

Contents

Part I Applied Methods of Modern Algebra and Analysis

1	Convergence Almost Everywhere of Orthorecursive Expansions in Functional Systems	3
	Vladimir V. Galatenko, Taras P. Lukashenko and Victor A. Sadovnichiy	
1.1	Introduction	3
1.2	Main Results	5
1.3	Proofs	6
1.4	Conclusion	10
	References	11
2	Billiard Systems as the Models for the Rigid Body Dynamics	13
	Victoria V. Fokicheva and Anatoly T. Fomenko	
2.1	Introduction	14
2.2	The Rigid Body Dynamics	18
2.3	Billiard Motion	24
2.4	Main Results	28
	References	32
3	Uniform Global Attractors for Nonautonomous Evolution Inclusions	35
	Mikhail Z. Zgurovsky and Pavlo O. Kasyanov	
3.1	Introduction and Setting of the Problem	35
3.2	Preliminary Properties of Weak Solutions	37
3.3	Uniform Global Attractor for all Weak Solutions of Problem	39
3.4	Proof of Theorem	40
3.5	Conclusions	40
	References	41

4	Minimal Networks: A Review	43
	Alexander O. Ivanov and Alexey A. Tuzhilin	
4.1	Steiner Problem and Its Generalizations	43
4.1.1	Fermat Problem	44
4.1.2	Graphs and Continuous Networks.	45
4.1.3	Steiner Problem for Continuous Networks	47
4.1.4	Local Structure of Shortest Trees. Locally Minimal Trees	48
4.1.5	Steiner Problem for Discrete Networks	51
4.2	Minimal Fillings.	52
4.3	Minimal Spanning Trees	53
4.4	Properties of Minimal Networks.	53
4.4.1	Minimal Spanning Trees	53
4.4.2	Shortest Trees	54
4.4.3	Locally Minimal Trees	54
4.4.4	Minimal Fillings.	57
4.5	Classifications	59
4.5.1	Shortest Trees	59
4.5.2	Locally Minimal Trees	61
4.6	How to Calculate or Estimate the Length of a Minimal Network of a Given Topology Without Constructing the Network Itself?	70
4.6.1	The Length of a Minimal Spanning Tree	70
4.6.2	Maxwell Formula	71
4.6.3	The Weight of a Minimal Filling	73
4.6.4	Ratios	74
4.7	Spaces of Compacts	75
4.7.1	Main Definitions and Results	75
	References	77
5	Generalized Pisot Numbers and Matrix Decomposition	81
	Nikolai M. Dobrovol'skii, Nikolai N. Dobrovolsky, Irina N. Balaba, Irina Yu. Rebrova, Dmitrii K. Sobolev and Valentina N. Soboleva	
5.1	Introduction	82
5.2	Notation and Preliminaries.	85
5.3	Some Class of Generalized Pisot Numbers and Reduced Cubic Irrationalities	91
5.4	Linear Fractional Transformation of Polynomials and Linear Transformation of Forms.	91
5.5	Linear Fractional Transformation of Integer Polynomials.	102
5.6	Behavior of Residual Fractions and Its Conjugate Numbers	104
5.7	Minimal Polynomials of Residual Fractions	108
5.8	Chain Sequence of Linear Fractional Transformations of Plane	114

5.9	Lagrange Algorithm for Reduced Algebraic Irrationality of Degree n	118
5.10	Modification Lagrange Algorithm for Continued Fraction Expansion of Algebraic Number.	122
5.11	Properties of Matrix Decomposition	124
5.12	Conversion Algorithm of Matrix Decomposition in Ordinary Continued Fraction	134
5.13	Results of Symbolic Computation.	137
5.14	Conclusion	138
	References	139
6	On the Periodicity of Continued Fractions in Hyperelliptic Fields	141
	Gleb V. Fedorov	
6.1	Introduction	141
6.2	Continued Fractions	142
6.3	Some Relations with Continued Fractions	144
6.4	Best Approximations	152
6.5	Properties of Periodic and Quasiperiodic Continued Fractions	153
6.6	Preliminary Details.	154
6.7	The Periodic Continued Fraction	155
	Appendix	156
	References	157
7	Method of Resolving Functions for the Differential-Difference Pursuit Game for Different-Inertia Objects	159
	Lesia V. Baranovska	
7.1	Differential-Difference Games of Pursuit. Problem Statement	159
7.2	Case of Different-Inertia Objects	161
7.3	Modification of Pontryagin's Condition.	164
7.4	Example	169
	References	176

Part II Discrete and Continuous Dynamical Systems

8	Characterization of Pullback Attractors for Multivalued Nonautonomous Dynamical Systems	179
	Jacson Simsen and José Valero	
8.1	Introduction	179
8.2	Pullback Attraction of Bounded Sets.	180
8.3	Pullback Attraction of Families of Sets	186
8.4	Application to a Reaction-Diffusion Equation.	190
	References	194

9	Global Attractors for Discontinuous Dynamical Systems with Multi-valued Impulsive Perturbations	197
	Oleksiy V. Kapustyan and Iryna V. Romaniuk	
9.1	Introduction	197
9.2	Construction of Impulsive DS with Multi-valued Impulsive Perturbation	198
9.3	The Main Results	201
	References	209
10	A Random Model for Immune Response to Virus in Fluctuating Environments	211
	Yusuke Asai, Tomás Caraballo, Xiaoying Han and Peter E. Kloeden	
10.1	Introduction	212
10.2	Preliminaries on Random Dynamical Systems	214
10.3	Properties of Solutions	216
10.4	Existence and Geometric Structure of Global Random Attractors	218
10.5	Numerical Simulations	221
	References	224
11	Some Aspects Concerning the Dynamics of Stochastic Chemostats	227
	Tomás Caraballo, María J. Garrido-Atienza and Javier López-de-la-Cruz	
11.1	Introduction	227
11.2	Random Dynamical Systems	229
11.3	Random Chemostat	231
11.3.1	Stochastic Chemostat Becomes a Random Chemostat	232
11.3.2	Random Chemostat Generates an RDS	234
11.3.3	Existence of the Random Attractor	239
11.3.4	Existence of the Random Attractor for the Stochastic Chemostat System	241
11.3.5	Numerical Simulations and Final Comments	242
	References	245
12	Higher-Order Allen–Cahn Models with Logarithmic Nonlinear Terms	247
	Laurence Cherfils, Alain Miranville and Shuiran Peng	
12.1	Introduction	247
12.2	Setting of the Problem	248
12.3	A Priori Estimates	251
12.4	The Dissipative Semigroup	255
	References	262

13	Uniform Global Attractor for Nonautonomous Reaction–Diffusion Equations with Carathéodory’s Nonlinearity.	265
	Nataliia V. Gorban and Liliia S. Paliichuk	
13.1	Introduction and Statement of the Problem	265
13.2	Auxiliaries.	268
13.3	Main Results	270
	References	271
14	Some Problems Connected with the Thue–Morse and Fibonacci Sequences	273
	Francisco Balibrea	
14.1	Introduction.	273
14.1.1	$(T - M)$ and Some Definitions and Properties	274
14.1.2	On the Solution of a Problem on Semigroups	276
14.2	A Problem on Transmission of Waves	278
14.2.1	Dynamics of the Thue–Morse System	282
14.2.2	Sharkovskii’s Program	285
14.2.3	A Fibonacci System	291
	References	292
15	Existence of Chaos in a Restricted Oligopoly Model with Investment Periods.	295
	Jose S. Cánovas	
15.1	Introduction.	295
15.2	The Model	296
15.3	Mathematical Tools	300
15.3.1	Periodic Orbits and Topological Dynamics	301
15.3.2	Dynamics of Continuous Interval Maps.	304
15.3.3	Piecewise Monotone Maps: Entropy and Attractors	305
15.3.4	Computing Topological Entropy.	307
15.4	Mathematical Analysis of the Model.	308
15.5	Conclusions and Final Remark.	313
	References	313
Part III Fundamental and Computational Mechanics		
16	Two Thermodynamic Laws as the Forth and the Fifth Integral Postulates of Continuum Mechanics	317
	Boris E. Pobedria and Dimitri V. Georgievskii	
16.1	The Second Law of Thermodynamics in the Carathéodory Form	317
16.2	Legendre Transforms and Thermodynamic Potentials	320
16.3	Mass Densities of Thermodynamic Potentials.	322

16.4	Two Thermodynamic Laws in the Form of Integral postulates.	324
	References	325
17	Flow Control Near a Square Prism with the Help of Frontal Flat Plates	327
	Iryna M. Gorban and Olha V. Khomenko	
17.1	Introduction	327
17.2	Problem Statement	330
17.3	Dynamic Model of a Standing Vortex.	332
17.4	Numerical Simulation of the Viscous Flow Past a Square Prism with Attached Frontal Plates	336
17.4.1	Details of Implementation of the 2D Vortex Method	336
17.4.2	Calculation of the Pressure Field and Forces on the Body.	339
17.4.3	Validation of the Algorithm.	340
17.4.4	Square Prism with Attached Frontal Plates. Results of Simulation	342
17.5	Conclusion	348
	References	349
18	Long-Time Behavior of State Functions for Badyko Models.	351
	Nataliia V. Gorban, Mark O. Gluzman, Pavlo O. Kasyanov and Alla M. Tkachuk	
18.1	Introduction and Setting of the Problem	351
18.2	Auxiliaries.	353
18.3	Main Results	355
18.4	Proof of Theorems	356
	References	357
 Part IV Optimization, Control and Decision Making		
19	Adaptive Control of Impulse Processes in Complex Systems Cognitive Maps with Multirate Coordinates Sampling	363
	Mikhail Z. Zgurovsky, Victor D. Romanenko and Yuriy L. Milyavsky	
19.1	Introduction	363
19.2	Problem Definition	364
19.3	Development of Controlled CM Impulse Process Model with Multirate Sampling	365
19.4	Impulse Processes Adaptive Automated Control in CM with Multirate Sampling	368
19.5	Practical Example.	371
19.6	Summary	373
	References	374

20	Estimation of Consistency of Fuzzy Pairwise Comparison Matrices using a Defuzzification Method	375
	Nataliya D. Pankratova and Nadezhda I. Nedashkovskaya	
20.1	Introduction	375
20.2	A Problem Statement	376
20.3	Definitions of Consistency of a FPCM	377
20.4	A Comparative Study of Definitions of a FPCM Consistency	378
20.5	Illustrative Examples.	381
20.6	Finding of the Most Inconsistent Element in a FPCM.	384
20.7	Conclusions.	385
	References	385
21	Approximate Optimal Control for Parabolic–Hyperbolic Equations with Nonlocal Boundary Conditions and General Quadratic Quality Criterion	387
	Volodymyr O. Kapustyan and Ivan O. Pyshnograiev	
21.1	Introduction.	387
21.2	The Problem with Distributed Control.	388
	21.2.1 Approximate Optimal Control	390
	21.2.2 Example of Calculations	390
21.3	The Problem with Divided Control.	391
	21.3.1 Approximate Control	393
	21.3.2 Example of Calculations	399
	References	400
22	On Approximate Regulator in Linear-Quadratic Problem with Distributed Control and Rapidly Oscillating Parameters	403
	Oleksiy V. Kapustyan and Alina V. Rusina	
22.1	Introduction.	403
22.2	Statement of the Problem	404
22.3	Main Results	405
	References	414
23	The Optimal Control Problem with Minimum Energy for One Nonlocal Distributed System	417
	Olena A. Kapustian and Oleg K. Mazur	
23.1	Introduction.	417
23.2	Setting of the Problem	418
23.3	The Classical Solvability of the Problem	419
23.4	The Main Result	425
23.5	Conclusion	426
	References	426

24	Optimality Conditions for L^1-Control in Coefficients of a Degenerate Nonlinear Elliptic Equation	429
	Peter I. Kogut and Olha P. Kuppenko	
24.1	Introduction	429
24.2	Notation and Preliminaries	431
24.3	Setting of the Optimal Control Problem	436
24.4	Existence of Weak Optimal Solutions	438
24.5	“Directional Stability” of Weighted Sobolev Spaces	442
24.6	On Differentiability of Lagrange Functional	446
24.7	Formalism of the Quasi-adjoint Technique	450
24.8	Substantiation of the Optimality Conditions for Optimal Control Problem in the Framework of Weighted Sobolev Spaces	457
24.9	The Hardy–Poincaré Inequality and Uniqueness of the Adjoint State	464
	References	470

Advances in Dynamical Systems and Control

Sadovnichiy, V.A.; Zgurovsky, M.Z. (Eds.)

2016, XXII, 471 p. 71 illus., 39 illus. in color., Hardcover

ISBN: 978-3-319-40672-5