Contents

1	Intro	duction	1
2	Parac	ligm for Chaos	5
	2.1	Order and Disorder	6
	2.2	Algorithms and the Turing Machine	8
	2.3	Complexity and Randomness	11
	2.4	Chaos in a Simple Dynamical System	14
3	Main	Features of Chaotic Systems	19
	3.1	Poincaré Sections	19
	3.2	Spectral Density and Correlation Functions	21
	3.3	Lyapunov's Exponent	25
	3.4	Invariant Measure	32
4	Recoi	nstruction of Dynamical Systems	35
	4.1	What Is Reconstruction?	35
	4.2	Embedding Dimension	38
	4.3	Attractor Dimension	41
	4.4	Finding the Embedding Dimension	47
	4.5	Global Reconstruction of Dynamical Systems	50
5	Conti	rolling Chaos	51
	5.1	Statement of the Problem	51
	5.2	Discrete Parametric Control and Its Strategy	52
	5.3	Main Equations for Chaos Control	56
	5.4	Control of Chaos Without Motion Equations	61
	5.5	Targeting Procedure in Dissipative Systems	65
	5.6	Chaos Control in Hamiltonian Systems	67
	5.7	Stabilization of the Chaotic Scattering	70
	5.8	Control of High-Periodic Orbits in Reversible Mapping	73
	5.9	Controlling Chaos in a Time-Dependant Irregular Environment	78
	5.10	Continuous Control with Feedback	80
	5.11	Can Quantum Dynamics Be Controlled?	91

vii

viii Contents

6	Sync	chronization of Chaotic Systems	. 101
	6.1	Statement of Problem	
	6.2	Geometry and Dynamics of the Synchronization Process	
	6.3	General Definition of Dynamical System Synchronization	
	6.4	Chaotic Synchronization of Hamiltonian Systems	
	6.5	Realization of Chaotic Synchronization Using Control Methods	
	6.6	Synchronization Induced by Noise	
	6.7	Synchronization of Space-Temporal Chaos	
	6.8	Additive Noise and NonIdentity Systems Influence on	
		Synchronization Effects	125
	6.9	Synchronization of Chaotic Systems and Transmission of	
		Information	129
7	Stock	hastic Resonance	. 135
	7.1	Qualitative Description of the Effect	. 135
	7.2	The Interaction Between the Particle and its Surrounding	
		Environment	138
	7.3	The Two-States Model	. 142
	7.4	Stochastic Resonance in Chaotic Systems	. 149
	7.5	Stochastic Resonance and Global Change in the Earth's Climate .	
8	The	Appearance of Regular Fluxes Without Gradients	. 159
•	8.1	Introduction	. 159
	8.2	Dynamical Model of the Ratchet	
	8.3	Ratchet Effect – an Example of Real Realization	
	8.4	Principal Types of Ratchets	
	8.5	Nonlinear Friction as the Mechanism of Directed Motion	
	0.0	Generation	176
	8.6	Change of Current Direction in the Deterministic Ratchet	. 182
	8.7	Bio or Molecular Motors	. 185
Re	ferenc	es	. 189
I	lev		105
8 5 3 4	re: X		. 17.