

Preface

Microwave imaging is a new area of research in imaging community. One of the applications for microwave imaging is biomedical imaging. Microwave imaging is the process by which radiofrequency electromagnetic waves are used to generate an image.

This book focuses on microwave tomography imaging which provides quantitative images. Generally, microwave tomography is categorized under inverse scattering problem. The focus in this book will be techniques that are based on global optimization and electromagnetic numerical methods. These methods usually are cumbersome due to their computational burden; therefore, they have got very little attention in the literature. To make these methods more applicable and feasible it is necessary to speed up the computations for real-time analysis.

In this effort, the book will provide parallelization techniques on high performance and general purpose computers. Additionally, it introduces the combination of classification methods to include *a priori* information, global optimization, and numerical forward solver that is unique. Also it discusses multilevel and hybrid optimization technique and some examples of its application in biomedical imaging.

Chapter 1 introduces the reader to different methods of microwave imaging. It will then give details of categories of microwave tomography and how global optimization fits into these categories.

Chapter 2 provides a background on finite-difference time domain numerical method in solving Maxwell's equations. The numerical method is used as what is called "forward solver".

Chapter 3 gives a general overview of evolutionary global optimizations that can be considered for microwave tomography.

Chapter 4 introduces one of the evolutionary optimization methods, genetic algorithms, and its application in microwave tomography. Some simple examples are provided in this chapter of image reconstruction using forward solver and genetic algorithms.

Chapter 5 provides details of how *a priori* information about dielectric properties can be used toward a regularization technique that can improve the convergence rate

and robustness of the results. Detailed examples of medical imaging are provided in this chapter.

Chapter 6 focuses on parallelization of finite-difference time domain forward solver and discusses how this method can be implanted on cluster computers or graphic programming units (GPUs).

Chapter 7 gives information on how different global optimization methods can be implemented on parallel machines, and finally Chap. 8 provides a comparison of different optimization methods.

Researchers in the field of biomedical and inverse imaging, graduate students, and engineers in the field of microwave and inverse scattering will benefit from this book. This book can be used at the graduate level in microwave imaging courses. It will be comprehensive enough to be used as a supplementary textbook and will cover the material required in a course on microwave tomography.

Grand Forks, ND, USA
February 2014

Sima Noghianian

Microwave Tomography

Global Optimization, Parallelization and Performance
Evaluation

Noghanian, S.; Sabouni, A.; Desell, T.; Ashtari, A.

2014, XVII, 198 p. 117 illus., 112 illus. in color.,

Hardcover

ISBN: 978-1-4939-0751-9