

Contents

Chapter 1. Prediction of Pixel Component Brightness in the Process of Progressive Hierarchical Lossless Image Compression	1
A. SHPORTKO and A. BOMBA	
1.1. Introduction	1
1.2. Problem statement	3
1.3. Pixel bypass sequence for implementing progressive hierarchical lossless image compression	6
1.4. Basic and additional symmetric hierarchical predictors	9
1.5. Asymmetric hierarchical predictors	14
1.6. Integrated application of hierarchical predictors	21
1.7. Conclusions and further prospects	26
1.8. References	27
Chapter 2. Spatial Analogues of Numerical Quasiconformal Mapping Methods for Identifying the Parameters of Quasiideal Fields	29
A. BOMBA and M. BOICHURA	
2.1. Introduction	29
2.2. Problem statement	30
2.3. Problem statement in the complex quasipotential domain	37
2.4. An approximate representation of the problem	42
2.5. Conclusions and further prospects	58
2.6. References	59
Chapter 3. Complexity of Extragradient-type Methods for Variational Inequalities in Banach Space	61
V. SEMENOV, O. KOVALENKO and S. DENYSOV	
3.1. Introduction	61
3.2. Preliminaries	65
3.3. Variational inequalities	69
3.4. Algorithms	71

3.5. Analysis	73
3.6. Conclusions	81
3.7. Acknowledgments	82
3.8. References	82
Chapter 4. Effect of Heat Generation Resulting from Biodegradation on the Surface Subsidence of a Solid Waste Storage Facility	87
L. SHOSTAK and P. MARTYNIUK	
4.1. Introduction	87
4.2. Heat generation during the biodegradation of organic residues	89
4.3. Generation of greenhouse gases during the biodegradation of organic residues.	95
4.4. Kinetics of biodegradation processes	97
4.5. Surface settlement of a solid waste landfill	99
4.6. The kinematic boundary condition at the upper moving boundary in the case of biodegradation	101
4.7. Modified consolidation equation considering biodegradation	104
4.8. Mathematical model of MSW landfill compaction considering the effect of biodegradation and heat release.	107
4.9. Finite element method in the problem of non-isothermal waste consolidation.	109
4.10. Approximation of the kinematic boundary condition	113
4.11. Results of numerical experiments.	114
4.12. Conclusion	122
4.13. References	122
Chapter 5. Grid Computing in the Study of Magnetic Levitation Systems	127
S. LYASHKO, S.S. ZUB, I.G. YALOVEGA and V.S. LYASHKO	
5.1. Overview of the computational approach	127
5.2. Introduction	128
5.3. Poisson brackets and motion equations	129
5.4. Mathematical model.	131
5.5. Numerical experiment method	134
5.6. Geometric integrator.	135
5.7. Estimation of the model's physical quantities.	136
5.8. Methods and programming tools	137
5.9. Parallel computing using grid and cloud resources for Monte Carlo trajectory generation.	138
5.10. Conclusions.	140
5.11. References	140

Chapter 6. Simulation and Optimization of Water Transfer in a Porous Pipe System and Polygon Porous Medium	143
D.A. KLYUSHIN, V.A. KOLESNYKOV and A.A. TYMOSHENKO	
6.1. Introduction	143
6.2. Physical model	144
6.3. Richards–Klute equation on a graph	146
6.4. Weak form of the Richards–Klute equation on a graph	148
6.5. Existence theorem	151
6.6. Stability results.	152
6.7. Numerical approximation	154
6.8. Numerical experiments	155
6.9. Optimal control of source intensity in Richards’ equation for polygon-type areas in a porous medium	158
6.10. Variational method.	160
6.11. Numerical approach	161
6.12. Area examples	164
6.13. Alternating direction method	165
6.14. Conclusion	167
6.15. References	168
 Chapter 7. Some Basic Properties of Gamma Processes	 171
F. FOURATI and N. LIMNIOS	
7.1. Introduction	171
7.2. Properties of gamma distribution.	172
7.2.1. Definition and basic properties	172
7.2.2. Connection with the normal distribution and chi-squared distribution	174
7.2.3. Connection with generalized spline distributions $M_n(\kappa; a)$	176
7.2.4. Connection with Thorin–Bondesson and infinitely divisible distributions.	177
7.3. Gamma processes	181
7.3.1. The gamma process as a Lévy process	181
7.3.2. Interpretation via subordination	186
7.3.3. Gamma processes on arbitrary measure spaces	186
7.4. Gamma process as a Markov process	188
7.5. Gamma processes in random environment	190
7.6. Extended gamma processes and their connection with Cox processes	192
7.6.1. Extended gamma processes	192
7.6.2. Connection with Cox processes	195
7.7. References	196

Chapter 8. A Hidden Markov Model Framework for Reliability Evaluation and Maintenance Planning	199
M.L. GAMIZ, N. LIMNIOS and M.C. SEGOVIA-GARCIA	
8.1. Introduction	199
8.2. Hidden Markov models	202
8.2.1. Hidden Markov model in discrete time	202
8.2.2. Hidden Markov model in continuous time	212
8.2.3. Hidden Markov model in continuous time with dependencies	217
8.3. Reliability estimation and maintenance policies	220
8.3.1. Reliability and maintenance in a DT-HMM	220
8.3.2. Reliability and maintenance in a CT-HMM	227
8.3.3. Reliability and maintenance in a CT-HMM with dependencies	230
8.4. Conclusion	234
8.5. Acknowledgments	235
8.6. References	235
Chapter 9. Matrix Polynomials on a Set of Noncommutative Matrices: Basic Properties	237
V.L. MAKAROV, O.F. KASHPUR and B.O. BOICHENKO	
9.1. Introduction	237
9.2. Laguerre and Laguerre–Cayley matrix polynomials: basic properties	238
9.3. Hermite matrix polynomials: basic properties.	244
9.4. Fundamental Lagrange matrix polynomials	245
9.5. Conclusion	246
9.6. References	246
Chapter 10. Quantum Hypothesis of Olfactory Perception.	249
D. KOROLIOUK, V. COLIZZI, M. ZOZIUK, M. MATTEI, and S. MARINI	
10.1. Introduction.	249
10.2. Functional-analytic framework	251
10.3. Molecular vibrational spectra and spectral theory.	254
10.4. Spectroscopic observables and selection rules.	257
10.5. Inelastic electron tunneling model: Hamiltonian formulation	260
10.6. Transition rates and resonance conditions	262
10.7. Thermal and open-system effects	265
10.8. Relation to Marcus theory and semiclassical limits	267
10.9. Engineering implications and design principles	270
10.10. Critical assessment and limitations	272
10.11. Conclusions and outlook	273
10.12. Appendix. Implications for medical sciences and biomedical ligand design.	274

10.12.1. Spectral selectivity beyond molecular shape.	275
10.12.2. Isotopic substitution as a diagnostic and design tool	275
10.12.3. Implications for GPCRs and redox-sensitive receptors	275
10.12.4. Towards spectral structure–activity relationships (S-SAR)	276
10.12.5. Drug selectivity and side-effect reduction	276
10.12.6. Molecular diagnostics and biosensing	277
10.12.7. Medical perspective	277
10.12.8. Comparative molecular vibrational spectrum – benzaldehyde (C ₆ H ₅ CHO) versus potassium cyanide (KCN)	277
10.13. References.	281
List of Authors	285
Index.	289