

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	A Brief History	1
1.2	Book Layout	5
	References.	6
<b>2</b>	<b>Nonlinear Discrete Systems</b>	<b>11</b>
2.1	Definitions	11
2.2	Fixed Points and Stability	13
2.3	Stability Switching Theory	24
2.4	Bifurcation Theory	41
	References.	50
<b>3</b>	<b>Discretization of Continuous Systems</b>	<b>51</b>
3.1	Continuous Systems	51
3.2	Basic Discretization.	54
3.2.1	Forward Euler's Method	55
3.2.2	Backward Euler's Method	59
3.2.3	Trapezoidal Rule Discretization	63
3.2.4	Midpoint Method	68
3.3	Introduction to Runge–Kutta Methods	72
3.3.1	Taylor Series Method	73
3.3.2	Runge–Kutta Method of Order 2	78
3.4	Explicit Runge–Kutta Methods	81
3.4.1	Runge–Kutta Method of Order 3	89
3.4.2	Runge–Kutta Method of Order 4	96
3.5	Implicit Runge–Kutta Methods	101
3.5.1	Polynomial Interpolation	102
3.5.2	Implicit Runge–Kutta Methods	105
3.5.3	Gauss Method	111
3.5.4	Radau Method	114
3.5.5	Lobatto Method	118

3.5.6	Diagonally Implicit RK Methods . . . . .	121
3.5.7	Stability of Implicit Runge–Kutta Methods. . . . .	124
3.6	Multi-step Methods . . . . .	128
3.6.1	Adams–Bashforth Methods . . . . .	128
3.6.2	Adams–Moulton Methods . . . . .	137
3.6.3	Explicit Adams Methods . . . . .	144
3.6.4	Implicit Adams Methods . . . . .	146
3.6.5	General Forms . . . . .	150
3.7	Generalized Implicit Multi-step Methods . . . . .	152
	References. . . . .	157
<b>4</b>	<b>Implicit Mapping Dynamics . . . . .</b>	<b>159</b>
4.1	Single-Step Implicit Maps . . . . .	159
4.2	Discrete Systems with Multiple Maps . . . . .	170
4.3	Complete Dynamics of a Henon Map System. . . . .	174
4.4	Multi-step Implicit Maps . . . . .	181
	References. . . . .	197
<b>5</b>	<b>Periodic Flows in Continuous Systems . . . . .</b>	<b>199</b>
5.1	Continuous Nonlinear Systems . . . . .	199
5.2	Continuous Time-Delay Systems . . . . .	218
5.2.1	Interpolated Time-Delay Nodes . . . . .	218
5.2.2	Integrated Time-Delay Nodes . . . . .	242
5.3	Discrete Fourier Series . . . . .	268
	References. . . . .	279
<b>6</b>	<b>Periodic Motions to Chaos in Duffing Oscillator. . . . .</b>	<b>281</b>
6.1	Period-1 Motions . . . . .	281
6.2	Period-m Motions . . . . .	285
6.3	Bifurcation Trees of Periodic Motions . . . . .	287
6.4	Frequency–Amplitude Characteristics . . . . .	294
6.4.1	Period-1 Motions to Chaos. . . . .	296
6.4.2	Period-3 Motions . . . . .	299
6.5	Numerical Simulations. . . . .	300
	Reference . . . . .	307
	<b>Index . . . . .</b>	<b>309</b>

Discretization and Implicit Mapping Dynamics

Luo, A.C.J.

2015, X, 310 p. 46 illus., 26 illus. in color., Hardcover

ISBN: 978-3-662-47274-3