Preface

This textbook is an introduction to signal processing primarily aimed at neuroscientists and biomedical engineers. The text was developed for a one-quarter course I teach for graduate and undergraduate students at the University of Chicago and the Illinois Institute of Technology. The purpose of the course is to introduce signal analysis to students with a reasonable but modest background in mathematics (including complex algebra, basic calculus, and introductory knowledge of differential equations) and a minimal background in neurophysiology, physics, and computer programming. To help the basic neuroscientist ease into the mathematics, the first chapters are developed in small steps, and many notes are added to support the explanations. Throughout the text, advanced concepts are introduced where needed, and in the cases where details would distract too much from the "big picture," further explanation is moved to an appendix. My goals are to provide students with the background required to understand the principles of commercially available analyses software, to allow them to construct their own analysis tools in an environment such as MATLAB,* and to make more advanced engineering literature accessible. Most of the chapters are based on 90-minute lectures that include demonstrations of MATLAB scripts. Chapters 7 and 8 contain material from three to four lectures. Each chapter can be considered as a stand-alone unit. For students who need to refresh their memory on supporting topics, I include references to other chapters. The figures, equations, and appendices are also referenced independently by chapter number.

The CD that accompanies this text contains the MATLAB scripts and several data files. These scripts were not developed to provide optimized algorithms but serve as examples of implementation of the signal processing task at hand. For ease of interpretation, all MATLAB scripts are commented; comments starting with % provide structure and explanation of procedures and the meaning of variables. To gain practical experience in signal processing, I advise the student to actively explore the examples and scripts included and worry about algorithm optimization later. All

* MATLAB is a registered trademark of The MathWorks, Inc.

scripts were developed to run in MATLAB (Version 7) including the toolboxes for signal processing (Version 6), image processing (Version 5), and wavelets (Version 3). However, aside from those that use a digital filter, the Fourier slice theorem, or the wavemenu, most scripts will run without these toolboxes. If the student has access to an oscilloscope and function generator, the analog filter section (Chapter 10) can be used in a lab context. The components required to create the RC circuit can be obtained from any electronics store.

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Finally, although she isn't very much interested in signal processing, I dedicate this book to my wife for her support: heel erg bedankt Ingrid.