

Contents

1	Epidemic Models: Their Spread, Analysis and Invasions in Scale-Free Networks	1
	Somnath Tagore	
1.1	Scale-Free Networks	1
1.1.1	Power-Law	3
1.2	Epidemics	5
1.2.1	Branching	5
1.3	Network Architectures	9
1.3.1	Concurrency	10
1.4	Propagation Phenomena in Real World Networks	11
1.5	Network Definition and Measurement	11
1.5.1	Data Collection Process	13
1.6	Robustness	15
1.7	Models of Infections	16
1.7.1	Susceptible-Infected-Recovered (SIR)	16
1.7.2	Susceptible-Infected-Susceptible (SIS)	18
1.8	Epidemic Invasions, Propagations and Outbursts	19
1.9	Combat and Immunization	19
1.9.1	Complex Topologies and Heterogeneous Structures	20
1.9.2	Damage Patterns	21
1.9.3	Immunity	22
1.10	Understanding Cascading Failures, Natural Disturbances	23
1.11	Conclusions	23
	References	24
2	Information Propagation in a Social Network: The Case of a Fish Schooling Algorithm	27
	A. Brabazon, W. Cui and M. O'Neill	
2.1	Introduction	28
2.1.1	Fish Schooling	28
2.1.2	How Do Fish Schools Make Decisions?	29

2.2	Background	30
2.2.1	Application of Fish School Algorithms	30
2.2.2	Golden Shiner Fish	31
2.3	Fish Algorithm	32
2.3.1	Prior Period Velocity.	32
2.3.2	Distributed Perception Influence	33
2.3.3	Individual Perception Influence.	34
2.4	Experimental Design	34
2.4.1	Benchmark Functions	35
2.4.2	Experiments	38
2.4.3	Experimental Settings	39
2.5	Results	40
2.5.1	Hypotheses Examined	40
2.5.2	Discussion of Results	41
2.5.3	Analysis of Components in FA.	46
2.5.4	Parameter Sensitivity Analysis	47
2.6	Conclusions	48
	References.	49
3	Models for Trust Inference in Social Networks.	53
	Cai-Nicolas Ziegler and Jennifer Golbeck	
3.1	Introduction	53
3.1.1	Trust Representation and Model	55
3.1.2	Overview of Trust Metrics for Social Networks	55
3.2	Design of Local Group Trust Metrics	57
3.2.1	Outline of Advogato Maxflow	57
3.2.2	The Appleseed Trust Metric.	60
3.2.3	Comparison of Advogato and Appleseed	71
3.3	Distrust	73
3.3.1	Semantics of Distrust	73
3.3.2	Incorporating Distrust into Appleseed	75
3.4	Expanding Network Coverage	79
3.4.1	Revisiting Trust Inference Algorithms	79
3.4.2	Experimental Analysis.	82
3.4.3	Results	84
3.5	Discussion and Outlook.	86
	References.	87
4	Assessing the Role of Network Effects in Propagation Phenomena in Real World Networks	91
	Newton Paulo Bueno	
4.1	Introduction	91
4.2	Basic Concepts and Ideas on Networks	92
4.2.1	Mean Degree	94

4.2.2	Centralization Degree	94
4.2.3	Assortativity Degree	95
4.3	Basic Types of Social Networks	96
4.4	Illustration: Assessing the Network Structure of a Small Irrigation System	97
4.5	Discussion and Conclusion.	101
	References.	104
5	Resource Constrained Randomized Coverage Strategies for Unstructured Networks	107
	Subrata Nandi and Niloy Ganguly	
5.1	Introduction	107
5.2	Background and Problem Definition	109
5.3	Coverage Strategy for $C(\mathcal{B}, *)$ Under Unconstrained Time	113
5.3.1	K -RW Dynamics on Regular Grids	113
5.3.2	Strategy $P^*(t)$ for d -Dimensional Grids	115
5.3.3	Empirical Verification	117
5.3.4	Remarks	122
5.4	Strategy for $C(\mathcal{B}, \mathcal{T})$ with Zero Walker Memory	123
5.4.1	Coverage Strategies $P(t)$ -RW($\alpha > 1$), $\lceil \frac{B}{T} \rceil$ -RW and P_C -RW	123
5.4.2	Performance Evaluation	123
5.4.3	Remarks	125
5.5	Strategy for $C(\mathcal{B}, \mathcal{T})$ with Finite Walker Memory	126
5.5.1	Dynamics of Mutual Overlap	126
5.5.2	Design of History-Based Proliferation $P(t, h)$ -RW	127
5.5.3	Performance Evaluation of $P(t, h)$ -RW and $P(t, h)$ -RW-e	128
5.6	Related Literature	130
5.7	Conclusions	132
	References.	133
6	Petri Net-Based Modelling and Simulation of Transport Network Segments	135
	František Čapkovič	
6.1	Introduction and Preliminaries	135
6.2	The Agent-Based Approach to the Traffic Lights Control.	138
6.2.1	The Supervisor Synthesis	139
6.2.2	Timed Petri Net-Based Model	143
6.3	Modelling the Intersection by Means of Hybrid Petri Nets	147
6.4	Simulation of Vehicle Flow Propagation Controlled by Traffic Lights.	148

6.5	Generalization	148
6.6	Conclusion.	151
	References.	153
7	Bio-inspired Routing Strategies for Wireless Sensor Networks . . .	155
	Pavel Krömer and Petr Musilek	
7.1	Introduction	155
7.2	Biologically-Inspired Methods	158
7.2.1	Swarm Intelligence	159
7.2.2	Evolutionary Algorithms	164
7.2.3	Other Bio-inspired Algorithms	165
7.3	Bio-inspired WSN Routing Algorithms	166
7.4	Conclusions	176
	References.	178
8	Analysis of Peer-to-Peer Botnet Attacks and Defenses.	183
	Ping Wang, Lei Wu, Baber Aslam and Cliff C. Zou	
8.1	Introduction	184
8.1.1	Botnets	184
8.1.2	Botnet Countermeasures	185
8.1.3	Contributions	186
8.1.4	Chapter Organization.	186
8.2	A Systematic Study on P2P Botnets	187
8.2.1	Stage One: Recruiting Bot Members	187
8.2.2	Stage Two: Forming the Botnet	187
8.2.3	Stage Three: Standing by for Instructions.	188
8.2.4	Discussion	191
8.3	Countermeasures.	192
8.3.1	Background on Kademlia P2P Protocol	193
8.3.2	Index Poisoning Defense	194
8.3.3	Sybil Defense.	199
8.3.4	P2P Botnet Passive Monitoring.	202
8.3.5	Others Countermeasures	206
8.3.6	Discussion	207
8.4	Related Work.	208
8.5	Conclusion.	210
	References.	210
9	Generating Robust and Efficient Networks Under Targeted Attacks	215
	Vitor H.P. Louzada, Fabio Daolio, Hans J. Herrmann and Marco Tomassini	
9.1	Introduction	215
9.2	Model	216

9.2.1	Robustness.	216
9.2.2	Efficiency	217
9.2.3	Integral Efficiency	217
9.2.4	Optimization Procedure	218
9.3	Results	218
9.4	Discussion	223
	References.	223
10	Cancer—A Story on Fault Propagation in Gene-Cellular Networks	225
	Damian Borys, Roman Jaksik, Michał Krześlak, Jarosław Śmieja and Andrzej Świerniak	
10.1	Introduction	225
10.2	Cell Cycle as a Fault Tolerant Control System	227
10.2.1	Cells—The Building Blocks of Life	227
10.2.2	Information Processing and Signal Propagation.	227
10.2.3	Intracellular Regulatory Systems.	228
10.2.4	The Cell Cycle Clock	229
10.2.5	Cell Cycle Checkpoints	231
10.2.6	Stress Resistance and Damage Recovery	232
10.3	Carcinogenesis—Failure of the Cell Cycle Control System.	233
10.3.1	Failure of DNA Repair Mechanisms	233
10.3.2	Cell Cycle Disruption	235
10.4	Tumor Angiogenesis and its Role in Disease Progression.	237
10.4.1	Pro and Anti-Angiogenic Factors and Mechanism of Angiogenesis	238
10.4.2	Angiogenesis—An Essential Step Towards Tumor Metastasis	241
10.5	Are Cancer Cells Good Players?	242
10.5.1	Evolutionary Games, Spatial Evolutionary Games and Mixed Spatial Evolutionary Games	242
10.5.2	Four-Phenotype Model of Interaction Between Tumor Cells—Time and Space Propagation	245
10.6	Conclusions and Discussion	249
	References.	250
11	Propagation Models and Analysis for Mobile Phone Data Analytics	257
	Derek Doran and Veena Mendiratta	
11.1	Introduction and Motivation	257
11.2	Mobile Phone Data Analytics	259
11.3	Information Diffusion	262

11.3.1	Characterizing Diffusion Frequency: Finite Mixture Models	263
11.3.2	User Mobility and Diffusion: Mobility Correlation Metrics	264
11.3.3	Modeling Pass-Along Dynamics: Causality Trees	266
11.3.4	Diffusion Maximization: Community Based Greedy Algorithm	269
11.4	Malware Propagation	272
11.4.1	Infection Dynamics with Recoverable Devices: SIR Epidemiological Model	272
11.4.2	Infection Dynamics Without Immunization: SIS Epidemiological Model	274
11.4.3	Maximizing Malware Damage: SIDR Epidemiological Model	278
11.5	Novel Applications	281
11.5.1	Churn Prediction: Sender-Centric Energy Propagation	281
11.5.2	Churn Prediction: Receiver-Centric Energy Propagation	283
11.5.3	Isolating Fraudulent Activity: Markov Clustering Algorithm	285
11.6	Future Research Directions	287
11.7	Concluding Remarks	289
	References	290

12 Information Propagation in Social Networks During Crises:

	A Structural Framework	293
	Daniela Pohl and Abdelhamid Bouchachia	
12.1	Introduction	293
12.2	Crisis Management and Social Media	295
12.3	Information Propagation in Crisis Situations	296
12.3.1	Network Analysis and Community-Detection	297
12.3.2	Role and Topic-Oriented Information Propagation	298
12.3.3	Infrastructure-Oriented Information Propagation	299
12.4	From SM to Structural Information Propagation	300
12.4.1	Topic Detection	302
12.4.2	Datasets	303
12.4.3	Offline Approaches	304
12.4.4	Online Approaches	305
12.5	Conclusion and Future Work	306
	References	307

13 Simulations of Financial Contagion in Interbank Networks:	
Some Methodological Issues	311
Mario Eboli	
13.1 Introduction	311
13.2 Analytic and Numerical Studies of Financial Contagion.	313
13.3 Direct Balance-Sheet Contagion in Financial Networks	314
13.3.1 The Linear Threshold Algorithm.	314
13.3.2 The Graph-Theoretic Approach.	315
13.3.3 The Lattice-Theoretic Approach	318
13.4 Some Methodological Issues	320
13.4.1 The Choice of the Algorithm	321
13.4.2 The Assumptions Made About the Exogenous Shocks.	322
13.4.3 Existence of the Simulated Functions and the Scope for Approximations	323
13.5 Concluding Remarks	325
References.	326
14 Maximizing Social Influence in Real-World	
Networks—The State of the Art and Current Challenges	329
Radosław Michalski and Przemysław Kazienko	
14.1 Introduction	329
14.2 Modelling the Spread of Influence	331
14.2.1 The Linear Threshold Model	332
14.2.2 The Independent Cascade Model	335
14.2.3 The Voter Model and the Naming Game	336
14.2.4 Summary.	336
14.3 Social Influence Challenges	337
14.3.1 Budget	337
14.3.2 Time	338
14.3.3 Number of Influenced	338
14.4 Maximizing the Spread of Influence	339
14.4.1 The Greedy Algorithm	339
14.4.2 Greedy Algorithm Optimization	340
14.4.3 Avoiding Greedy Search	341
14.4.4 Summary.	342
14.5 Temporal Social Networks	343
14.5.1 Contact Sequences	343
14.5.2 Interval Graphs.	344
14.5.3 Limitations of the Time-Aggregated Approach	345
14.6 Spread of Influence—Temporal Approach	346
14.6.1 Introduction	346
14.6.2 Experimental Setup	346

14.6.3	Results	349
14.6.4	Summary	350
14.7	Maximizing the Spread of Influence in Dynamic Networks . . .	350
14.7.1	Learning Influence Probabilities	351
14.7.2	Real-World Datasets Evaluation	352
14.7.3	Social Influence Maximization	353
14.8	Summary	355
	References.	355
Index	361

Propagation Phenomena in Real World Networks

Król, D.; Fay, D.; Gabryś, B. (Eds.)

2015, XVIII, 364 p. 97 illus., 32 illus. in color., Hardcover

ISBN: 978-3-319-15915-7