

Table of Contents

Preface	xiii
Introduction	xv
PART 1. GRAPH THEORY AND NETWORK MODELING	1
Chapter 1. The Space-time Variability of Road Base Accessibility: Application to London	3
Manuel APPERT and Laurent CHAPELON	
1.1. Bases and principles of modeling	3
1.1.1. Modeling of the regional road network	3
1.1.2. Congestion or suboptimal accessibility	6
1.2. Integration of road congestion into accessibility calculations	10
1.2.1. Time slots	10
1.2.2. Evaluation of demand by occupancy rate.	11
1.2.3. Evaluation of demand by flows.	12
1.2.4. Calculation of driving times.	15
1.3. Accessibility in the Thames estuary	19
1.3.1. Overall accessibility during the evening rush hour (5-6 pm)	21
1.3.2. Performance of the road network between 1 and 2 pm and 5 and 6 pm.	23
1.3.3. Network performance between 1 and 2 pm.	23
1.3.4. Network performance between 5 and 6 pm.	25
1.3.5. Evolution of network performances related to the Lower Thames Crossing (LTC) project	26
1.4. Bibliography	28

Chapter 2. Journey Simulation of a Movement on a Double Scale	31
Fabrice DECOUIGNY	
2.1. Visitors and natural environments: multiscale movement	32
2.1.1. Leisure and consumption of natural environments	32
2.1.2. Double movement on two distinct scales	33
2.1.3. Movement by car	33
2.1.4. Pedestrian movement	34
2.2. The FRED model	35
2.2.1. Problems	35
2.2.2. Structure of the FRED model	36
2.3. Part played by the network structure	37
2.4. Effects of the network on pedestrian diffusion	39
2.4.1. Determination of the potential path graph: a model of cellular automata	39
2.4.2. Two constraints of diffusion	40
2.4.3. Verification of the model in a theoretical area	42
2.5. Bibliography	44
Chapter 3. Determination of Optimal Paths in a Time-delay Graph	47
Hervé BAPTISTE	
3.1. Introduction.	47
3.2. Floyd's algorithm for arcs with permanent functionality	49
3.3. Floyd's algorithm for arcs with permanent and temporary functionality	51
3.3.1. Principle	51
3.3.2. Description.	52
3.4. Conclusion: other developments of Floyd's timetable algorithm	60
3.4.1. Determination of the complete movement chain	60
3.4.2. Overview of all the means of mass transport.	62
3.4.3. Combination of means with permanent and temporary functionality	62
3.4.4. The evaluation of a timetable offer under the constraint of departure or arrival times	63
3.4.5. Application of Floyd's algorithm to graph properties.	65
3.5. Bibliography	66
Chapter 4. Modeling the Evolution of a Transport System and its Impacts on a French Urban System	67
Hervé BAPTISTE	
4.1. Introduction.	67
4.2. Methodology: RES and RES-DYNAM models	68
4.2.1. Modeling of the interactions: procedure and hypotheses.	68

4.2.2. The area of reference	71
4.2.3. Initial parameters	73
4.3. Analysis and interpretation of the results	79
4.3.1. Demographic impacts	79
4.3.2. Alternating migrations revealing demographic trends	82
4.3.3. Evolution of the transport network configuration	84
4.4. Conclusion	86
4.5. Bibliography	88
PART 2. GRAPH THEORY AND NETWORK REPRESENTATION	91
Chapter 5. Dynamic Simulation of Urban Reorganization of the City of Tours	93
Philippe MATHIS	
5.1. Simulations data	96
5.2. The model and its adaptations	99
5.2.1. D.LOCA.T model.	99
5.2.2. Opening of the model and its modifications	101
5.2.3. Extension of the theoretical base of the model.	102
5.3. Application to Tours	103
5.3.1. Specific difficulties during simulations	103
5.3.2. First results of simulation	104
5.4. Conclusion	109
5.5. Bibliography	109
Chapter 6. From Social Networks to the Sociograph for the Analysis of the Actors' Games	111
Sébastien LARRIBE	
6.1. The legacy of graphs	112
6.2. Analysis of social networks	117
6.3. The sociograph and sociographies	119
6.4. System of information representation	127
6.5. Bibliography	129
Chapter 7. RESCOM: Towards Multiagent Modeling of Urban Communication Spaces	131
Ossama KHADDOUR	
7.1. Introduction.	131
7.2. Quantity of information contained in phatic spaces	132
7.3. Prospective modeling in RESCOM.	136
7.3.1. Phatic attraction surfaces	136
7.3.2. Game of choice	138

7.4. Huff's approach	142
7.5. Inference	143
7.6. Conclusion	145
7.8. Bibliography	146
Chapter 8. Traffic Lanes and Emissions of Pollutants	147
Christophe DECOUPIGNY	
8.1. Graphs and pollutants emission by trucks	147
8.1.1. Calculation of emissions.	150
8.1.2. Calculation of the minimum paths	152
8.1.3. Analysis of subsets	154
8.2. Results.	159
8.2.1. Section of the A28	159
8.2.2. French graph.	165
8.2.3. Subset.	168
8.3. Bibliography	173
PART 3. TOWARDS MULTILEVEL GRAPH THEORY.	175
Chapter 9. Graph Theory and Representation of Distances: Chronomaps and Other Representations	177
Alain L'HOSTIS	
9.1. Introduction.	177
9.2. A distance on the graph.	179
9.3. A distance on the map	180
9.4. Spring maps	182
9.5. Chronomaps: space-time relief maps.	186
9.6. Conclusion	190
9.7. Bibliography	191
Chapter 10. Evaluation of Covisibility of Planning and Housing Projects	193
Kamal SERRHINI	
10.1. Introduction	193
10.2. The representation of space and of the network: multiresolution topography	194
10.2.1. The VLP system.	194
10.2.2. Acquiring geographical data: DMG and DMS	197
10.2.3. The Conceptual Data Model (CDM) starting point of a graph.	197
10.2.4. Principle of multiresolution topography (relations 1 and 2 of the VLP)	198

10.2.5. Need for overlapping of several spatial resolutions (relation 2 of the VLP)	199
10.2.6. Why a square grid?	200
10.2.7. Regular and irregular hierarchical tessellation: fractalization	202
10.3. Evaluation of the visual impact of an installation: covisibility	202
10.3.1. Definitions, properties, vocabulary and some results	202
10.3.2. Operating principles of the covisibility algorithm (relations 3 and 4 of the VLP)	205
10.3.3. Why a covisibility algorithm of the centroid-centroid type?	212
10.3.4. Comparisons between the method of covisibility and recent publications	214
10.4. Conclusion	218
10.5. Bibliography	220
Chapter 11. Dynamics of Von Thünen’s Model: Duality and Multiple Levels	223
Philippe MATHIS	
11.1. Hypotheses and ambitions at the origin of this dynamic von Thünen model	224
11.2. The current state of research	227
11.3. The structure of the program	227
11.4. Simulations carried out	231
11.4.1. The first simulation: a strong instability in the isolated state with only one market town	232
11.4.2. The second simulation: reducing instability	235
11.4.3. The third simulation: the competition of two towns	237
11.4.4. The fourth simulation: the competition between five towns of different sizes	239
11.5. Conclusion	241
11.6. Bibliography	244
Chapter 12. The Representation of Graphs: A Specific Domain of Graph Theory	245
Philippe MATHIS	
12.1. Introduction	245
12.1.1. The freedom of drawing a graph or the absence of representation rules	246
12.2. Graphs and fractals	246
12.2.1. Mandelbrot’s graphs and fractals	248
12.2.2. Graph and a tree-structured fractal: Mandelbrot’s H-fractal	251
12.2.3. The Pythagoras tree	254
12.2.4. An example of multiplane plotting	256

12.2.5. The example of the Sierpinski carpet and its use in Christaller's theory	256
12.2.6. Development of networks and fractals in extension	258
12.2.7. Grid of networks: borderline case between extension and reduction	259
12.2.8. Application examples of fractals to transport networks.	260
12.3. Nodal graph	261
12.3.1. Planarity and duality	270
12.4. The cellular graph	290
12.5. The faces of the graph: from network to space	296
12.6. Bibliography	299
Chapter 13. Practical Examples	301
Philippe MATHIS	
13.1. Premises of multiscale analysis	301
13.1.1. Cellular percolation	301
13.1.2. Diffusion of agents reacting to the environment	303
13.1.3. Taking relief into account in the difficulty of the trip	304
13.2. Practical application of the cellular graph: fine modeling of urban transport and spatial spread of pollutant emissions	305
13.2.1. The algorithmic transformation of a graph into a cellular graph at the level of arcs	305
13.2.2. The algorithmic transformation of a graph into a cellular graph at the level of the nodes	307
13.3. Behavior rules of the agents circulating in the network	309
13.3.1. Strict rules	310
13.3.2. Elementary rules.	310
13.3.3. Behavioral rules	311
13.4. Contributions of an MAS and cellular simulation on the basis of a graph representing the circulation network	311
13.4.1. Expected simulation results	311
13.4.2. Limits of application of laws considered as general.	312
13.5. Effectiveness of cellular graphs for a truly door-to-door modeling	314
13.6. Conclusion	314
13.7. Bibliography	315
PART 4. GRAPH THEORY AND MAS.	317
Chapter 14. Cellular Graphs, MAS and Congestion Modeling	319
Jean-Baptiste BUGUELLOU and Philippe MATHIS	
14.1. Daily movement modeling: the agent-network relation	320
14.1.1. The modeled space: Indre-et-Loire department	320

14.1.2. Diagram of activities: a step toward the development of a schedule	321
14.1.3. Typology of possible agent activities	322
14.1.4. Individual behavior mechanism: the daily scale	323
14.2. Satisfaction and learning	324
14.2.1. The choice of an acceptable solution.	324
14.2.2. Collective learning and convergence of the model toward a balanced solution	326
14.2.3. Examination of the transport network	327
14.3. Local congestion	328
14.3.1. The peaks represent different types of intersections.	329
14.3.2. The emergence of congestion fronts on edges	330
14.3.3. Intersection modeling.	333
14.3.4. Limited peak capacity: crossings and traffic circles	336
14.3.5. In conclusion on crossings.	351
14.4. From microscopic actions to macroscopic variables a global validation test	352
14.4.1. The appropriateness of the model with traditional throughput-speed, density-speed and throughput-density curves	352
14.4.2. The distribution of traffic density over time	356
14.4.3. The measure of lost transport time by agents because of congestion	357
14.4.4. Spatial validation	358
14.5. Conclusion	359
14.6. Bibliography	360
Chapter 15. Disruptions in Public Transport and Role of Information . . .	363
Julien COQUIO and Philippe MATHIS	
15.1. The model and its objectives	364
15.1.1. Public transport	364
15.1.2. Hypotheses to verify	366
15.2. The PERTURB model.	367
15.2.1. Theoretical fields mobilized.	367
15.2.2. Working hypotheses	368
15.2.3. Functionalities	369
15.3. The simulation platform.	372
15.4. Simulations in real space: Île-de-France	373
15.4.1. Disruptions simulated in the Île-de-France public transport	374
15.4.2. Node-node calculations: measure of the deterioration of relational potentials between two network vertices	375
15.4.3. Unipolar calculations: measures of the deterioration of traveling opportunities from a network vertice	381

15.4.4. Multipolar calculations: global measures of structural impacts	386
15.5. Simulations in theoretical transport systems.	388
15.5.1. The initial network and line creation.	388
15.5.2. Studied disruption.	390
15.5.3. Multipolar calculations.	391
15.5.4. Simulations integrating capacity constraints	396
15.6. Discussion on hypotheses.	401
15.6.1. Field of structural vulnerability	401
15.6.2. Field of functional vulnerability	402
15.7. Conclusion	403
15.8. Bibliography	405
Conclusion	407
List of Authors	423
Index	425