Preface

MATLAB has achieved widespread application throughout the engineering community. The popularity of MATLAB among engineers is due primarily to its powerful capabilities and ease of use. Furthermore, its long history has resulted in its being very well developed and well tested. Engineers can trust its answers. Today, no student should leave engineering school without attaining at least some proficiency with MATLAB.

MATLAB has evolved over a period of years with input from our user community. In university environments, it has become the standard instructional tool for introductory courses in applied linear algebra, as well as advanced courses in other areas. In industrial settings, MATLAB is used for research and to solve practical engineering and mathematical problems. Typical uses include general-purpose numeric computation, algorithm prototyping, and special purpose problem solving with matrix formulations that arise in disciplines such as automatic control theory, statistics, and digital signal processing (time-series analysis).

TEXT OBJECTIVES

The main goal of this book is to help you become competent at solving the kinds of mathematical problems that you will likely encounter as an engineering student, as well as a practicing engineer. The book can be used as a self-study guide, but was written to be used as a hands-on, self-paced tutorial component in an introductory course within an engineering curriculum. Reference lists of MATLAB commands at the end of each chapter allow the book to also be used as a helpful future reference.

Problems covered in the text extend from arithmetic to calculus, providing hands-on experience with MATLAB's extensive range of capabilities. Three chapters are dedicated, respectively, to civil, mechanical, and electrical engineering, allowing the reader to see how "real-world" engineering problems might be solved using MATLAB.

This text emphasizes plotting and programming. The creation of simple plots is introduced early, in Chapter 1, and the complexity of sample plotting problems is gradually increased until Chapter 4, which covers the topic in detail. Programming in MATLAB is also described early, in detail, in Chapter 3. From then on, programming problems continue to appear throughout the text.

Another goal of this book is to train the reader to learn and follow good problem solving techniques. Since MATLAB is a programming language, this technique will be similar to that applied whenever one is using a computer to solve a problem. This technique, described at the end of Chapter 1, will be used to solve "MATLAB applications" at the ends of Chapters 1 through 6.

A final goal of this book is that you learn to enjoy using MATLAB, so you will want to use it to solve your problems. In this way, you may be motivated to go beyond this book and learn how to use MATLAB's advanced features in your future work as an engineering student and practicing engineer.

TEXT ORGANIZATION

The subject matter in this book is divided into nine chapters. Chapter 1, *Getting Started with MATLAB*, explains how to start and quit the MATLAB program, walks through a first problem in plotting, and describes the Command Window and its pull-down menus. Chapter 1 also covers recording, saving, and printing your work, and how to get help.

Chapter 2, *Basic Operations*, describes the basics of using MATLAB. It explains how to declare and manipulate scalars, vectors, and matrices. Each of its three sections ends with a simple plotting problem. Chapter 3, *Programming*, explains how to write MATLAB scripts, functions, and programs. It also describes how to create and use data files and how to measure program performance. Programming is introduced early in the text so that user-defined functions and programs can be used throughout the remainder of the text.

Chapter 4, *Matrix Computations*, is the "meat" of the book for the typical engineer. It describes how to use the bulk of MATLAB's many powerful functions. The chapter describes those MATLAB operations most useful to engineers, including the matrix transpose, determinants, and the dot and cross products. Chapter 4 also explains how to solve sets of equations and how to solve polynomial-related problems.

Chapter 5, *Plotting*, describes the creation of both 2-D and 3-D plots. It also describes the creation of a number of MATLAB special plots, including polar plots, bar graphs, pie charts, and even animated plots. Putting plotting at this point in the text allows us to use the matrix operations of Chapter 4 as examples. Chapter 6, *Data Analysis*, shows you how to perform data analysis, create histograms, and perform linear and polynomial regression. Chapter 6 also explains how to perform differentiation and integration and how to perform Fourier analysis.

Chapters 7, 8, and 9 each contain a set of engineering problems relating, respectively, to civil, mechanical, and electrical engineering. The problems are more complex and lengthy than are the example problems found at the ends of the previous chapters' sub-sections. However, their complexity should not be beyond the ability of a typical motivated engineering student.

Each chapter is structured in the following way.

1. A brief discussion of an engineering topic, usually of an historical nature.
2. A chapter **Introduction**.
3. The body of the chapter.
4. A chapter **Summary**.
5. An **Engineering Application** that relates back to the engineering topic that started the chapter.
6. A table of **Key Terms** used in this Chapter.
7. A table of MATLAB **Commands and Functions** used in this Chapter.
8. A set of chapter **Exercises**.
9. **Solutions** to the sub-section self-tests

From Chapter 2 on, every sub-section within each chapter ends with a single example problem that demonstrates the application of the concepts covered in that sub-section. There are over 70 of these example problems. In order to quickly move things along at the end of each sub-section, these problems are kept straightforward and little attempt is made to tie the problems specifically to engineering. Following each of these sub-section examples is a **Sub-Section Self-Test** problem that gives the student the opportunity to apply the relevant concepts.

Engineering problems are presented in the chapter-end **Engineering Applications** and in Chapters 7, 8, and 9. The two-fold goal of Chapters 7, 8, and 9 is to present a balanced cross-section of engineering problems that:

1. suggest some of the design problems that different types of engineers encounter and;
2. demonstrate MATLAB's ability to solve a large variety of difficult problems, such as derivatives, integrals, ordinary differential equations, and sets of simultaneous equations.

Combined, there are over 225 exercises at the ends of the 9 chapters.

A concise overview of MATLAB features is provided in the Appendix.

Prerequisites

This book assumes you have some knowledge of algebra, geometry, and trigonometry. Increasingly, throughout the text, more knowledge is assumed. In the final chapters, some knowledge of subjects related to civil, mechanical, and electrical engineering is assumed. These subjects include surveying, statics, mechanics, and basic electric circuits. No prior experience with a computer is assumed by this text.

MATLAB Versions

This book describes MATLAB 6 for Windows 95, Windows 98, Windows NT, and Windows 2000. However, most of the content is also applicable to MATLAB 5 and MATLAB 4. The Editor/Debugger is not provided with versions prior to MATLAB 5; however, any common text editor can be used in its place. The book is fully compatible with the *Student Edition of MATLAB 6*.