The underlying mathematical models are presented in a way that also newcomers in the field have a chance to understand the relation between the special applications and the mathematics needed for successfully treating these problems. The reader gets an insight into a modern field of scientific computing with applications formerly not presented in such form, leading from the basics to actual research activities.

The papers published in this volume were presented at the Second International Conference on Ultra-WidebandiShort-Pulse (UWB/SP) Electromagnetics, ApriIS-7, 1994. To place this second international conference in proper perspective with respect to the first conference held during October 8-10, 1992, at Polytechnic University, some background information is necessary. As we had hoped, the first conference struck a responsive cord, both in timeliness and relevance, among the electromagnetic community 1. Participants at the first conference already inquired whether and when a follow-up meeting was under consideration. The first concrete proposal in this direction was made a few months after the first conference by Prof. A. Terzuoli of the Air Force Institute of Technology (AFIT), Dayton, Ohio, who has been a strong advocate of time-domain methods and technologies. He initially proposed a follow-up time-domain workshop under AFIT auspices. Realizing that interest in this subject is lodged also at other Air Force installations, we suggested to enlarge the scope, and received in this endeavor the support of Dr. A. Nachman of AFOSR (Air Force Office of Scientific Research), Bolling Air Force Base, Washington, D.C.

A time-domain inverse scattering technique for estimating the location, shape, and permittivity of a dielectric cylinder in a slab medium is proposed. In this paper, the finite-difference time domain is employed for the analysis of the forward scattering part, and asynchronous particle swarm optimization (APSO) is applied for the reconstruction of the two-dimensional homogeneous dielectric cylinder. For the forward scattering, several electromagnetic pulses are launched to illuminate the unknown scatterers, and then the surrounding scattered electromagnetic fields are measured. In order to efficiently describe the details of the shape, a sub-gridding technique is implemented in the finite-difference time domain method. Then, the simulated electromagnetic fields are used for inverse scattering, in which APSO is employed to transform the inverse scattering problem into an optimization problem. APSO is a population-based optimization approach that aims to minimize a cost function between measurements and computer-simulated data. The numerical results presented for the two examples of scatterers under transverse-electric incidence demonstrate that the proposed method is capable of reconstructing a complicated shape with a rapid rate of convergence and robust immunity to noise.

Inverse problems in wave propagation occur in geophysics, ocean acoustics, civil and environmental engineering, ultrasonic non-destructive testing, biomedical ultrasonics, radar, astrophysics, as well as other areas of science and technology. The papers in this volume cover these scientific and technical topics, together with fundamental mathematical investigations of the relation between waves and scatterers.

This thesis presents both theoretical formulations and experimental methods for performing broadband time-domain inverse scattering. The inverse scattering problem is very important for a number of application areas including nondestructive evaluation, geophysical probing, medical imaging and military target identification. Emphasis is placed on the use of microwaves to probe the unknown object, although much of the theory presented applies to other types of waves such as acoustic and elastic waves. Distorted-Born iterative method (DBIM) inverse scattering algorithms are presented for solving 2-D TM and TE problems. The TM algorithm is shown to be capable of accurately inverting objects with contrast as high as 10:1, but the TE algorithm breaks down when the object contrast exceeds 2:1 due to the buildup of polarization charges inside the object. A local-shape-function (LSF) inverse scattering algorithm is presented for imaging very strong scattering objects such as metallic scatterers. The LSF algorithm has a higher resolution capability than the DBIM algorithm for reconstructing closely spaced metallic scatterers. The LSF algorithm also converges faster in the metallic scatterer case. Broadband time-domain data are preferable to continuous-wave (CW) data at just a few discrete frequencies due to the higher information content inherent in a broadband pulse and the ability to use time gating to eliminate unwanted early-time and late-time arrival signals. Broadband time-domain data may be collected in a practical microwave measurement system using either a step-frequency radar approach or an impulse radar. There are advantages and disadvantages to using both data collection methods, and the choice of one technology over the other depends primarily on the application. A prototype step-frequency radar system has been developed to demonstrate the capability of our inverse scattering algorithms with real experimental data. Reconstructions of both metallic and dielectric objects including metallic cylinders and plastic PVC pipes in air from experimental data are shown. A commercial monostatic impulse radar system is described and plans are discussed for building a rudimentary bistatic impulse radar. A method is presented for implementing an efficient finite-difference time-domain (FDTD) electromagnetic scattering algorithm on a massively parallel supercomputer. The main challenge in designing an efficient algorithm is in the implementation of an absorbing boundary condition at the edge of the FDTD grid. Since the inverse scattering methods that we present here rely on the solution of forward scattering problems at each step in an iterative algorithm, the efficient FDTD algorithm allows us to solve very large inverse scattering problems quickly on a massively parallel supercomputer.

A comprehensive and updated overview of the theory, algorithms and applications of for electromagnetic inverse scattering problems Offers the recent and most important advances in inverse scattering grounded in fundamental theory, algorithms and practical engineering applications Covers the latest, most relevant inverse scattering techniques like signal subspace methods, time reversal, linear sampling, qualitative methods, compressive sensing, and noniterative methods Emphasizes theory, mathematical derivation and physical insights of various inverse scattering problems Written by a leading expert in the field

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Provides a review of developments in the fields of direct and inverse electromagnetic wave scattering. Contributions from leading researchers in these fields from all over the world are gathered in this book to discuss the state of the topic and directions for future research, starting from the fundamental structure of wave scattering problems and finishing with an assessment of the impact of this structure in applications

An introduction to the most relevant theoretical and algorithmic aspects of modern microwave imaging approaches Microwave imaging—a technique used in sensing a given scene by means of interrogating microwaves—has recently proven its usefulness in providing excellent diagnostic capabilities in several areas, including civil and industrial engineering, nondestructive testing and evaluation, geophysical prospecting, and biomedical engineering. Microwave Imaging offers comprehensive descriptions of the most important techniques so far proposed for short-range microwave imaging—including reconstruction procedures and imaging systems and apparatus—enabling the reader to use microwaves for diagnostic purposes in a wide range of applications. This hands-on resource features: A review of the electromagnetic inverse scattering problem formulation, written from an engineering perspective and with notations The most effective reconstruction techniques based on diffracted waves, including time- and frequency-domain methods, as well as deterministic and stochastic space-domain procedures Currently proposed imaging apparatus, aimed at fast and accurate measurements of the scattered field data Insight on near field probes, microwave axial tomographs, and microwave cameras and scanners A discussion of practical applications with detailed descriptions and discussions of several specific examples (e.g., materials evaluation, crack detection, inspection of civil and industrial structures, subsurface detection, and medical applications) A look at emerging techniques and future trends Microwave Imaging is a practical resource for engineers, scientists, researchers, and professors in the fields of civil and industrial engineering, nondestructive testing and evaluation, geophysical prospecting, and biomedical engineering.

Radar-based imaging of aircraft targets is a topic that continues to attract a lot of attention, particularly since these imaging methods have been recognized to be the foundation of any successful all-weather non-cooperative target identification technique. Traditional books in this area look at the topic from a radar engineering point of view. Consequently, the basic issues associated with model error and image interpretation are usually not addressed in any substantive fashion. Moreover, applied mathematicians frequently find it difficult to read the radar engineering literature because it is jargon-laden and device specific, meaning that the skills most applicable to the problem's solution are rarely applied. Enabling an understanding of the subject and its current mathematical research issues, Radar Imaging of Airborne Targets: A Primer for Applied Mathematicians and Physicists presents the issues and techniques associated with radar imaging from a mathematical point of view rather than from an instrumentation perspective. The book concentrates on scattering issues, the inverse scattering problem, and the approximations that are usually made by practical algorithm developers. The author also explains the consequences of these approximations to the resultant radar image and its interpretation, and examines methods for reducing model-based error.

The conference provides an overview of the state of the art developments and innovations in Antennas, Propagation, and Measurements, highlighting the latest requirements for future applications

Europe's place in the world throughout the narrative and in the primary source feature, 'The Global Record.' The seventh edition has been carefully revised and edited for greater accessibility, and features a streamlined design that incorporates pedagogical features such as focus questions, key terms, and section summaries to better support students of western civilization. The reconceived narrative and restructured organization, featuring smaller, more cohesive learning units, lend to greater ease of use for both students and instructors. History CourseMate, a set of media-rich study tools with interactive eBook that gives students access to quizzes, flashcards, primary sources, videos and more, are available for this new edition. (CourseMate may be bundled with the text or purchased separately.) Available in the following split options: WESTERN CIVILIZATION: BEYOND BOUNDARIES, Seventh Edition Complete, Volume I: To 1715, Volume II: Since 1560, Volume A: To 1500, Volume B: 1300-1815, and Volume C: Since 1789. Available with InfoTrac Student Collections http://gocengage.com/infotrac.

This timely book presents innovative technologies for use in the diagnosis, monitoring, and treatment of brain disease. These technologies offer exciting possibilities in the medical field owing to their low-cost, portability and safety. The authors address cerebrovascular diseases such as stroke, ischemia, haemorrhage, and vasospasm, these diseases having an ever-increasing societal relevance due to the global ageing population. The authors describe the potential of novel techniques such as microwave imaging and present innovative modalities for treatment of brain tumours using electromagnetic fields and nano-composites, as well as for monitoring brain temperature during surgery. Finally, Emerging Electromagnetic Technologies for Brain Diseases Diagnostics, Monitoring and Therapy addresses the perspectives which arise from multi-modal multi-spectral EM modalities, which make a synergic use of the different portions of the electromagnetic spectrum. This text will be of interest to readers from various different areas, given the fundamental interdisciplinarity of the subject matter. This includes researchers or practitioners in the field of electrical engineering, applied physicists, and applied mathematicians working on imaging applications for biomedical and electromagnetic technologies. Neurologists and radiologists may also find this book of interest, as may graduate students in these areas.