

Preface

This book started as a set of lectures in computational science for inverse problems where electromagnetics was used as an example. Talking with many graduate students and other faculty, I realized that there is much “know-how” that is based on practical experience but is not covered in any course or book.

Such experience is crucial if we desire to solve realistic problems, write our own computer programs, and work with field data sets.

The book attempts to bridge the gap between more theoretical papers and books on inverse and forward problems and the complete applied material that gives very little detail on how to do things in practice. I have tried to stay away from formal mathematics and added computer codes that enable the reader to solve realistic problems. Working through the codes that are attached to this book (see www.siam.org/books/mn01) the user should be able to solve moderate-size electromagnetic (EM) forward and inverse problems on a stretched rectangular mesh.

The book is by no means complete. I do not cover finite element methods, Bayesian techniques, uncertainty estimation, and many other important topics. On the other hand, the book is mostly self-contained. It enables the reader to program a forward and an inverse EM problem from start to finish. I believe that issues such as uncertainty can be best served by gaining some first-hand experience with the forward and inverse problems.

The book can be used by students who wish to study EM forward and inverse problems as well as students interested in applied inverse problems with partial differential equations as constraints. The MATLAB software that accompanies this book can be used to solve realistic inverse EM problems and can be easily modified to solve other problems such as medical EIT or DOT. I hope that students as well as practitioners will find it useful.

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