

Contents

1	Information processing in bio-developmental systems	10
1.1	M-ary Modulation Signalling for Intercellular Communication	10
1.2	Emulation of Synchronous Automata Networks with Dynamically Changing Topologies by Asynchronous Automata Networks	19
1.3	Information Processing Functionality of Spiking Neurons for Image Feature Extraction	30
2	Information processing in neural and non-neural biosystems	43
2.1	Sensitivity and stability: A signal propagation sweet spot in a sheet of recurrent centre crossing neurons	43
2.2	Towards Smart Biosensors: Hints From Deciphering the Enigma of Human Creativity	53
2.3	Event-driven simulation of cerebellar granule cells	66
2.4	A cerebellum-like spiking neural network for robot control	76
3	Evolutionary algorithms	89
3.1	Towards a parsimonious analysis of regeneration and self-repair in animal evolution	89
3.2	An effective Immunological Algorithm with self-avoiding, penalty and repair heuristics for Protein Structure Prediction in 3DCubic Lattice	101
3.3	Colouring graphs using a GRN/cell-based system	112
3.4	Natural Computation Inspired by Protein Binding	121
4	Automata and cellular automata	134
4.1	Hybrid Networks of Evolutionary Processors with Simple Splicing Rules	134
4.2	A Cell Pattern Generation Model Based on an Extended Artificial Regulatory Network	149
4.3	CrickBot: A mobile robot with a bio-mimetic control architecture	159
5	Evolving, adapting, and neural hardware	170
5.1	Learning to hear: The emergence of spectro-temporal response fields in a model of auditory cortex	170
5.2	Unruly Motifs - No Convergent Evolution of Network Topologies	181
5.3	Extreme - Temperature Electronics Adaptability Based on Hormonal System Regulation	192
6	Machine Learning	206
6.1	Novel Embryonic Arrays With Neural Network Characteristics	206
6.2	Neural Assembly Formation with Complementary Roles of Classical and Temporal Coding	215
6.3	Optimal connection strategies in one and two-dimensional associative memory models	227
7	Novel bio-information processing systems	236
7.1	Confrontation between models and real data for DNA molecules space structure	236
7.2	Pomitaxis: Computing with a Bacterial-Inspired Algorithm	246
7.3	Nonlinear transient computation in cortical columns	261
8	Enzyme and gene networks	268
8.1	Positive circuits and two-dimensional spatial differentiation: Application to the formation of sense organs in Drosophila	268
8.2	Mathematical modeling and Sensitivity analysis of G1/S phase in the cell cycle including the DNA damage signal transduction pathway	281
8.3	A network cell with molecular tokens that divides from centrosome signals.	293
9	Modelling of metabolic pathways and responses	305
9.1	Algebraic Properties of Automata Associated to Petri Nets and Applications to Computation in Intermediary Metabolism	305
9.2	Krohn-Rhodes Analysis of Computation in BioChemical Reactions	317

9.3 Why Biological Systems Are Rarely Chaotic	329
10 Self-organising, self-repairing, and self-replicating systems	338
10.1 Calcium signaling mechanisms as a biological rhythm: a theoretical study	338
10.2 Bio-inspired Self-organizing Cellular Systems	350
10.3 The Role of Body Wall Muscles in <i>C. elegans</i> Locomotion	363
11 Simulation of genetic and ecological systems	376
11.1 Modeling the fitness of plant morphologies across three levels of complexity	376
11.2 Toward a formal expression of morphogenesis; a mechanical based integration of cell growth at tissue scale	387
11.3 Dsweep: A lightweight tool for distributed parameter sweeps	400