Electromagnetic and Acoustic Wave Tomography
Nathan Blaunstien and Vladimir Yakubov, Editors
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The topic of this book is the inverse problem theory applied to radio-wave tomography. The book is highly theoretical, probably most suited for physicist and mathematicians, as it provides rigorous mathematical development of the physical–mathematical models of the direct and inverse problem with specific application to tomography. The book describes a number of experiments and applications of the developed radio-wave tomography theory for the image reconstruction of hidden/embedded radio-waves opaque and semi-opaque objects and shapes, and non-destructive measurements, through the processing of multi-angle and multi-frequency [ultra-wide band (UWB) signals] remote measurements of scattered radio signals. The only acoustics connection in the book is the application of the theory to ultrasonic tomography.

The book is divided into 6 sections. Section I provides the mathematical rigor to distinguish between direct and inverse problems and then defines the approaches need to deal the inverse problem solution. Having established the inverse problem formulations, these are used to solve various types of inverse problems. The theory presented in the Chapters 1, 2 and 3 would apply to any inverse tomography and wave tomography problems whether dealing with radio, magnetic or acoustic waves; however, Chapters 4 and 5 and then all the chapters in Sections II to VI focus on magnetic, eddy current and radio tomography. The exception is Section IV and Chapter 12 that include a discussion on ultrasonic tomography.

Section II describes a series of experiments in wave tomography that are mainly focused to verify and prove the theory presented in Section I. The chapters describe the equipment used in the experiments and then the different applications ranging from tomograms of objects in building materials, in bags and luggage, etc., with various radio-wave transparent, semitransparent and opaque objects. The concept of UWB and multi-aspect processing is introduced to improve on the quality of the tomograms.

Section III is focused on the practical applications as compared to the laboratory experiments of Section II. Application in subterranean mapping for detection of subsurface objects, space-based mapping of forests for assessment of forest covers, house inspection mapping for hidden objects, detection of buried people and detection of people behind walls are described.

Section IV as mentioned earlier introduces the concept of combining ultrasonic tomography with radio wave tomography and present a number of experiments performed to demonstrate the advantage of combining ultrasonics with radio waves for creating non-contacting tomograms. The advantage is that, while electromagnetic waves can detect electro-physical inhomogeneities, ultrasonic waves detect changes in density; thus, when combined, the material composition of the hidden object can be determined.

Section V presents applications of magnetic and eddy current tomography for the detection of material defects such as inhomogeneities and cracks. The final section, Section VI, is dedicated to visualization methods, especially in the rendition of 3D objects from the tomogram data. The data can be generated in layers and then combined to create the 3D object.

The book contains brief biography of the editors, Nathan Blaunstien and Vladimir Yakubov. Nathan Blaunstien is Emeritus Professor in the Department of Communication Systems Engineering at the Ben-Gurion University of the Negev, Beer-Sheva, Israel. He is a native of Moldova, former USSR. He has an MS degree from Tomsk University, and a PhD and DS from the Academy of Science USSR, Moscow, Russia. He has over 200 publications, books and book chapters predominantly in radiophysics. Vladimir Yakubov is also a native of Russia and received his MS degree from Tomsk University and PHD from the Siberian Physical and Technical Institute. He has numerous publications in the field radio-wave tomography.

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