

Preface

Numerical Computing with MATLAB is a textbook for an introductory course in numerical methods, MATLAB, and technical computing. The emphasis is on informed use of mathematical software. We want you learn enough about the mathematical functions in MATLAB that you will be able to use them correctly, appreciate their limitations, and modify them when necessary to suit your own needs. The topics include

- introduction to MATLAB,
- linear equations,
- interpolation,
- zero and roots,
- least squares,
- quadrature,
- ordinary differential equations,
- random numbers,
- Fourier analysis,
- eigenvalues and singular values,
- partial differential equations.

George Forsythe initiated a software-based numerical methods course at Stanford University in the late 1960s. The textbooks by Forsythe, Malcolm, and Moler [1] and Kahaner, Moler, and Nash [2] that evolved from the Stanford course were based upon libraries of Fortran subroutines.

This textbook is based upon MATLAB. NCM, a collection of over 70 M-files, forms an essential part of the book. Many of the over 200 exercises involve modifying and extending the programs in NCM. The book also makes extensive use of computer graphics, including interactive graphical expositions of numerical algorithms.

The prerequisites for the course, and the book, include

September 21, 2013

- calculus,
- some familiarity with ordinary differential equations,
- some familiarity with matrices,
- some computer programming experience.

If you've never used MATLAB before, the first chapter will help you get started. If you're already familiar with MATLAB, you can glance over most of the first chapter quickly. Everyone should read the section in the first chapter about floating-point arithmetic.

There is probably too much material here for a one-quarter or one-semester course. Plan to cover the first several chapters and then choose the portions of the last four chapters that interest you.

Make sure that the NCM collection is installed on your network or your personal computer as you read the book. The software is available from a Web site devoted to the book [3]:

`http://www.mathworks.com/moler`

There are three types of NCM files:

- `gui` files: interactive graphical demonstrations;
- `tx` files: textbook implementations of built-in MATLAB functions;
- others: miscellaneous files, primarily associated with exercises.

When you have NCM available,

`ncmgui`

produces the figure shown on the next page. Each thumbnail plot is actually a push button that launches the corresponding `gui`.

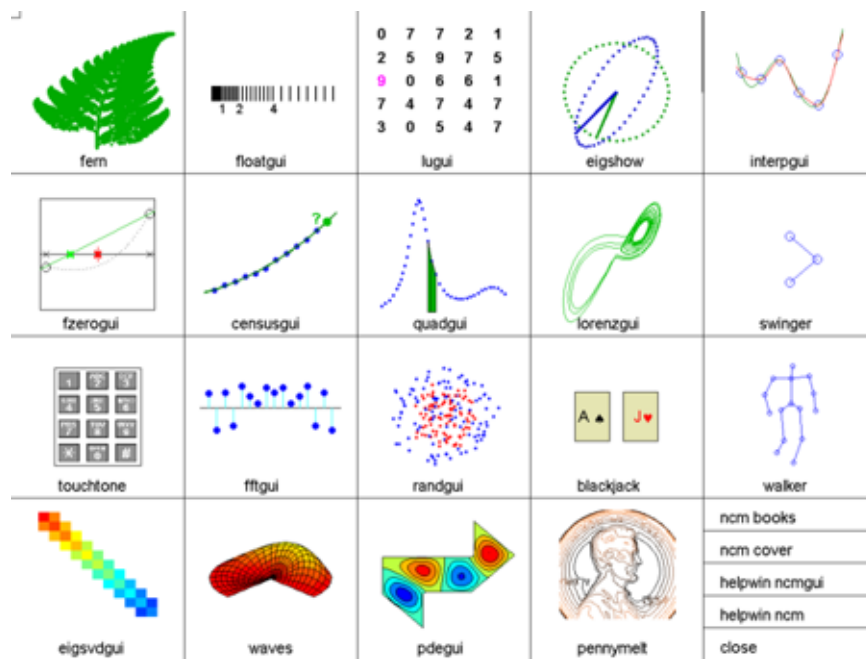
This book would not have been possible without the people at The MathWorks and at SIAM. Both groups are professional, creative, and delightful to work with. They have been especially supportive of this book project. Out of the many friends and colleagues who have made specific contributions, I want to mention five in particular. Kathryn Ann Moler has used early drafts of the book several times in courses at Stanford and has been my best critic. Tim Davis and Charlie Van Loan wrote especially helpful reviews. Lisl Urban did an immaculate editing job. My wife Patsy has lived with my work habits and my laptop and loves me anyway. Thanks, everyone.

A revised reprint in 2008 included a change in the section on Google PageRank that improves the handling of web pages with no out links, a short new section in the Random Numbers chapter, removal of material on `inline` and `feval`, and correction of a few dozen minor typographical errors.

A significant update in September 2013 incorporates over 60 changes. Many of them have been recommended by Professor Zhiyong Zhang of Nanjing University of Posts and Telecommunications in China (NJUPT), who prepared a Chinese

translation for BUAA press. The census example in section 5.3 includes the 2010 census. Output from `format long` shows 16 significant digits. Symbolic Toolbox usage reflects the MuPad connection. Many thanks to Prof. Zhang.

Cleve Moler
 Sept. 16, 2013



ncmgui

Bibliography

- [1] G. FORSYTHE, M. MALCOLM, AND C. MOLER, *Computer Methods for Mathematical Computations*, Prentice–Hall, Englewood Cliffs, NJ, 1977.
- [2] D. KAHANER, C. MOLER, AND S. NASH, *Numerical Methods and Software*, Prentice–Hall, Englewood Cliffs, NJ, 1989.
- [3] C. MOLER, *Numerical Computing with MATLAB*,
Electronic edition: The MathWorks, Inc., Natick, MA, 2004.
<http://www.mathworks.com/moler>
Print edition: SIAM, Philadelphia, 2004.
<http://www.ec-securehost.com/SIAM/ot87.html>