

Contents

Chapter 1.	Introduction	1
Chapter 2.	Chemical Kinetics and Enzyme Dynamics	3
2.1.	Introduction to MATLAB	10
2.1.1.	Basic Arithmetic Operations, Creating Variables, and Calling Functions	10
2.1.2.	Vector and Matrix Calculations	12
2.1.3.	Symbolic Calculation	15
Chapter 3.	Ordinary Differential Equations	19
3.1.	Cancer Model	24
3.2.	Root-Finding Algorithms	26
3.2.1.	Bisection Method	26
3.2.2.	Newton's Method	27
3.2.3.	Built-In MATLAB Functions for Root Finding	28
Chapter 4.	Epidemiology of Infectious Diseases	33
4.1.	HIV Infection	37
4.2.	Waterborne Disease	38
4.3.	Numerical Methods for Ordinary Differential Equations	40
4.3.1.	Euler Method	40
4.3.2.	Runge–Kutta Methods	43
4.3.3.	MATLAB Built-In ODE Solvers	46
Chapter 5.	Chemostats and Competition Among Species	49
5.1.	Food Chain	55
5.2.	Eigenvalue Solvers	56
5.2.1.	Power Method	57
5.2.2.	Shifted Inversed Power Method	58
5.2.3.	MATLAB Built-In Eigenvalue Solvers	58
Chapter 6.	Bifurcation Theory	61
6.1.	Numerical Computation of Bifurcation Diagrams	67

Chapter 7.	Neuronal Oscillations	73
7.1.	Numerical Computation of Neuronal Oscillations	78
Chapter 8.	Conservation Laws	81
8.1.	Age Structure of Cells	84
8.2.	Antibiotic Resistance in Hospitals	85
8.3.	Numerical Methods for Hyperbolic Equations	87
Chapter 9.	Neurofilaments Transport in Axon	93
9.1.	Numerical Computation of Neurofilaments Transport in Axon	97
Chapter 10.	Diffusion and Chemotaxis	103
10.1.	Dictyostelium discoideum	108
10.2.	Angiogenesis	110
10.3.	Diffusion/Dispersion in Population Dynamics	111
10.4.	MATLAB Solver for Parabolic PDEs	112
Chapter 11.	Cancer	119
11.1.	Numerical Approach for the Cancer Cells Model	123
Chapter 12.	Cancer Therapy	127
12.1.	Viral Therapy	127
12.2.	Treatment of GM-CSF	129
12.3.	Numerical Approach for the Cancer Therapy Model	131
Chapter 13.	Granulomas	139
13.1.	Numerical Approach to the Granulomas Model	143
Bibliography		147
Answers to Problems		149
Index		153

Mathematical Modeling of Biological Processes

Friedman, A.; Kao, C.-Y.

2014, VI, 154 p. 32 illus., 17 illus. in color., Softcover

ISBN: 978-3-319-08313-1