

Bibliography

- [1] Akimov, V.; Soutchanski, M. (1994). Automata simulation of N-person social dilemma games. *J. Conflict Resolution* **38**, 138–148.
- [2] Allen, P. (1998). Modelling complex economic evolution. In: F. Schweitzer; G. Silverberg (eds.), *Evolution und Selbstorganisation in der Ökonomie / Evolution and Self-Organization in Economics*, Berlin: Duncker & Humblot, vol. 9 of *Selbstorganisation. Jahrbuch für Komplexität in den Natur- Sozial- und Geisteswissenschaften*, pp. 47–75.
- [3] Allen, P.; Sanglier, M. (1979). A dynamic model of growth in a central place system. *Geogr. Anal.* **11/3**, 256–272.
- [4] Alt, W. (1980). Biased random walk models for chemotaxis and related diffusion approximations. *J. Math. Biol.* **9**, 147–177.
- [5] Alt, W. (1988). Modelling of motility in biological systems. In: *ICIAM'87 Proceedings*, Philadelphia: SIAM, pp. 15–30.
- [6] Alt, W. (1990). Correlation analysis of two-dimensional locomotion paths. In: W. Alt; G. Hoffmann (eds.), *Biological Motion*, Berlin: Springer, vol. 89 of *Lecture Notes in Biomathematics*, pp. 254–268.
- [7] Alt, W. (1995). Elements of a systematic search in animal behavior and model simulations. *BioSystems* **34**, 11–26.
- [8] Alt, W.; Hoffmann, G. (eds.) (1990). *Biological Motion*, vol. 89 of *Lecture Notes in Biomathematics*. Berlin: Springer.
- [9] Andersen, P. W.; Arrow, K. J.; Pines, D. (eds.) (1988). *The Economy as an Evolving Complex System*. Reading, MA: Addison-Wesley.
- [10] Anderson, T. L.; Donath, M. (1990). Animal behaviour as a paradigm for developing robot autonomy. In: P. Maes (ed.), *Designing Autonomous Agents*, Cambridge, MA: MIT Press, pp. 145–168.
- [11] Andreazza, P.; Lefaucheux, F.; Mutaftschiev, B. (1988). Nucleation in confined space: Application to the crystallization in gels. *J. Cryst. Growth* **92**, 415–422.
- [12] Andresen, B.; Hoffmann, K. H.; Mosegaard, K.; Nulton, J.; Pedersen, J. M.; Salamon, P. (1988). On lumped models for thermodynamic properties of simulated annealing problems. *J. Phys. (France)* **49**, 1485.
- [13] Appleby, S. (1995). Estimating the cost of a telecommunications network using the fractal structure of the human population distribution. *IEEE Proc.-Commun.* **142**, 172–178.
- [14] Arthur, W. B. (1993). On designing economic agents that behave like human agents. *J. Evol. Econ.* **3**, 1–22.
- [15] Arthur, W. B. (1994). Inductive reasoning and bounded rationality. *Am. Econ. Assoc. Pap. Proc.* **84**, 406–411.
- [16] Arthur, W. B.; Durlauf, S. N.; Lane, D. (eds.) (1997). *The Economy as an Evolving Complex System II*. Reading, MA: Addison-Wesley.

- [17] Asselmeyer, T.; Ebeling, W. (1997). Mixing of thermodynamic and biological strategies in optimization. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 153–163.
- [18] Asselmeyer, T.; Ebeling, W. (1997). Unified description of evolutionary strategies over continuous parameter spaces. *BioSystems* **41**, 167–178.
- [19] Asselmeyer, T.; Ebeling, W.; Rosé, H. (1996). Smoothing representation of fitness landscapes – the genotype-phenotype map of evolution. *BioSystems* **39**, 63–76.
- [20] Asselmeyer, T.; Ebeling, W.; Rosé, H. (1997). Evolutionary strategies of optimization. *Phys. Rev. E* **56**, 1171–1180.
- [21] Astumian, R. D. (1997). Thermodynamics and kinetics of a Brownian motor. *Science* **276**, 917–922.
- [22] Astumian, R. D.; Bier, M. (1994). Fluctuation driven ratchets: Molecular motors. *Phys. Rev. Lett.* **72/11**, 1766–1769.
- [23] Attygalle, A. B.; Steghaus-Kovac, S.; Ahmed, V. U. (1991). *cis*-Isogeraniol, a recruitment pheromone of the ant *Leptogenys diminuta*. *Naturwissenschaften* **78**, 90–92.
- [24] Attygalle, A. B.; Vostrowsky, O.; Bestmann, H. J.; Steghaus-Kovac, S.; Marschwitz, U. (1988). (3*R*,4*S*)-4-Methyl-3-heptanol, the trail pheromone of the ant *Leptogenys diminuta*. *Naturwissenschaften* **75**, 315–317.
- [25] Auerbach, F. (1913). Das Gesetz der Bevölkerungskonzentration. *Petermanns Mitteilungen* **59/1**, 74–76.
- [26] Axelrod, R. (1997). *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*. Princeton, NJ: Princeton University Press.
- [27] Bäck, T. (1994). Selective pressure in evolutionary algorithms: A characterization of selection mechanisms. In: R. K. Belew; L. B. Booker (eds.), *Proc. 1st IEEE Conf. Evol. Computation*, Piscataway, NJ: IEEE Press, pp. 57–62.
- [28] Bäck, T. (1995). Generalized convergence models for tournament- and (5,1)-selection. In: L. Eshelman (ed.), *Proc. 6th Int. Conf. Genet. Algorithms*, San Francisco: Morgan Kaufmann, pp. 2–8.
- [29] Bäck, T.; Doernemann, H.; Hammel, U.; Frankhauser, P. (1996). Modeling urban growth by cellular automata. In: H. M. Voigt; W. Ebeling; H. P. Schwefel; I. Rechenberg (eds.), *Parallel Problem Solving from Nature - PPSN IV*, Berlin: Springer, vol. 1141 of *Lecture Notes in Computer Science*, pp. 636–645.
- [30] Banaerjee, A. V. (1992). A simple model of herd behavior. *Q. J. Econ.* **107**, 797–817.
- [31] Bartels, J.; Schmelzer, J.; Schweitzer, F. (1990). The influence of depletion effects on homogeneous nucleation rates. *Zeitschrift für Physikalische Chemie (München)* **166**, 119–123.
- [32] Bartussek, R.; Hägggi, P. (1995). Brownsche Motoren. Wie aus Brownscher Bewegung makroskopischer Transport wird. *Physikalische Blätter* **51/6**, 506–507.
- [33] Bartussek, R.; Hägggi, P.; Kissner, J. G. (1994). *Europhysics Lett.* **28**, 459.
- [34] Bartussek, R.; Hägggi, P.; Lindner, B.; Schimansky-Geier, L. (1997). Ratchets driven by harmonic and white noise. *Physica D* **109**, 17–23.
- [35] Bartussek, R.; Reimann, P.; Hägggi, P. (1996). Precise numerics versus theory for correlation ratchets. *Phys. Rev. Lett.* **76/7**, 1166–1169.
- [36] Batty, M. (1991). Cities as fractals: simulating growth and form. In: A. Crilly; R. Earnshaw; H. Jones (eds.), *Fractals and Chaos*, New York: Springer, pp. 43–69.

- [37] Batty, M. (1991). Generating urban forms from diffusive growth. *Environ. Planning A* **23**, 511–544.
- [38] Batty, M. (1992). Urban modeling in computer-graphic and geographic information system environments. *Environ. Planning B* **19**, 663–688.
- [39] Batty, M. (1994). Urban models 25 years on. *Environ. Planning B* **21/5**, 515.
- [40] Batty, M. (1997). Cellular automata and urban form: A primer. *J. Am. Planning Assoc.* **63/2**, 266.
- [41] Batty, M.; Couclelis, H.; Eichen, M. (1997). Urban systems as cellular automata. *Environ. Planning B* **24/2**, 159.
- [42] Batty, M.; Longley, P. A. (1987). Fractal-based description of urban form. *Environ. Planning B* **14**, 123–134.
- [43] Batty, M.; Longley, P. A. (1994). *Fractal Cities*. London: Academic Press.
- [44] Batty, M.; Longley, P. A.; Fotheringham, S. (1989). Urban growth and form: Scaling, fractal geometry, and diffusion-limited aggregation. *Environ. Planning A* **21/11**, 1447–1472.
- [45] Batty, M.; Xie, Y. (1994). From cells to cities. *Environ. Planning B* **21**, 31–48.
- [46] Becker, R. (1961). *Theorie der Wärme*. Berlin: Springer.
- [47] Ben-Jacob, E.; Cohen, I.; Czirók, A. (1995). Smart bacterial colonies: From complex patterns to cooperative evolution. *Fractals* **3**, 849–868.
- [48] Ben-Jacob, E.; Cohen, I.; Levine, H. (2000). Cooperative self-organization of microorganisms. *Adv. Phys.* **49(4)**, 395–554.
- [49] Ben-Jacob, E.; Cohen, I.; Shochet, O.; Aranson, I.; Levine, H.; Tsimring, L. (1995). Complex bacterial patterns. *Nature* **373**, 566–567.
- [50] Ben-Jacob, E.; Shochet, O.; Tenenbaum, A.; Cohen, I.; Czirók, A.; Vicsek, T. (1994). Generic modelling of cooperative growth patterns in bacterial colonies. *Nature* **368**, 46–49.
- [51] Ben-Jacob, E.; Shochet, O.; Cohen, I.; Czirók, A.; Vicsek, T. (1995). Cooperative formation of chiral patterns during growth of bacterial colonies. *Phys. Rev. Lett.* **75/15**, 2899–2902.
- [52] Ben-Jacob, E.; Shochet, O.; Tenenbaum, A.; Cohen, I.; Czirók, A.; Vicsek, T. (1994). Communication, regulation and control during complex patterning of bacterial colonies. *Fractals* **2/1**, 15–44.
- [53] Benguigui, L. (1992). Some speculations on fractals and railway networks. *Physica A* **191**, 75–78.
- [54] Berg, H. C. (1975). How bacteria swim. *Sci. Am.* **233**, 36–44.
- [55] Berg, H. C. (1983). *Random Walks in Biology*. Princeton, NJ: Princeton University Press.
- [56] Berg, H. C. (1990). Bacterial microprocessing. *Cold Spring Harbor Symp. Quant. Biol.* **55**, 539–545.
- [57] Bernasconi, J. (1987). Low autocorrelation binary sequences: Statistical mechanics and configuration space analysis. *J. Physique* **48**, 559.
- [58] Biebricher, C. K.; Nicolis, G.; Schuster, P. (1995). *Self-Organization in the Physico-Chemical and Life Sciences*, vol. 16546 of *EU Report*.
- [59] Biler, P. (1995). Growth and accretion of mass in an astrophysical model. *Appl. Math.* **23/2**, 179–189.
- [60] Bloh, W. v.; Block, A.; Schellnhuber, H. J. (1997). Self-stabilization of the biosphere under global change: A tutorial geophysiological approach. *Tellus B* **49**, 249–262.
- [61] Boisfleury-Chevance, A.; Rapp, B.; Gruler, H. (1989). Locomotion of white blood cells: A biophysical analysis. *Blood Cells* **15**, 315–333.

- [62] Bonabeau, E.; Dorigo, M.; Théraulaz, G. (1999). *Swarm Intelligence: From Natural to Artificial Systems*. Santa Fe Institute Studies on the Sciences of Complexity, New York: Oxford University Press.
- [63] Bonabeau, E.; Dorigo, M.; Theraulaz, G. (2000). Inspiration for optimization from social insect behaviour. *Nature* **406**, 39–42.
- [64] Bonabeau, E.; Theraulaz, G.; Camazine, S. (1997). Self-organization in social insects. *Trends Ecol. Evol.* **12/5**, 188.
- [65] Borgers, A.; Timmermans, H. J. P. (1986). City centre entry points, store location patterns and pedestrian route choice behaviour: A microlevel simulation model. *Socio-Economic Planning Sci.* **20**, 25–31.
- [66] Boseniuk, T.; Ebeling, W. (1988). Optimization of NP-complete problems by Boltzmann-Darwin strategies including life-cycles. *Europhysics Lett.* **6**, 107.
- [67] Boseniuk, T.; Ebeling, W.; Engel, A. (1987). Boltzmann and Darwin strategies in complex optimization. *Phys. Lett.* **125**, 307–310.
- [68] Boyarsky, A. (1975). A Markov chain model for human granulocyte movement. *J. Math. Biol.* **2**, 69–78.
- [69] Brandt, K. (1997). Regional dynamic processes in the economy. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 489–500.
- [70] Brooks, R. A.; Maes, P. (eds.) (1994). *Artificial Life IV. Proceedings of the Fourth International Workshop on the Synthesis and Simulation of Living Systems*. Cambridge, MA: MIT Press.
- [71] Bruckner, E.; Ebeling, W.; Jimenez Montano, M. A.; Scharnhorst, A. (1994). Hyperselection and innovation described by a stochastic model of technological change. In: L. Leydesdorff; P. van den Besselaar (eds.), *Evolutionary Economics and Chaos Theory: New Directions in Technology Studies*, London: Pinter, pp. 79–90.
- [72] Bruckner, E.; Ebeling, W.; Jiménez-Montano, M. A.; Scharnhorst, A. (1996). Nonlinear effects of substitution – an evolutionary approach. *J. Evol. Econ.* **6**, 1–30.
- [73] Buchholtz, V.; Pöschel, T. (1997). Adaptive evolutionary optimization of team work. *Int. J. Bifurcation Chaos* **7/3**, 751–757.
- [74] Budrene, E. O.; Berg, H. C. (1991). Escherichia coli. *Nature* **349**, 630–633.
- [75] Burchard, R. P. (1982). Trail following by gliding bacteria. *J. Bacteriol.* **152**, 495–501.
- [76] Calenbuhr, V.; Deneubourg, J. L. (1990). A model for trail following in ants: Individual and collective behaviour. In: W. Alt; G. Hoffmann (eds.), *Biological Motion*, Berlin: Springer, pp. 453–469.
- [77] Calenbuhr, V.; Deneubourg, J. L. (1991). Chemical communication and collective behaviour in social and gregarious insects. In: W. Ebeling; M. Peschel; W. Weidlich (eds.), *Models of Selforganization in Complex Systems - MOSES*, Berlin: Akademie-Verlag, vol. 64 of *Mathematical Research*, pp. 322–331.
- [78] Caro, G. D.; Dorigo, M. (1998). An adaptive multi-agent routing algorithm inspired by ants behavior. In: *Proc. 5th Annu. Australasian Conf. Parallel Real-Time Syst. (PART98)*, Berlin: Springer, pp. 261–272.
- [79] Carraway, R. L.; Morin, T. L.; Moskowitz, H. (1990). Generalized dynamic programming for multicriteria optimization. *Eur. J. Operational Res.* **44**, 95–104.
- [80] Case, K. E.; Fair, R. C. (1992). *Principles of Economics*. Englewood Cliffs, NJ: Prentice-Hall.
- [81] Challet, D.; Chessa, A.; Marsili, M.; Zhang, Y.-C. (2001). From minority games to real markets. *Quant. Finance* **1**, 168–176.

- [82] Challet, D.; Zhang, Y.-C. (1998). On the minority game: Analytical and numerical studies. *Physica A* **256**, 514–532.
- [83] Chopard, B.; Droz, M. (1998). *Cellular Automata Modeling of Physical Systems*. Collection Alea, Cambridge: Cambridge University Press.
- [84] Chopard, B.; Luthi, P.; Droz, M. (1994). Microscopic approach to the formation of Liesegang patterns. *J. Stat. Phys.* **76/1–2**, 661–677.
- [85] Christaller, W. (1933). *Die zentralen Orte in Süddeutschland*. Jena: Fischer. Eine ökonomisch-geographische Untersuchung über die Gesetzmäßigkeit der Verbreitung und Entwicklung der Siedlungen mit städtischen Funktionen. Reprints: Darmstadt: Wissenschaftliche Buchgesellschaft, 1980, *Central Places in Southern Germany*, (English translation by C.W. Baskin), London: Prentice-Hall, 1966.
- [86] Cladis, P. E.; Palffy-Muhoray, P. (eds.) (1995). *Spatio-Temporal Patterns in Nonequilibrium Complex Systems*. Reading, MA: Addison-Wesley.
- [87] Clark, C. (1951). Urban population densities. *J. R. Stat. Soc. A* **114**, 490–496.
- [88] Cliff, D.; Miller, G. F. (1996). Co-evolution of pursuit and evasion 2: Simulation methods and results. In: P. Maes; M. Mataric; J.-A. Meyer; J. Pollack; S. Wilson (eds.), *From Animals to Animats*, Cambridge, MA: MIT Press, vol. 4, pp. 506–515.
- [89] Couclelis, H. (1985). Cellular worlds: A framework for modeling micro-macro dynamics. *Environ. Planning A* **17**, 585–596.
- [90] Crist, T. O.; Haefner, J. W. (1994). Spatial model of movement and foraging in harvester ants (*Pogonomyrmex*) (II): The roles of environment and seed dispersion. *J. Theor. Biol.* **166**, 315–323.
- [91] Czirok, A.; Barabasi, A. L.; Vicsek, T. (1999). Collective motion of self-propelled particles: Kinetic phase transition in one dimension. *Phys. Rev. Lett.* **82(1)**, 209–212.
- [92] Czirok, A.; Ben-Jacob, E.; Cohen, I.; Vicsek, T. (1996). Formation of complex bacterial colonies via self-generated vortices. *Phys. Rev. E* **54(2)**, 1791–1801.
- [93] Czirok, A.; Vicsek, T. (2000). Collective behavior of interacting self-propelled particles. *Physica A* **281**, 17–29.
- [94] Darley, V. (1994). Emergent phenomena and complexity. In: R. A. Brooks; P. Maes (eds.), *Artificial Life IV. Proceedings of the Fourth International Workshop on the Synthesis and Simulation of Living Systems*, Cambridge, MA: MIT Press, pp. 411–416.
- [95] Darwen, J.; Yao, X. (1997). Speciation as automatic categorical modularization. *IEEE Trans. on Evol. Computation* **1(2)**, 101–108.
- [96] Davis, B. (1990). Reinforced random walks. *Probl. Theor. Relat. Fields* **2**, 203–229.
- [97] Deadman, P.; Brown, R.; Gimblet, R. (1993). Modelling rural residential settlement patterns with cellular automata. *J. Environ. Manage.* **37**, 147–160.
- [98] DeAngelis, D. L.; Gross, L. J. (eds.) (1992). *Individual-Based Models and Approaches in Ecology: Populations, Communities, and Ecosystems*. New York: Chapman and Hall.
- [99] Dendrinos, D. S.; Haag, G. (1984). Towards a stochastic theory of location: Empirical evidence. *Geogr. Anal.* **16**, 287–300.
- [100] Dendrinos, D. S.; Sonis, M. (1990). *Chaos and Socio-Spatial Dynamics*. Berlin: Springer.
- [101] Deneubourg, J. L.; Goss, S.; Franks, N.; Pasteels, J. M. (1989). The blind leading the blind: Modeling chemically mediated army ant raid patterns. *J. Insect Behav.* **2/5**, 719–725.

- [102] Deneubourg, J. L.; Goss, S.; Franks, N.; Sendova-Franks, A.; Detrain, C.; Chretien, L. (1991). The dynamics of collective sorting: Robot-like ants and ant-like robots. In: J. A. Meyer; S. W. Wilson (eds.), *From Animals to Animats*, Cambridge, MA: MIT Press, pp. 356–363.
- [103] Deneubourg, J. L.; Gregoire, J. C.; Le Fort, E. (1990). Kinetics of larval gregarious behavior in the bark beetle *Dendroctonus micans* (Coleoptera: Scolytidae). *J. Insect Behav.* **3/2**, 169–182.
- [104] Derenyi, I.; Vicsek, T. (1995). Cooperative transport of Brownian particles. *Phys. Rev. Lett.* **75/3**, 374–377.
- [105] Dickinson, R.; Tranquillo, R. T. (1993). A stochastic model for adhesion-mediated cell random motility and haptotaxis. *J. Math. Biol.* **31**, 563–600.
- [106] Dorigo, M.; Bonabeau, E.; Theraulaz, G. (2000). Ant algorithms and stigmergy. *Future Generation Comput. Syst.* **16/8**, 851–871.
- [107] Dorigo, M.; Caro, G. D. (1999). The ant colony optimization meta-heuristic. In: D. Corne; M. Dorigo; F. Glover (eds.), *New Ideas in Optimization*, New York: McGraw-Hill, pp. 11–32.
- [108] Dorigo, M.; Gambardella, L. M. (1997). Ant colonies for the travelling salesman problem. *BioSystems* **43**, 73–81.
- [109] Dunn, G. A. (1983). Characterizing a kinesis response: Time averaged measures of cell speed and directional persistence. In: H. Keller; G. O. Till (eds.), *Leukocyte Locomotion and Chemotaxis*, Basel: Birkhäuser, pp. 14–33.
- [110] Dunn, G. A.; Brown, A. F. (1987). A unified approach to analyzing cell motility. *J. Cell. Sci. Suppl.* **8**, 81–102.
- [111] Durrett, R.; Levin, S. (1998). Spatial aspects of interspecific competition. *Theor. Population Biol.* **53**, 30–43.
- [112] Dworkin, M.; Kaiser, D. (eds.) (1993). *Myxobacteria*, vol. II. Washington, DC: American Society for Microbiology.
- [113] Ebeling, W. (1981). Structural stability of stochastic systems. In: H. Haken (ed.), *Chaos and Order in Nature*, Berlin: Springer, vol. 11 of *Springer Series in Synergetics*, pp. 188–195.
- [114] Ebeling, W. (1990). Applications of evolutionary strategies. *Syst. Anal. Model. Simul.* **7**, 3–16.
- [115] Ebeling, W. (1994). Self-organization, valuation and optimization. In: R. K. Mishra; D. Maaß; E. Zwierlein (eds.), *On Self-Organization*, Berlin: Springer, vol. 61 of *Springer Series in Synergetics*, pp. 185–196.
- [116] Ebeling, W. (2000). Problems of a statistical ensemble theory for systems far from equilibrium. In: J. A. Freund; T. Pöschel (eds.), *Stochastic Processes in Physics, Chemistry and Biology*, Berlin: Springer, vol. 557 of *Lecture Notes in Physics*, pp. 390–399.
- [117] Ebeling, W.; Engel, H.; Herzl, H. (1990). *Selbstorganisation in der Zeit*. Berlin: Akademie-Verlag.
- [118] Ebeling, W.; Engel-Herbert, H. (1980). The influence of external fluctuations on self-sustained temporal oscillations. *Physica A* **104**, 378–396.
- [119] Ebeling, W.; Feistel, R. (1982). *Physik der Selbstorganisation und Evolution*. Berlin: Akademie-Verlag.
- [120] Ebeling, W.; Feistel, R. (1994). *Chaos und Kosmos. Prinzipien der Evolution*. Heidelberg: Spektrum Akademischer Verlag.
- [121] Ebeling, W.; Freund, J.; Schweitzer, F. (1998). *Komplexe Strukturen: Entropie und Information*. Stuttgart: Teubner.
- [122] Ebeling, W.; Rosé, H.; Schuchhardt, J. (1994). Evolutionary strategies for solving frustrated problems. In: R. K. Belew; L. B. Booker (eds.), *Proc. 1st IEEE Conf. Evol. Computation*, Piscataway, NJ: IEEE Press, pp. 79–81.

- [123] Ebeling, W.; Schimansky-Geier, L.; Schweitzer, F. (1990). Stochastic theory of nucleation in open molecular systems. *Zeitschrift für physikalische Chemie (Neue Folge)* **169**, 1–10.
- [124] Ebeling, W.; Schweitzer, F. (2001). Swarms of particle agents with harmonic interactions. *Theory Biosci.* **120(3–4)**, 207–224.
- [125] Ebeling, W.; Schweitzer, F.; Schimansky-Geier, L.; Ulbricht, H. (1990). Stochastic approach to cluster formation in adiabatically expanding molecular beams. *Zeitschrift für physikalische Chemie (Leipzig)* **271**, 1113–1122.
- [126] Ebeling, W.; Schweitzer, F.; Tilch, B. (1999). Active Brownian particles with energy depots modelling animal mobility. *BioSystems* **49**, 17–29.
- [127] Edelstein-Keshet, L. (1994). Simple models for trail following behaviour: Trunk trails versus individual foragers. *J. Math. Biol.* **32**, 303–328.
- [128] Edelstein-Keshet, L.; Watmough, J.; Ermentrout, G. B. (1995). Trail following in ants: Individual properties determine population behaviour. *Behav. Ecol. Sociobiol.* **36**, 119–133.
- [129] Eden, M. (1961). A two-dimensional growth process. In: J. Neyman (ed.), *Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, Vol. IV: Biology and Problems of Health*, Berkeley: University of California Press, pp. 223–239.
- [130] Eigen, M. (1971). The self-organization of matter and the evolution of biological macromolecules. *Naturwissenschaften* **58**, 465.
- [131] Eigen, M.; Schuster, P. (1979). *The Hypercycle*. Berlin: Springer.
- [132] Einstein, A. (1905). Über die von der molekularkinetischen Theorie der Wärme geforderte Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen. *Annalen der Physik (Leipzig)* **17**, 549–560.
- [133] Einstein, A. (1926). *Investigations on the Theory of the Brownian Motion*. London: Methuen (edited by R. Fürth).
- [134] Engelmore, R.; Morgan, T. (eds.) (1988). *Blackboard Systems*. Insight Series in Artificial Intelligence. Reading, MA: Addison-Wesley.
- [135] Epstein, J. M.; Axtell, R. (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Cambridge, MA: MIT Press/Brookings.
- [136] Erdmann, U. (1997). *Ensembles von Van-der-Pol-Oszillatoren*. Master's Thesis, Humboldt University, Berlin.
- [137] Erdmann, U.; Ebeling, W.; Schimansky-Geier, L.; Schweitzer, F. (2000). Brownian Particles far from Equilibrium. *Eur. Phys. J. B* **15(1)**, 105–113.
- [138] Family, F. (1993). Fractal structures and dynamics of cluster growth. In: P. J. Reynolds (ed.), *On Clusters and Clustering. From Atoms to Fractals*, Amsterdam: North-Holland, pp. 323–344.
- [139] Family, F.; Vicsek, T. (eds.) (1991). *Dynamics of Fractal Surfaces*. Singapore: World Scientific.
- [140] Feinberg, M.; Horn, F. J. M. (1974). Dynamics of open chemical systems and the algebraic structure of the underlying reaction network. *Chem. Eng. Sci.* **29**, 775–789.
- [141] Feistel, R.; Ebeling, W. (1982). Models of Darwin processes and evolutionary principles. *BioSystems* **15**, 291.
- [142] Feistel, R.; Ebeling, W. (1989). *Evolution of Complex Systems. Self-Organization, Entropy and Development*. Dordrecht: Kluwer.
- [143] Ferber, J. (1999). *Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence*. Harlow: Addison-Wesley-Longman.
- [144] Fischer, M. M.; Fröhlich, J. (eds.) (2001). *Knowledge, Complexity and Innovation Systems*. Advances in Spatial Sciences, Berlin: Springer.
- [145] Fisher, R. A. (1930). *The Genetical Theory of Natural Selection*. Oxford: Oxford University Press.

- [146] Fogel, D. B. (1995). *Evolutionary Computation – Towards a New Philosophy of Machine Intelligence*. Piscataway, NJ: IEEE Press.
- [147] Föllmer, H. (1974). Random economies with many interacting agents. *J. Math. Econ.* **1**, 51–62.
- [148] Fomin, F.; Petrov, N. (1996). Pursuit-evasion and search problems on graphs. *Congressus Numerantium* **122**, 47–58.
- [149] Franke, K.; Gruler, H. (1990). Galvanotaxis of human granulocytes: Electric field jump studies. *Eur. Biophys. J.* **18**, 335–346.
- [150] Frankhauser, P. (1990). Fractal structures of urban systems. *Methods Operations Res.* **60**, 697–708.
- [151] Frankhauser, P. (1991). Aspects fractals des structures urbaines. *L'Espace Géographique* **1**, 45–69.
- [152] Frankhauser, P. (1991). *Beschreibung der Evolution urbaner Systeme mit der Mastergleichung*. Ph.D. Thesis, Universität Stuttgart.
- [153] Frankhauser, P. (1991). The Pareto-Zipf distribution of urban systems as stochastic process. In: W. Ebeling; M. Peschel; W. Weidlich (eds.), *Models of Self-Organization in Complex Systems: MOSES*, Berlin: Akademie-Verlag, pp. 276–287.
- [154] Frankhauser, P. (1992). Fractal properties of settlement structures. In: *Proc. 1st Int. Semin. Struct. Morphol.*, Montpellier-La Grande Motte, pp. 357–368.
- [155] Frankhauser, P. (1994). Fractales, tissus urbains et réseaux de transport. *Rev. Écon. Pol.* **104 (2/3)**, 435–455.
- [156] Frankhauser, P. (1994). *La Fractalité des Structures Urbaines*. Paris: Anthropos.
- [157] Frankhauser, P.; Sadler, R. (1992). Fractal analysis of urban structures. In: *Natural Structures – Principles, Strategies and Models in Architecture and Nature. Proc. Int. Symp. SFB 230*, Stuttgart, vol. 4 of *Mitteilungen des SFB 230*, pp. 57–65.
- [158] Franks, N.; Gomez, N.; Goss, S.; Deneubourg, J. L. (1991). The blind leading the blind in army ant raid patterns: Testing a model of self-organization (*Hymenoptera: Formicidae*). *J. Insect Behav.* **4/5**, 583–607.
- [159] Freimuth, R. D.; Lam, L. (1992). Active walker models for filamentary growth patterns. In: L. Lam; V. Naroditsky (eds.), *Modeling Complex Phenomena*, New York: Springer, pp. 302–313.
- [160] Fricke, T.; Schimansky-Geier, L. (1996). Moving spots in three dimensions in activator-inhibitor dynamics. In: H. Engel; F.-J. Niedernostheide; H.-G. Purwins; E. Schöll (eds.), *Self-Organization in Activator-Inhibitor Systems: Semiconductors, Gas-Discharges and Chemical Active Media-Dynamics*, Berlin: Wissenschaft & Technik, pp. 184–189.
- [161] Fromherz, P.; Zeiler, A. (1994). Dissipative condensation of ion channels described by a Langevin–Kelvin equation. *Phys. Lett. A* **190**, 33–37.
- [162] Fujita, M. (1989). *Urban Economic Theory*. Cambridge: Cambridge University Press.
- [163] Fürth, R. (1920). Die Brownsche Bewegung bei Berücksichtigung einer Persistenz der Bewegungsrichtung. Mit Anwendungen auf die Bewegung lebender Infusorien. *Z. Phys.* **11**, 244–256.
- [164] Galam, S. (1990). Social paradoxes of majority rule voting and renormalization group. *J. Stat. Phys.* **61(3–4)**, 943–951.
- [165] Galam, S. (1991). Renormalisation group, political paradoxes, and hierarchies. In: W. Ebeling; M. Peschel; W. Weidlich (eds.), *Models of Self-Organization in Complex Systems: MOSES*, Berlin: Akademie-Verlag, pp. 53–59.

- [166] Galam, S. (1997). Rational decision making: A random field Ising model at $T = 0$. *Physica A* **238**, 66–88.
- [167] Galam, S.; Moscovici, S. (1991). Towards a theory of collective phenomena: Consensus and attitude change in groups. *Eur. J. Soc. Psychol.* **21**, 49–74.
- [168] Galluccio, A.; Loebel, M.; Vondrak, J. (2000). A new algorithm for the Ising problem: Partition function for finite lattice graphs. *Phys. Rev. Lett.* **84**, 5924–5927.
- [169] Gardiner, C. W. (1983). *Handbook of Stochastic Methods for Physics, Chemistry and the Natural Sciences*. Berlin: Springer.
- [170] Gerhart, M.; Schuster, H. (1995). *Das Digitale Universum*. Braunschweig: Vieweg.
- [171] Gervet, J.; Deneubourg, J. L. (1991). Task differentiation in *Polistes* wasp colonies: A model for self-organizing groups of robots. In: J. A. Meyer; S. W. Wilson (eds.), *From Animals to Animats*, Cambridge, MA: MIT Press, pp. 346–355.
- [172] Ghent, A. W. (1960). A study of the group feeding behaviour of the larvae of the jack pine sawfly *Neodiprion pratti banksianae* Rho. *Behaviour* **16/1–2**, 110–148.
- [173] Gilbert, E. N.; Pollack, H. O. (1968). Steiner minimal trees. *SIAM J. Appl. Math.* **16**, 1–29.
- [174] Gilbert, N.; Doran, J. (eds.) (1994). *Simulating Societies: The Computer Simulation of Social Processes*. London: University College.
- [175] Gilbert, N.; Terna, P. (2000). How to build and use agent-based models in social science. *Mind Soc.* **1**, 57–72.
- [176] Gilbert, N.; Troitzsch, K. G. (1999). *Simulation for the Social Scientist*. Buckingham, Philadelphia: Open University Press.
- [177] Gipps, P. G.; Marksjö, B. (1985). A micro-simulation model for pedestrian flows. *Math. Comput. Simulation* **27**, 95–105.
- [178] Goldberg, D. E. (1989). *Genetic Algorithms in Search, Optimization and Machine Learning*. Reading, MA: Addison-Wesley.
- [179] Goodchild, M.; Mark, D. M. (1987). The fractal nature of geographical phenomena. *Ann. Assoc. Am. Geogr.* **77**, 265–178.
- [180] Goss, S.; Aron, S.; Deneubourg, J. L.; Pasteels, J. M. (1989). Self-organized shortcuts in the Argentine ant. *Naturwissenschaften* **76**, 579–581.
- [181] Graham, R. (1973). Statistical theory of instabilities in stationary non-equilibrium systems with applications to lasers and nonlinear optics. In: G. Höhler (ed.), *Quantum Statistics in Optics and Solid State Physics*, Berlin: Springer, vol. 66 of *Springer Tracts in Modern Physics*, p. 111.
- [182] Grassé, P. P. (1959). La reconstruction du nid et les coordinations interindividuelles chez *Bellicositermes Natalensis* et *Cubitermes sp*. La théorie de la stigmergie: Essai d'interprétation du comportement des termites constructeurs. *Insectes Sociaux* **6**, 41–81.
- [183] Grimsehl, E. (1977). *Lehrbuch der Physik, Bd. 1: Mechanik, Akustik, Wärmelehre*. Leipzig: Teubner, 22nd ed.
- [184] Gruler, H. (1995). Cell migration, molecular machines, and living liquid crystals. *J. Trace Microprobe Tech.* **13(3)**, 403–412.
- [185] Gruler, H. (1995). New insights into directed cell migration: Characteristics and mechanisms. *Nouv. Rev. Fr. Hematol.* **37**, 255–265.
- [186] Gruler, H.; Boisfleury-Chevance, A. d. (1994). Directed cell movement and cluster formation: Physical principles. *J. Physique I (France)* **4**, 1085–1105.
- [187] Gruler, H.; Bültmann, B. (1984). Analysis of cell movement. *Blood Cells* **10**, 61–77.

- [188] Gruler, H.; Nuccitelli, R. (1991). Neural crest cell galvanotaxis: New data and novel approach to the analysis of both galvanotaxis and chemotaxis. *Cell Mot. Cytoskel.* **19**, 121–133.
- [189] Grünbaum, D.; Okubo, A. (1994). Modelling social animal aggregation. In: S. A. Levin (ed.), *Frontiers in Theoretical Biology*, New York: Springer, vol. 100 of *Lecture Notes in Biomathematics*.
- [190] Günther, R.; Shapiro, B.; Wagner, P. (1992). Physical complexity and Zipf's law. *J. Theor. Phys.* **31**, 525–543.
- [191] Gutowitz, H. (ed.) (1991). *Cellular Automata: Theory and Experiment*. Cambridge: MIT Press.
- [192] Haag, G. (1994). The rank-size distribution of settlements as a dynamic multifractal phenomenon. *Chaos, Solitons & Fractals* **4**, 519–534.
- [193] Haag, G.; Dendrinos, D. S. (1983). Towards a stochastic theory of location: A nonlinear migration process. *Geogr. Anal.* **15**, 269–286.
- [194] Haag, G.; Munz, M.; Pumain, P.; Sanders, L.; Saint-Julien, T. (1992). Interurban migration and the dynamics of a system of cities: 1. The stochastic framework with an application to the French urban system. *Environ. Planning A* **24**, 181–198.
- [195] Haag, G.; Weidlich, W. (1984). A stochastic theory of interregional migration. *Geogr. Anal.* **16**, 331–357.
- [196] Haefner, J. W.; Crist, T. O. (1994). Spatial model of movement and foraging in harvester ants (*Pogonomyrmex*) (I): The roles of memory and communication. *J. Theor. Biol.* **166**, 299–313.
- [197] Haken, H. (1973). *Zeitschrift für Physik* **273**, 267
- [198] Haken, H. (1978). *Synergetics. An Introduction. Nonequilibrium Phase Transitions in Physics, Chemistry and Biology*. Berlin: Springer, 2nd enl. ed.
- [199] Haken, H. (1983). *Advanced Synergetics – Instability Hierarchies of Self-Organizing Systems and Devices*. Berlin: Springer.
- [200] Hall, R. L. (1977). Amoeboid movement as a correlated walk. *J. Math. Biol.* **4**, 327–335.
- [201] Hall, R. L.; Peterson, S. C. (1979). Trajectories of human granulocytes. *Biophys. J.* **25**, 365–372.
- [202] Halsey, T. C.; Leibig, M. (1990). Electrodeposition and diffusion-limited aggregation. *J. Chem. Phys.* **92/6**, 3756–3767.
- [203] Hänggi, P.; Bartussek, R. (1996). Brownian rectifiers: How to convert Brownian motion into directed transport. In: J. Parisi; S. C. Müller; W. Zimmermann (eds.), *Nonlinear Physics of Complex Systems – Current Status and Future Trends*, Berlin: Springer, pp. 294–308.
- [204] Harada, Y.; Iwasa, Y. (1994). Lattice population dynamics for plants with dispersing seeds and vegetative propagation. *Res. Population Ecol.* **36**, 237–249.
- [205] Hegselmann, R.; Flache, A. (1998). Understanding complex social dynamics: A plea for cellular automata based modelling. *J. Artif. Soc. Soc. Simulation* **1(3)**. <http://www.soc.surrey.ac.uk/JASSS/1/3/1.html>.
- [206] Hegselmann, R. H.; Mueller, U.; Troitzsch, K. G. (eds.) (1996). *Modeling and Simulation in the Social Sciences from the Philosophy of Science Point of View*. Dordrecht: Kluwer.
- [207] Hegselmann, R. H.; Peitgen, H. O. (eds.) (1996). *Modelle sozialer Dynamiken: Ordnung, Chaos und Komplexität*. Wien: Hölder-Pichker-Tempsky.
- [208] Helbing, D. (1992). A fluid-dynamic model for the movement of pedestrians. *Complex Syst.* **6**, 391–415.
- [209] Helbing, D. (1993). Stochastic and Boltzmann-like models for behavioral changes, and their relation to game theory. *Physica A* **193**, 241–258.

- [210] Helbing, D. (1995). *Quantitative Sociodynamics. Stochastic Methods and Models of Social Interaction Processes*. Dordrecht: Kluwer Academic.
- [211] Helbing, D. (1997). *Verkehrsdynamik. Neue physikalische Modellierungskonzepte*. Berlin: Springer.
- [212] Helbing, D. (2001). Traffic and related self-driven many-particle systems. *Rev. Mod. Phys.* **73**(4), 1067–1141.
- [213] Helbing, D.; Farkas, I.; Molnar, P.; Vicsek, T. (2002). Simulation of pedestrian crowds in normal and evacuation situations. In: M. Schreckenberg; S. D. Sharma (eds.), *Pedestrian and Evacuation Dynamics*, Berlin: Springer, pp. 21–58.
- [214] Helbing, D.; Farkas, I.; Vicsek, T. (2000). Freezing by heating in a driven mesoscopic system. *Phys. Rev. Lett.* **84**, 1240–12.
- [215] Helbing, D.; Farkas, I.; Vicsek, T. (2000). Simulating dynamical features of escape panic. *Nature* **407**, 487–490.
- [216] Helbing, D.; Greiner, A. (1997). Modeling and simulation of multilane traffic flow. *Phys. Rev. E* **55**, 5498–5507.
- [217] Helbing, D.; Keltsch, P.; Molnár, P. (1997). Modelling the evolution of human trail systems. *Nature* **388**, 47–50.
- [218] Helbing, D.; Molnár, P. (1995). Social force model for pedestrian dynamics. *Phys. Rev. E* **51/5**, 4282–4286.
- [219] Helbing, D.; Molnár, P. (1996). Fußgänderdynamik in der Stadt. In: K. Teichmann; J. Wilke (eds.), *Prozeß und Form natürlicher Konstruktionen*, Berlin: Ernst & Sohn, p. 217.
- [220] Helbing, D.; Molnár, P. (1997). Self-organization phenomena in pedestrian crowds. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 569–578.
- [221] Helbing, D.; Molnar, P.; Schweitzer, F. (1994). Computer simulations of pedestrian dynamics and trail formation. In: *Evolution of Natural Structures. Proc. 3rd Int. Symp. SFB 230*, Stuttgart, vol. 9 of *Mitteilungen des SFB 230*, pp. 229–234.
- [222] Helbing, D.; Schweitzer, F.; Keltsch, J.; Molnár, P. (1997). Active walker model for the formation of human and animal trail systems. *Phys. Rev. E* **56/3**, 2527–2539.
- [223] Helbing, D.; Weidlich, W. (1995). Quantitative Soziodynamik. Gegenstand, Methodik, Ergebnisse und Perspektiven. *Kölner Zeitschrift für Soziologie und Sozialpsychologie* **47**, 114–140.
- [224] Henderson, J. V. (1979). *Economic Theory and the Cities*. New York: Academic Press.
- [225] Henderson, J. V. (1988). *Urban Development. Theory, Fact, and Illusion*. Oxford: Oxford University Press.
- [226] Henderson, J. V. (1996). Ways to think about urban concentration: Neoclassical urban systems versus the new economic geography. *Int. Reg. Sci. Rev.* **19**, 31–36.
- [227] Henderson, L. F. (1971). The statistics of crowd fluids. *Nature* **229**, 381–383.
- [228] Henderson, L. F. (1974). On the fluid mechanics of human crowd motion. *Transp. Res.* **8**, 509–515.
- [229] Henderson, L. F.; Jenkins, D. M. (1974). Response of pedestrians to traffic challenge. *Transp. Res.* **8**, 71–74.
- [230] Henderson, L. F.; Lyons, D. J. (1972). Sexual differences in human crowd motion. *Nature* **230**, 353–355.
- [231] Henisch, H. K. (1988). *In Vitro Veritas. Crystals in Gels and Liesegang Rings*. Cambridge: Cambridge University Press.

- [232] Herrero, M. A.; Velasquez, J. J. L. (1996). Singularity patterns in a chemotaxis model. *Math. Ann.* **306**, 583–623.
- [233] Hespanha, P.; Kim, H. J.; Sastry, S. (1999). Multiple-agent probabilistic pursuit-evasion games. Technical report, Dept. Electrical Engineering and Computer Science, University of California at Berkeley.
- [234] Höfer, T. (1999). Chemotaxis and aggregation in the cellular slime mould. In: S. C. Müller; J. Parisi; W. Zimmermann (eds.), *Transport and Structure. Their Competitive Roles in Biophysics and Chemistry*, Berlin: Springer, vol. 532 of *Lecture Notes in Physics*, pp. 137–150.
- [235] Höfer, T.; Sherratt, J. A.; Maini, P. K. (1995). *Dictyostelium discoideum*: Cellular self-organization in an excitable biological medium. *Proc. R. Soc. London B* **259**, 249–257.
- [236] Holland, J.; Miller, J. (1991). Adaptive agents in economic theory. *Am. Econ. Rev. Pap. Proc.* **81**, 365–370.
- [237] Holland, J. H. (1975). *Adaptation in Natural and Artificial Systems*. Ann Arbor: University of Michigan Press.
- [238] Hölldobler, B.; Möglich, M. (1980). The foraging system of *Pheidole militicida* (*Hymenoptera: Formicidae*). *Insectes Sociaux* **27/3**, 237–264.
- [239] Hölldobler, B.; Wilson, E. O. (1990). *The Ants*. Cambridge, MA: Belknap.
- [240] Holyst, J. A.; Hagel, T.; Haag, G. (1997). Destructive role of competition and noise for control of microeconomical chaos. *Chaos, Solitons & Fractals* **8/9**, 1489–1505.
- [241] Holyst, J. A.; Hagel, T.; Haag, G.; Weidlich, W. (1996). How to control a chaotic economy? *J. Evol. Econ.* **6**, 31–42.
- [242] Hongler, M. O.; Ryter, D. M. (1978). *Zeitschrift für Physik B* **31**, 333.
- [243] Hopfield, J. J.; Tank, D. W. (1985). Computing RC-networks. *Biol. Cybernetics* **52**, 141.
- [244] Horn, F. J. M. (1973). On a connexion between stability and graphs in chemical kinetics. I. Stability and the reaction diagram. *Proc. R. Soc. London A* **334**, 299–312.
- [245] Horn, F. J. M. (1973). On a connexion between stability and graphs in chemical kinetics. II. Stability and the complex graph. *Proc. R. Soc. London A* **334**, 313–330.
- [246] Huberman, B.; Glance, N. (1993). Evolutionary games and computer simulations. *Proc. Natl. Acad. Sci. USA* **90(16)**, 7715–7718.
- [247] Humpert, K.; Becker, S.; Brenner, K. (1996). Entwicklung großstädtischer Agglomerationen. In: K. Teichmann; J. Wilke (eds.), *Prozeß und Form natürlicher Konstruktionen*, Berlin: Ernst & Sohn, pp. 182–189.
- [248] Humpert, K.; Brenner, K.; Becker, S. (eds.) (2002). *Fundamental Principles of Urban Growth*. Wuppertal: Müller und Busmann.
- [249] Humpert, K.; Bohm, H. J.; Nagler, H. (1989). Natürliche Prozesse – Haus und Stadt. Die universellen Gestaltwerdungsprozesse menschlicher Siedlungen. In: *Beiträge z. 1. Int. Symp. SFB 230, Teil 2*, Stuttgart, vol. 3 of *Mitteilungen des SFB 230*, pp. 17–38.
- [250] Humpert, K.; Brenner, K. (1992). Das Phänomen der Stadt als fraktale Struktur. In: *Das Phänomen der Stadt. Berichte aus Forschung und Lehre*, Stuttgart: Städtebauliches Institut, Universität Stuttgart, pp. 223–269.
- [251] Humpert, K.; Brenner, K.; Becker, S. (1996). Von Nördlingen bis Los Angeles - fraktale Gesetzmäßigkeiten der Urbanisation. *Spektrum der Wissenschaft*, 18–22.
- [252] Huston, M.; DeAngelis, D.; Post, W. (1988). New computer models unify ecological theory. *BioScience* **38**, 682–691.

- [253] Ikegami, T. (1994). From genetic evolution to emergence of game strategies. *Physica D* **75**, 310–327.
- [254] Ising, E. (1925). Beitrag zur Theorie des Ferromagnetismus. *Zeitschrift für Physik* **31**, 235–258.
- [255] Itami, R. (1988). Cellular worlds – models for dynamic conceptions of landscape. *Landscape Architecture*, 52–57.
- [256] Jäger, W.; Luckhaus, S. (1992). On explosions of solutions to a system of partial differential equations modelling chemotaxis. *Trans. AMS* **329**, 819–824.
- [257] Jantsch, E. (1980). *The Self-Organizing Universe. Scientific and Human Implications of the Emerging Paradigm of Evolution*. Oxford: Pergamon.
- [258] Jimenez Montano, M. A.; Ebeling, W. (1980). A stochastic evolutionary model of technological change. *Collective Phenomena* **3**, 107–114.
- [259] Johnson, D. S.; Lenstra, J. K.; Rinnooy Kan, A. H. G. (1978). The complexity of the network design problem. *Networks* **8**, 279–285.
- [260] Jülicher, F.; Prost, J. (1995). Cooperative molecular motors. *Phys. Rev. Lett.* **75/13**, 2618–2621.
- [261] Kacperski, K.; Holyst, J. A. (1996). Phase transitions and hysteresis in a cellular automata-based model of opinion formation. *J. Stat. Phys.* **84**, 169–189.
- [262] Kacperski, K.; Holyst, J. A. (1997). Leaders and clusters in a social impact model of opinion formation. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 367–378.
- [263] Kai, S. (ed.) (1992). *Pattern Formation in Complex Dissipative Systems*. Singapore: World Scientific.
- [264] Kai, S.; Müller, S. C. (1985). Spatial and temporal macroscopic structures in chemical reaction systems: Precipitation patterns and interfacial motion. *Sci. Form* **1/1**, 9–39.
- [265] Kaiser, D. (1979). Social gliding is correlated with the presence of pili in *Myxococcus xanthus*. *Proc. Natl. Acad. Sci. USA* **76/11**, 5952–5956.
- [266] Kappler, O. (1931). *Annalen der Physik* **11**, 233.
- [267] Kareiva, P.; Shigesada, N. (1983). Analyzing insect movement as a correlated random walk. *Oecologica* **56**, 234–238.
- [268] Kauffman, S. A. (1993). *The Origins of Order: Self-Organization and Selection in Evolution*. Oxford: Oxford University Press.
- [269] Kayser, D. R.; Aberle, L. K.; Pochy, R. D.; Lam, L. (1992). Active walker models: Tracks and landscapes. *Physica A* **191**, 17–24.
- [270] Keller, E.; Segel, L. (1970). Initiation of slime mold aggregation viewed as an instability. *J. Theor. Biol.* **26**, 399–415.
- [271] Keller, J. B.; Rubinow, S. I. (1981). Recurrent precipitation and Liesegang rings. *J. Chem. Phys.* **74/9**, 5000–5007.
- [272] Kirkpatrick, S.; Gelatt, C. D.; Vecchi, M. P. (1983). Optimization by simulated annealing. *Science* **220**, 671.
- [273] Kirman, A. (1992). Whom or what does the representative agent represent? *J. Econ. Perspect.* **6**, 126–139.
- [274] Kirman, A. (1993). Ants, rationality, and recruitment. *Q. J. Econ.* **108**, 37–155.
- [275] Kirman, A.; Zimmermann, J.-B. (eds.) (2001). *Economies with Heterogeneous Interacting Agents*, vol. 503 of *Lecture Notes in Economics and Mathematical Systems*. Berlin: Springer.
- [276] Klimontovich, Y. L. (1994). Nonlinear Brownian motion. *Physics-Uspekhi* **37(8)**, 737–766.

- [277] Kohring, G. A. (1996). Ising models of social impact: The role of cumulative advantage. *J. Physique I (France)* **6**, 301–308.
- [278] Kooijman, S. A. L. M. (1993). *Dynamic Energy Budgets in Biological Systems*. Cambridge: Cambridge University Press.
- [279] Krischer, K.; Mikhailov, A. S. (1994). Bifurcation to traveling spots in reaction-diffusion systems. *Phys. Rev. Lett.* **73**, 23.
- [280] Kropp, J.; Block, A.; Bloh, W. v.; Klenke, T.; Schellnhuber, H. J. (1997). Multifractal characterization of microbially induced magnesian calcite formation in recent tidal flat sediments. *Sediment. Geol.* **109**, 37–51.
- [281] Krugman, P. (1991). *Geography and Trade*. Cambridge, MA: MIT Press.
- [282] Krugman, P. (1991). Increasing returns and economic geography. *J. Political Econ.* **99**, 483–499.
- [283] Krugman, P. (1992). A dynamic spatial model. *National Bureau of Economic Research Working Paper* **4219**.
- [284] Krugman, P. (1996). *The Self-Organizing Economy*. Oxford: Blackwell.
- [285] Krugman, P. (1996). Urban concentration: The role of increasing returns and transportation costs. *Int. Reg. Sci. Rev.* **19**, 5–30.
- [286] Kube, C. R.; Zhang, H. Z. (1994). Collective robotics: from social insects to robots. *Adaptive Behav.* **2(2)**, 189–218.
- [287] Laarhoven, P. J. M.; Aarts, E. H. C. (1987). *Simulated Annealing: Theory and Applications*. Dordrecht: Reidel.
- [288] Lam, L. (1995). Active walker models for complex systems. *Chaos, Solitons & Fractals* **6**, 267–285.
- [289] Lam, L. (1995). Electrodeposition pattern formation: An overview. In: H. Merchant (ed.), *Defect Structure, Morphology and Properties of Deposits*, The Minerals, Metals & Materials Society, pp. 169–193.
- [290] Lam, L.; Naroditsky, V. (eds.) (1992). *Modeling Complex Phenomena*. New York: Springer.
- [291] Lam, L.; Pochy, R. (1993). Active walker models: Growth and form in nonequilibrium systems. *Comput. Phys.* **7**, 534–541.
- [292] Lam, L.; Veinott, M. C.; Pochy, R. (1995). Abnormal spatiotemporal growth. In: P. E. Cladis; P. Palffy-Muhoray (eds.), *Spatio-Temporal Patterns in Nonequilibrium Complex Systems*, Reading, MA: Addison-Wesley, pp. 659–670.
- [293] Lambrinos, D.; Maris, M.; Kobayashi, H.; Labhart, T.; Pfeifer, R.; Wehner, R. (1997). An autonomous agent navigating with a polarized light compass. *Adaptive Behav.* **6(1)**, 175–206.
- [294] Lane, D. (1992). Artificial worlds and economics. *J. Evol. Econ.* **3**, 89–107.
- [295] Langton, C. G. (ed.) (1994). *Artificial Life III. Proc. Workshop on Artificial Life*, June 1992. Reading, MA: Addison-Wesley.
- [296] Latané, B.; Nowak, A.; Liu, J. M. (1994). Dynamism, polarization, and clustering as order parameters of social systems. *Behavioral Sci.* **39**, 1–24.
- [297] Lauffenburger, D. A. (1985). Chemotaxis: Analysis for quantitative studies. *Biotech. Prog.* **1/3**, 151–160.
- [298] Lee, K. J.; McCormick, W. D.; Pearson, J. E.; Swinney, H. L. (1994). Experimental observation of self-replicating spots in a reaction-diffusion system. *Nature* **369**, 215–218.
- [299] Leven, R. W.; Koch, B. P.; Pompe, B. (1989). *Chaos in dissipativen Systemen*. Berlin: Akademie-Verlag.
- [300] Lewenstein, M.; Nowak, A.; Latané, B. (1992). Statistical mechanics of social impact. *Phys. Rev. A* **45(2)**, 703–716.
- [301] Lewin, K. (1951). *Field Theory in Social Science*. New York: Harper and Brothers.

- [302] Lindgren, K.; Nordahl, M. G. (1994). Evolutionary dynamics of spatial games. *Physica D* **75**, 292–309.
- [303] Lindner, B.; Schimansky-Geier, L.; Reimann, P.; Hänggi, P. (1997). Mass separation by ratchets. *Proc. Am. Phys. Soc.* **41**, 309–314.
- [304] Lobo, J.; Schuler, R. (1997). Efficient organization, urban hierarchies and landscape criteria. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 547–558.
- [305] Lorenz, H. W. (1993). *Nonlinear Dynamical Equations and Chaotic Economy*. Berlin: Springer.
- [306] Lösch, A. (1940). *Die räumliche Ordnung der Wirtschaft*. Jena: Fischer. Reprint: *The Economics of Location* (English translation by W.G. Woglom), New Haven: Yale University Press, 1954.
- [307] Lotka, A. J. (1941). The law of urban concentration. *Science* **94**.
- [308] Lotka, A. J. (1945). The law of evolution as a maximum principle. *Hum. Biol.* **17/3**, 167–194.
- [309] Lövås, G. G. (1994). Modelling and simulation of pedestrian traffic flow. *Transp. Res. B* **28/6**, 429–443.
- [310] Lovely, P. S.; Dahlquist, F. W. (1975). Statistical measures of bacterial motility and chemotaxis. *J. Theor. Biol.* **50**, 477–496.
- [311] Luczka, J.; Bartussek, R.; Hänggi, P. (1995). White noise induced transport in periodic structures. *Europhysics Lett.* **31**, 431.
- [312] Luna, F.; Stefansson, B. (eds.) (2000). *Economic Simulations in Swarm: Agent-Based Modelling and Object Oriented Programming*, vol. 14 of *Advances in Computational Economics*. Dordrecht: Kluwer.
- [313] Maddox, J. (1994). Directed motion from random noise. *Nature* **369**, 181.
- [314] Maddox, J. (1994). More models of muscle movement. *Nature* **368**, 287.
- [315] Maes, P. (ed.) (1991). *Designing Autonomous Agents. Theory and Practice From Biology to Engineering and Back*. Cambridge, MA: MIT Press.
- [316] Magnasco, M. O. (1993). Forced thermal ratchets. *Phys. Rev. Lett.* **71/10**, 1477–1481.
- [317] Magnasco, M. O. (1994). Molecular combustion motors. *Phys. Rev. Lett.* **72/16**, 2656–2659.
- [318] Magnasco, M. O. (1996). Brownian combustion engines. In: M. Millonas (ed.), *Fluctuations and Order: The New Synthesis*, New York: Springer, pp. 307–320.
- [319] Makse, H.; Havlin, S.; Schwartz, M.; Stanley, H. E. (1996). Method for generating long-range correlations for large systems. *Phys. Rev. E* **53/5**, 5445–5449.
- [320] Makse, H.; Havlin, S.; Stanley, H. E. (1995). Modelling urban growth patterns. *Nature* **377**, 608–612.
- [321] Makse, H.; Havlin, S.; Stanley, H. E.; Schwartz, M. (1995). Novel method for generating long-range correlations. *Chaos, Solitons & Fractals* **6**, 295–303.
- [322] Malchow, H.; Schimansky-Geier, L. (1985). *Noise and Diffusion in Bistable Nonequilibrium Systems*, vol. 5 of *Teubner-Texte zur Physik*. Leipzig: Teubner.
- [323] Mandelbrot, B. B. (1983). *The Fractal Geometry of Nature*. New York: Freeman.
- [324] Mansilla, R. (1997). A new algorithmic approach to the minority game. *Complex Syst.* **11**, 387–401.
- [325] Margolus, N. (1984). Physics-like models of computation. *Physica D* **10**, 81–95.

- [326] Marimon, R.; McGrattan, E.; Sargent, T. J. (1990). Money as a medium of exchange in an economy with artificially intelligent agents. *J. Econ. Dynamics Control* **14**, 329–373.
- [327] Maschwitz, U.; Mühlberg, M. (1975). Zur Jagdstrategie einiger orientalischer *Leptogenys*-Arten (*Formicidae: Ponerinae*). *Oecologia* **38**, 65–83.
- [328] Matsuda, H.; Ogita, A.; A.Sasaki; Sato, K. (1992). Statistical mechanics of population: The lattice Lotka–Volterra model. *Prog. Theor. Phys.* **88**, 1035–1049.
- [329] Matsuda, H.; Tamachi, N.; Ogita, A.; A.Sasaki (1987). A lattice model for population biology. In: E. Teramoto; M. Yamaguti (eds.), *Mathematical Topics in Biology*, New York: Springer, vol. 71 of *Lecture Notes in Biomathematics*, pp. 154–161.
- [330] Matsushima, M.; Ikegami, T. (1998). Evolution of strategies in the three person iterated Prisoner’s Dilemma game. *J. Theor. Biol.* **195**, 53–67.
- [331] Matsushita, M.; Sano, M.; Hayakawa, Y.; Honjo, H.; Sawada, Y. (1984). Fractal structures of zinc metal leaves grown by electrodeposition. *Phys. Rev. Lett.* **53/3**, 286–289.
- [332] Mayne, A. J. (1954). Some further results in the theory of pedestrians and road traffic. *Biometrika* **41**, 375–389.
- [333] McBryan, O. A. (1994). An overview of message passing environments. *Parallel Computing* **20(4)**, 417–444.
- [334] McCoy, B.; Wu, T. (1978). *The Two-Dimensional Ising Model*. Cambridge, MA: Harvard University Press.
- [335] Metropolis, N.; Rosenbluth, A.; Rosenbluth, M.; Teller, A.; Teller, E. (1953). *J. Chem. Phys.* **21**, 1087.
- [336] Meyer, J. A.; Wilson, S. W. (eds.) (1991). *From Animals to Animats. Proc. 1st Int. Conf. Simulation of Adaptive Behav.* Cambridge, MA: MIT Press.
- [337] Mikhailov, A.; Zanette, D. H. (1999). Noise-induced breakdown of coherent collective motion in swarms. *Phys. Rev. E* **60**, 4571–4575.
- [338] Mikhailov, A. S. (1990). *Foundations of Synergetics*. vol. I: *Distributed Active Systems*. Berlin: Springer.
- [339] Mikhailov, A. S. (1993). Collective dynamics in models of communicating populations. In: H. Haken; A. S. Mikhailov (eds.), *Interdisciplinary Approaches to Nonlinear Complex Systems*, Berlin: Springer.
- [340] Mikhailov, A. S.; Meinköhn, D. (1997). Self-motion in physico-chemical systems far from thermal equilibrium. In: L. Schimansky-Geier; T. Pöschel (eds.), *Stochastic Dynamics*, Berlin: Springer, vol. 484 of *Lecture Notes in Physics*, pp. 334–345.
- [341] Millonas, M. M. (1992). A connectionist type model of self-organized foraging and emergent behavior in ant swarm. *J. Theor. Biol.* **159**, 529–552.
- [342] Millonas, M. M. (ed.) (1996). *Fluctuations and Order: The New Synthesis*. New York: Springer.
- [343] Millonas, M. M.; Dykman, M. I. (1994). Transport and current reversal in stochastically driven ratchets. *Phys. Lett. A* **185**, 65–69.
- [344] Mills, E. S.; Tan, J. P. (1980). A comparison of urban population density functions in developed and developing countries. *Urban Stud.* **17**, 313–321.
- [345] Minar, M.; Burkhardt, R.; Langton, C.; Askenazy, M. (1996). *The Swarm Simulation System: A Toolkit for Building Multi-Agent Simulations*. Santa Fe Institute.
- [346] Minsky, M.; Papert, S. (1973). *Artificial Intelligence*. Eugene: Oregon State System of Higher Education.
- [347] Minsky, M. L. (1986). *The Society of Mind*. New York: Simon & Schuster.

- [348] Misra, K. B. (1991). Multicriteria redundancy optimization using an efficient search procedure. *Int. J. Syst. Sci.* **22**, 2171–2183.
- [349] Moller, R.; Lambrinos, D.; Pfeifer, R.; Labhart, T.; Wehner, R. (1998). Modeling ant navigation with an autonomous agent. In: R. Pfeifer; B. Blumberg; J.-A. Meyer; S. Wilson (eds.), *From Animals To Animats*, Cambridge, MA: MIT Press, vol. 5, pp. 185–194.
- [350] Molnár, P. (1996). *Modellierung und Simulation der Dynamik von Fußgängerströmen*. Aachen: Shaker.
- [351] Molnar, P.; Starke, J. (2000). Communication fault tolerance in distributed robotic systems. In: L. E. Parker; G. Bekey; J. Barhen (eds.), *Distributed Autonomous Robotic Systems*, Berlin: Springer, vol. 4, pp. 99–108.
- [352] Molofsky, J.; Durrett, R.; Dushoff, J.; Griffeth, D.; Levin, S. (1999). Local frequency dependence and global coexistence. *Theor. Population Biol.* **55**, 270–282.
- [353] Moore, C. (1997). Majority-vote cellular automata, ising dynamics, and P-completeness. *J. Stat. Phys.* **88**, 795–805.
- [354] Mueller, U.; Troitzsch, K. (eds.) (1996). *Social Science Microsimulation: A Challenge for Computer Science*. Berlin: Springer.
- [355] Mühlenbein, H. (1989). Parallel genetic algorithm, population dynamics and combinatorial optimization. In: H. Schaffer (ed.), *Proc. 3rd Int. Conf. Genet. Algorithms*, San Francisco: Morgan Kaufmann, pp. 416–421.
- [356] Mühlenbein, H.; Schlierkamp-Voosen, D. (1994). The science of breeding and its application to the breeder genetic alogorithm. *Evol. Computation* **1**, 335–360.
- [357] Müller, J. P.; Wooldridge, M. J.; Jennings, N. R. (eds.) (1997). *Intelligent Agents III : Agent Theories, Architectures, and Languages*. Berlin: Springer.
- [358] Müller, M.; Wehner, R. (1988). Path integration in desert ants, *Cataglyphis fortis*. *Proc. Natl. Acad. Sci. USA* **85**, 5287–5290.
- [359] Müller, S.; Kai, S.; Ross, J. (1982). Curiosities in periodic precipitation patterns. *Science* **216**, 635–637.
- [360] Munz, M.; Weidlich, W. (1990). Settlement formation, II. Numerical simulation. *Ann. Reg. Sci.* **24**, 177–196.
- [361] Nagel, K.; Rasmussen, S.; Barrett, C. L. (1997). Network traffic as a self-organized critical phenomenon. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 579–592.
- [362] Nakamura, H. (1980). Ecological studies of the European pine sawfly, *Neodiprion sertifer* (Geoffroy) (Hymenoptera: Diprionidae), I. The effect of larval aggregation and its form. *Jpn. J. Appl. Entomol. Zool.* **24**, 137–144.
- [363] Navin, P. D.; Wheeler, R. J. (1969). Pedestrian flow characteristics. *Traffic Eng.* **39**, 31–36.
- [364] Nicolis, G.; Prigogine, I. (1977). *Self-Organization in Non-Equilibrium Systems: From Dissipative Structures to Order Through Fluctuations*. New York: Wiley.
- [365] Niedersen, U.; Schweitzer, F. (eds.) (1993). *Ästhetik und Selbstorganisation*, vol. 4 of *Selbstorganisation. Jahrbuch für Komplexität in den Natur- Sozial- und Geisteswissenschaften*. Berlin: Duncker & Humblot.
- [366] Niemeyer, L.; Pietronero, L.; Wiesmann, H. J. (1984). Fractal dimension of dielectric breakdown. *Phys. Rev. Lett.* **52**, 1033–1036.
- [367] Nolfi, S.; Floreano, D. (2000). *Evolutionary Robotics: The Biology, Intelligence, and Technology of Self-Organizing Machines*. Cambridge, MA: MIT Press.

- [368] Nossal, R. (1983). Stochastic aspects of biological locomotion. *J. Stat. Phys.* **30**, 391–399.
- [369] Nossal, R.; Weiss, G. H. (1974). A descriptive theory of cell migration on surfaces. *J. Theor. Biol.* **47**, 103–113.
- [370] Nowak, A.; Szamrej, J.; Latané, B. (1990). From private attitude to public opinion: A dynamic theory of social impact. *Psychol. Rev.* **97**, 362–376.
- [371] Nowak, M. A.; May, R. M. (1992). Evolutionary games and spatial chaos. *Nature* **359**, 826–829.
- [372] Nowak, M. A.; May, R. M. (1993). The spatial dilemmas of evolution. *Int. J. Bifurcation Chaos* **3**(1), 35–78.
- [373] Nulton, J. D.; Salamon, P. (1988). Statistical mechanics of combinatorial optimization. *Phys. Rev. A* **37**, 1351.
- [374] O'Connor, K.; Zusman, D. R. (1989). Patterns of cellular interactions during fruiting-body formation in *Myxococcus xanthus*. *J. Bacteriol.* **171**/**11**, 6013–6024.
- [375] Okubo, A. (1986). Dynamic aspects of animal grouping: Swarms, schools, flocks, and herds. *Adv. Biophys.* **22**, 1–94.
- [376] Osyczka, A.; Kundu, S. (1995). A new method to solve generalized multicriteria optimization problems using the simple genetic algorithm. *Structural Optimization* **10**, 94–99.
- [377] Othmer, H. G.; Dunbar, S. R.; Alt, W. (1988). Models of dispersal in biological systems. *J. Math. Biol.* **26**, 263–298.
- [378] Othmer, H. G.; Stevens, A. (1997). Aggregation, blowup and collapse: The ABC's of taxis in reinforced random walks. *SIAM J. Appl. Math.* **57**/**4**, 1044–1081.
- [379] Parisi, J.; Müller, S. C.; Zimmermann, W. (eds.) (1996). *Nonlinear Physics of Complex Systems – Current Status and Future Trends*. Berlin: Springer.
- [380] Parisi, J.; Müller, S. C.; Zimmermann, W. (eds.) (1998). *A Perspective Look at Nonlinear Media – From Physics to Biology and Social Sciences*. Berlin: Springer.
- [381] Parrish, J. K.; Hamner, W. (eds.) (1997). *Animal Groups in Three Dimensions*. Cambridge: Cambridge University Press.
- [382] Parunak, H. V. D. (1997). Go to the ant: Engineering principles from natural agent systems. *Ann. Operations Res.* **75**, 69–101.
- [383] Pasteels, J. M.; Deneubourg, J. L. (eds.) (1987). *From Individual To Collective Behavior in Social Insects*, vol. 54 of *Experientia Supplementum*. Basel: Birkhäuser.
- [384] Pasteels, J. M.; Gregoire, J. C.; Rowell-Rahier, M. (1983). The chemical ecology of defense in arthropods. *Annu. Rev. Entomol.* **28**, 263–289.
- [385] Patlak, C. S. (1953). Random walk with persistence and external bias. *Bull. Math. Biol.* **15**, 311–338.
- [386] Payne, T. L.; Birch, M. C.; Kennedy, C. E. (eds.) (1986). *Mechanisms in Insect Olfaction*. Oxford: Clarendon Press.
- [387] Perrin, J. B. (1908). *Comptes Rendus, Paris* **146**, 967.
- [388] Phipps, M. (1989). Dynamical behavior of cellular automata under the constraint of neighborhood coherence. *Geogr. Anal.* **21**/**3**, 197–215.
- [389] Pochy, R. D.; Kayser, D. R.; Aberle, L. K.; Lam, L. (1993). Boltzmann active walkers and rough surfaces. *Physica D* **66**, 166–171.
- [390] Portugali, J. (2000). *Self-Organization and the City*. Berlin: Springer.
- [391] Portugali, J.; Benenson, I. (1997). Human agents between local and global forces in a self-organizing city. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 537–546.

- [392] Pricer, J. L. (1908). The life history of the carpenter ant. *Biol. Bull. Mar. Biol. Lab. Woods Hole* **14**, 177–218.
- [393] Pumain, D. (1982). *La Dynamique des Villes*. Paris: Economica.
- [394] Pumain, D. (1993). Geography, physics and synergetics. In: G. Haag; U. Mueller; K. G. Troitzsch (eds.), *Economic Evolution and Demographic Change*, Berlin: Springer, vol. 395 of *Lecture Notes in Economics and Mathematical Systems*, pp. 157–175.
- [395] Pumain, D.; Haag, G. (1991). Urban and regional dynamics – Towards an integrated approach. *Environ. Planning A* **23**, 1301–1313.
- [396] Puu, T. (1993). Pattern formation in spatial economics. *Chaos, Solitons & Fractals* **3**, 99–129.
- [397] Racz, Z.; Plischke, M. (1985). Active zone of growing clusters: Diffusion-limited aggregation and the Eden model in two and three dimensions. *Phys. Rev. A* **31/2**, 985–994.
- [398] Rapp, B.; de Boisfleury-Chevance, A.; Gruler, H. (1988). Galvanotaxis of human granulocytes. Dose-response curve. *Eur. Biophys. J.* **16**, 313–319.
- [399] Rascle, M.; Ziti, C. (1995). Finite time blow-up in some models of chemotaxis. *J. Math. Biol.* **33**, 388–414.
- [400] Rateitschak, K.; Klages, R.; Hoover, W. G. (2000). The Nosé–Hoover thermostatted Lorentz gas. *J. Stat. Phys.* **101**, 61–77.
- [401] Rayleigh, J. W. S. (1877). *The Theory of Sound*. London: Macmillan. Second, revised and enlarged edition 1894–96, reprinted by Dover, 1976.
- [402] Rechenberg, I. (1994). *Evolutionsstrategie '94*. Stuttgart: Frommann-Holzboog.
- [403] Reichenbach, H. (1966). *Myxococcus spp. (Myxobacerales)*: Schwarmentwicklung und Bildung von Protocysten. *Publikationen zu wissenschaftlichen Filmen* **1A**, 557–578.
- [404] Reichenbach, H. (1974). *Chondromyces apiculatus (Myxobacerales)*: Schwarmentwicklung und Bildung von Protocysten. *Publikationen zu wissenschaftlichen Filmen. Sektion Biologie* **7/3**, 245–263.
- [405] Reichl, L. E. (1992). *The Transition to Chaos*. New York: Springer.
- [406] Reimann, P.; Bartussek, R.; Häußler, R.; Hänggi, P. (1996). *Phys. Lett. A* **215**, 26.
- [407] Reimann, P.; Grifoni, M.; Hänggi, P. (1997). Quantum ratchets. *Phys. Rev. Lett.* **79/1**, 10–13.
- [408] Rettenmeyer, C. W. (1963). Behavioral studies of army ants. *Univ. Kans. Sci. Bull.* **44**, 281–465.
- [409] Richter, G. (1999). *Flip-Tick Architecture: A design paradigm for cycle-oriented distributed systems*. GMD Report 84, GMD, Sankt Augustin.
- [410] Richter, G.; Schmitz, A.; Veit, H. (2000). Towards more design flexibility for architectures of autonomous robot control system. In: E. Pagliello; F. Groen; T. Arai; R. Dillmann; A. Stentz (eds.), *Intelligent Autonomous Systems 6*, IOS Press, vol. 6, pp. 777–784.
- [411] Riethmüller, T.; Rosenkranz, D.; Schimansky-Geier, L. (1996). Granular flow modelled by Brownian particles. In: D. E. Wolf; M. Schreckenberg; A. Bachem (eds.), *Traffic and Granular Flow*, Singapore: World Scientific, p. 293.
- [412] Risken, H. (1984). *The Fokker–Planck Equation*. Springer, Berlin.
- [413] Ritz, D. A. (1994). Social aggregation in pelagic invertebrates. *Adv. Mar. Biol.* **30**, 155–216.
- [414] Röpke, G. (1987). *Statistische Mechanik für das Nichtgleichgewicht*. Berlin: Deutscher Verlag der Wissenschaften.
- [415] Rosé, H.; Ebeling, W.; Asselmeyer, T. (1996). The density of states – A measure of the difficulty of optimization problems. In: H. M. Voigt; W. Ebeling;

- H. P. Schwefel; I. Rechenberg (eds.), *Parallel Problem Solving from Nature – PPSN IV*, Berlin: Springer, vol. 1141 of *Lecture Notes in Computer Science*, pp. 208–217.
- [416] Rosé, H.; Hempel, H.; Schimansky-Geier, L. (1994). Stochastic dynamics of catalytic CO oxidation on Pt(100). *Physica A* **206**, 421.
- [417] Rousselet, J.; Salome, L.; Adjari, A.; Prost, J. (1994). Directional motion of Brownian particles induced by a periodic asymmetric potential. *Nature* **370**, 446–448.
- [418] Rovinsky, A. B.; Menzinger, M. (1992). Chemical instability induced by a differential flow. *Phys. Rev. Lett.* **69**, 1193–1196.
- [419] Rustem, B.; Velupillai, K. (1990). Rationality, computability and complexity. *J. Econ. Dynamics Control* **14**, 419–432.
- [420] Sakoda, J. M. (1971). The checkerboard model of social interaction. *J. Math. Sociol.* **1**, 119–132.
- [421] Salamon, P.; Nulton, J.; Robinson, J.; Pedersen, J. M.; Ruppeiner, G.; Liao, L. (1988). Simulated annealing with constant thermodynamic speed. *Comput. Phys. Commun.* **49**, 423.
- [422] Sargent, T. J. (1993). *Bounded Rationality in Macroeconomics*. Oxford: Clarendon Press.
- [423] Schaaf, R. (1985). Stationary solutions of chemotaxis systems. *Trans. AMS* **292**, 531–556.
- [424] Schaur, E. (1991). *Non-Planned Settlements: Characteristic Features – Path Systems, Surface Subdivision*, vol. 39 of *IL*. Stuttgart: Universität Stuttgart.
- [425] Schelling, T. (1969). Models of segregation. *Am. Econ. Rev.* **59**, 488–493.
- [426] Schellnhuber, H. J. (1996). Towards an integrated model of the Earth system. *EGS Newslett.* **59**, 8.
- [427] Schienbein, M.; Gruler, H. (1993). Langevin equation, Fokker–Planck equation and cell migration. *Bull. Math. Biol.* **55**, 585–608.
- [428] Schimansky-Geier, L.; Kschischko, M.; Fricke, T. (1997). Flux of particles in sawtooth media. *Phys. Rev. Lett.* **79/18**, 3335–3338.
- [429] Schimansky-Geier, L.; Mieth, M.; Rosé, H.; Malchow, H. (1995). Structure formation by active Brownian particles. *Phys. Lett. A* **207**, 140–146.
- [430] Schimansky-Geier, L.; Pöschel, T. (eds.) (1997). *Stochastic Dynamics*, vol. 484 of *Lecture Notes in Physics*. Berlin: Springer.
- [431] Schimansky-Geier, L.; Schweitzer, F.; Mieth, M. (1997). Interactive structure formation with Brownian particles. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 101–118.
- [432] Schimansky-Geier, L.; Zülicke, C.; Schöll, E. (1991). Domain formation due to Ostwald ripening in bistable systems far from equilibrium. *Z. Physik B* **84**, 433–441.
- [433] Schimansky-Geier, L.; Zülicke, C.; Schöll, E. (1992). Growth of domains under global constraints. *Physica A* **188**, 436–442.
- [434] Schmelzer, J.; Schweitzer, F. (1987). Ostwald ripening of bubbles in liquid-gas solutions. *J. Non-Equilibrium Thermodynamics* **12**, 255–270.
- [435] Schnaars, S. P. (1994). *Managing Imitation Strategies: How Later Entrants Seize Markets from Pioneers*. New York: Free Press.
- [436] Schneirla, T. C. (1933). Studies of army ants in Panama. *J. Comp. Psychol.* **15**, 267–299.
- [437] Schneirla, T. C. (1940). Further studies on the army ant behavior pattern: Mass organization in the swarm-raiders. *J. Comp. Psychol.* **29**, 401–461.
- [438] Schreckenberg, M.; Sharma, S. D. (eds.) (2002). *Pedestrian and Evacuation Dynamics*. Berlin: Springer.

- [439] Schuster, H. G. (1984). *Deterministic Chaos – An Introduction*. Weinheim: Physik-Verlag.
- [440] Schwefel, H.-P. (1981). *Numerical Optimization of Computer Models*. New York: Wiley.
- [441] Schweitzer, F. (1992). Simulation of cluster growth in pores with diffusion interaction. *Surf. Sci.* **272**, 235–239.
- [442] Schweitzer, F. (1996). Selbstorganisation von Wege- und Transportsystemen. In: K. Teichmann; J. Wilke (eds.), *Prozeß und Form natürlicher Konstruktionen*, Berlin: Ernst & Sohn, pp. 163–169.
- [443] Schweitzer, F. (1996). Self-organization of trail networks using active Brownian particles. In: R. Hofestädt; T. Lengauer; M. Löffler; D. Schomburg (eds.), *Computer Science and Biology*, IMISE Report No. 1, Leipzig, pp. 299–301.
- [444] Schweitzer, F. (1997). Active Brownian particles: Artificial agents in physics. In: L. Schimansky-Geier; T. Pöschel (eds.), *Stochastic Dynamics*, Berlin: Springer, vol. 484 of *Lecture Notes in Physics*, pp. 358–371.
- [445] Schweitzer, F. (1997). Structural and functional information – an evolutionary approach to pragmatic information. *World Futures: J. Gen. Evol.* **50**, 533–550.
- [446] Schweitzer, F. (1997). Wege und Agenten: Reduktion und Konstruktion in der Selbstorganisationstheorie. In: H. J. Krug; L. Pohlmann (eds.), *Evolution und Irreversibilität*, Berlin: Duncker & Humblot, vol. 8 of *Selbstorganisation. Jahrbuch für Komplexität in den Natur- Sozial- und Geisteswissenschaften*, pp. 113–135.
- [447] Schweitzer, F. (1998). Modelling migration and economic agglomeration with active Brownian particles. *Adv. Complex Syst.* **1/1**, 11–37.
- [448] Schweitzer, F. (1998). Ökonomische Geographie: Räumliche Selbstorganisation in der Standortverteilung. In: F. Schweitzer; G. Silverberg (eds.), *Evolution und Selbstorganisation in der Ökonomie/Evolution and Self-Organization in Economics*, Berlin: Duncker & Humblot, vol. 9 of *Selbstorganisation. Jahrbuch für Komplexität in den Natur- Sozial- und Geisteswissenschaften*, pp. 97–125.
- [449] Schweitzer, F. (ed.) (2002). *Modeling Complexity in Economic and Social Systems*. Singapore: World Scientific.
- [450] Schweitzer, F.; Bartels, J.; Pohlmann, L. (1991). Simulation of opinion structures in social systems. In: W. Ebeling; M. Peschel; W. Weidlich (eds.), *Models of Self-Organization in Complex Systems: MOSES*, Berlin: Akademie-Verlag, pp. 236–243.
- [451] Schweitzer, F.; Ebeling, W.; Rosé, H.; Weiss, O. (1996). Network optimization using evolutionary strategies. In: H. M. Voigt; W. Ebeling; H. P. Schwefel; I. Rechenberg (eds.), *Parallel Problem Solving from Nature – PPSN IV*, Berlin: Springer, vol. 1141 of *Lecture Notes in Computer Science*, pp. 940–949.
- [452] Schweitzer, F.; Ebeling, W.; Rosé, H.; Weiss, O. (1998). Optimization of road networks using evolutionary strategies. *Evol. Computation* **5/4**, 419–438.
- [453] Schweitzer, F.; Ebeling, W.; Tilch, B. (1998). Complex motion of Brownian particles with energy depots. *Phys. Rev. Lett.* **80/23**, 5044–5047.
- [454] Schweitzer, F.; Ebeling, W.; Tilch, B. (2001). Statistical mechanics of canonical-dissipative systems and applications to swarm dynamics. *Phys. Rev. E* **64**, 021110-(1–12).
- [455] Schweitzer, F.; Hofstet, J. (2000). Modelling collective opinion formation by means of active Brownian particles. *Eur. Phys. J. B* **15(4)**, 723–732.
- [456] Schweitzer, F.; Lao, K.; Family, F. (1997). Active random walkers simulate trunk trail formation by ants. *BioSystems* **41**, 153–166.

- [457] Schweitzer, F.; Schimansky-Geier, L. (1994). Clustering of active walkers in a two-component system. *Physica A* **206**, 359–379.
- [458] Schweitzer, F.; Schimansky-Geier, L. (1996). Clustering of active walkers: Phase transitions from local interactions. In: M. Millonas (ed.), *Fluctuations and Order: The New Synthesis*, New York: Springer, pp. 293–305.
- [459] Schweitzer, F.; Schimansky-Geier, L.; Ebeling, W.; Ulbricht, H. (1988). A stochastic approach to nucleation in finite systems. Theory and computer simulations. *Physica A* **150**, 261–278.
- [460] Schweitzer, F.; Schimansky-Geier, L.; Ebeling, W.; Ulbricht, H. (1988). Stochastics of nucleation in isolated gases including carrier molecules. *Physica A* **153**, 573–591.
- [461] Schweitzer, F.; Silverberg, G. (eds.) (1998). *Evolution und Selbstorganisation in der Ökonomie/Evolution and Self-Organization in Economics*, vol. 9 of *Selbstorganisation. Jahrbuch für Komplexität in den Natur-, Sozial- und Geisteswissenschaften*. Berlin: Duncker & Humblot.
- [462] Schweitzer, F.; Steinbrink, J. (1994). Die Berliner Bebauungsstruktur. *ARCH+* **122**, 34.
- [463] Schweitzer, F.; Steinbrink, J. (1997). Urban cluster growth: Analysis and computer simulation of urban aggregations. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 501–518.
- [464] Schweitzer, F.; Steinbrink, J. (1998). Estimation of megacity growth: Simple rules versus complex phenomena. *Appl. Geogr.* **18/1**, 69–81.
- [465] Schweitzer, F.; Steinbrink, J. (2002). Analysis and computer simulation of urban cluster distributions. In: K. Humpert; K. Brenner; S. Becker (eds.), *Fundamental Principles of Urban Growth*, Wuppertal: Müller und Busmann, pp. 142–157.
- [466] Schweitzer, F.; Tilch, B. (1999). Modelling a dynamic switch by means of active Brownian particles. Preprint, to be submitted.
- [467] Schweitzer, F.; Tilch, B. (1999). Stochastic approach to network formation in an active walker model. Preprint, to be submitted.
- [468] Schweitzer, F.; Tilch, B. (2002). Self-assembling of networks in an agent-based model. *Phys. Rev. E* **66**, 026113-(1–9).
- [469] Schweitzer, F.; Tilch, B.; Ebeling, W. (2000). Uphill motion of active Brownian particles in piecewise linear potentials. *Eur. Phys. J. B* **14(1)**, 157–168.
- [470] Schweitzer, F.; Zimmermann, J. (2001). Communication and self-organization in complex systems: A basic approach. In: M. M. Fischer; J. Fröhlich (eds.), *Knowledge, Complexity and Innovation Systems, Advances in Spatial Sciences*, Berlin: Springer, chap. 14, pp. 275–296.
- [471] Schweitzer, F.; Zimmermann, J.; Mühlenbein, H. (2002). Coordination of decisions in a spatial agent model. *Physica A* **303(1-2)**, 189–216.
- [472] Segel, L. A. (1977). A theoretical study of receptor mechanisms in bacterial chemotaxis. *SIAM J. Appl. Math.* **32/3**, 653–665.
- [473] Shapiro, A.; Horn, F. J. M. (1979). On the possibility of sustained oscillations, multiple steady states, and asymmetric steady states in multicell reaction systems. *Math. Biosci.* **44**, 19–39.
- [474] Sibani, P.; Pedersen, K. M.; Hoffmann, K. H.; Salamon, P. (1990). Monte Carlo dynamics of optimization: A scaling description. *Phys. Rev. A* **42**, 7080.
- [475] Silverberg, G.; Verspagen, B. (1994). Collective learning, innovation and growth in a boundedly rational, evolutionary world. *J. Evol. Econ.* **4**, 207–226.

- [476] Simon, H. (1992). *Economics, Bounded Rationality and the Cognitive Revolution*. Brookfield, VT: Edward Elgar.
- [477] Sinai, Y. G. (1970). Dynamical systems with elastic reflections. *Russ. Math. Surv.* **25**, 137.
- [478] Skellam, J. G. (1973). The formulation and interpretation of mathematical models of diffusional processes in population biology. In: M. S. Bartlett; R. W. Hiorns (eds.), *The Mathematical Theory of the Dynamics of Biological Populations*, New York: Academic Press, pp. 63–85.
- [479] Slanina, F. (2000). Social organization in the minority game model. *Physica A* **286(1–2)**, 367–376.
- [480] Starke, J.; Schanz, M.; Haken, H. (1998). Self-organized behaviour of distributed autonomous mobile robotic systems by pattern formation principles. In: R. Dillmann; T. Lüth; P. Dario; H. Wörn (eds.), *Distributed Autonomous Robotic Systems*, Berlin: Springer, vol. 3, pp. 89–100.
- [481] Stauffer, D.; Stanley, H. E. (1990). *From Newton to Mandelbrot. A Primer in Theoretical Physics*. Berlin: Springer.
- [482] Steels, L. (ed.) (1995). *The Biology and Technology of Intelligent Autonomous Agents*. Berlin: Springer.
- [483] Steiglitz, K.; Weiner, P.; Kleitman, D. J. (1969). The design of minimum-cost survivable networks. *IEEE Trans. Circuit Theory* **CT-16/4**, 455–460.
- [484] Steinbock, O. (1998). Path optimization in chemical and biological systems on the basis of excitation waves. In: J. Parisi; S. C. Müller; W. Zimmermann (eds.), *A Perspective Look at Nonlinear Media – From Physics to Biology and Social Sciences*, Berlin: Springer, pp. 179–191.
- [485] Steuer, R. E. (1989). *Multiple Criteria Optimization: Theory, Computation, and Application*. Malabar, FL: Krieger.
- [486] Steuernagel, O.; Ebeling, W.; Calenbuhr, V. (1994). An elementary model for directed active motion. *Chaos, Solitons & Fractals* **4**, 1917–1930.
- [487] Stevens, A. (1990). Simulations of the aggregation and gliding behavior of Myxobacteria. In: W. Alt; G. Hoffmann (eds.), *Biological Motion*, Berlin: Springer, vol. 89 of *Lecture Notes in Biomathematics*, pp. 548–555.
- [488] Stevens, A. (1991). A model for gliding and aggregation of Myxobacteria. In: A. Holden; M. Markus; H. G. Othmer (eds.), *Nonlinear Wave Processes in Excitable Media*, New York: Plenum Press, pp. 269–276.
- [489] Stevens, A. (1993). Aggregation of Myxobacteria – a many particle system. In: *Proc. First Eur. Conf. Math. Appl. Biol. Med.*, Winnipeg: Wuerz, pp. 519–524.
- [490] Stevens, A. (1995). Trail following and aggregation of Myxobacteria. *J. Biol. Syst.* **3**, 1059–1068.
- [491] Stevens, A. (1996). Simulation of chemotaxis-equations in two space dimensions. In: J. Parisi; S. C. Müller; W. Zimmermann (eds.), *Nonlinear Physics of Complex Systems – Current Status and Future Trends*, Berlin: Springer.
- [492] Stevens, A.; Schweitzer, F. (1997). Aggregation induced by diffusing and nondiffusing media. In: W. Alt; A. Deutsch; G. Dunn (eds.), *Dynamics of Cell and Tissue Motion*, Basel: Birkhäuser, pp. 183–192.
- [493] Stratonovich, R. L. (1967). *Topics in the Theory of Random Noise*. New York: Gordon and Breach, Vol. 2.
- [494] Sudd, J. H.; Franks, N. R. (1987). *The Behavioural Ecology of Ants*. Glasgow: Blackie.
- [495] Suleiman, R.; Troitzsch, K. G.; Gilbert, N. (eds.) (2000). *Tools and Techniques for Social Science Simulation*. Heidelberg: Physica Verlag.
- [496] Sunderam, V. (1990). PVM. A framework for parallel distributed computing. *Concurrency Pract. Exper.* **3(4)**, 315–339.

- [497] Sunderam, V. (1994). The PVM concurrent computing system: Evolution, experiences and trends. *Parallel Computing* **20**(4), 531–545.
- [498] Szabó, G.; Antal, T.; Szabó, P.; Droz, M. (2000). Spatial evolutionary prisoner's dilemma game with three strategies and external constraints. *Phys. Rev. E* **62**, 1095–1115.
- [499] Szabó, G.; Csaba, T. (1998). Evolutionary prisoner's dilemma game on a square lattice. *Phys. Rev. E* **58**(1), 69–73.
- [500] Takayasu, H.; Inaoka, H. (1992). New type of self-organized criticality in a model of erosion. *Phys. Rev. Lett.* **68**/7, 966–969.
- [501] Takayasu, H.; Inaoka, H. (1992). A simulation of pattern formation by erosion. In: S. Kai (ed.), *Pattern Formation in Complex Dissipative Systems*, Singapore: World Scientific, pp. 103–107.
- [502] Teichmann, K.; Wilke, J. (eds.) (1996). *Prozeß und Form "Natürlicher Konstruktionen"*. Der Sonderforschungsbereich 230. Berlin: Ernst & Sohn.
- [503] Terna, P. (1998). Simulation tools for social scientists: Building agent based models with SWARM. *J. Artif. Soc. Soc. Simulation* **1**(2), <http://www.soc.surrey.ac.uk/JASSS/1/2/4.html>.
- [504] v. Thünen, J. H. (1826). *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*. Rostock.
- [505] Tilch, B. (1996). *Strukturbildung mit Aktiven Brownschen Teilchen*. Master's Thesis, Humboldt University, Berlin.
- [506] Tilch, B.; Schweitzer, F.; Ebeling, W. (1999). Directed motion of Brownian particles with internal energy depot. *Physica A* **273**(3–4), 294–314.
- [507] Tobler, W. (1979). Cellular geography. In: S. Gale; G. Olsson (eds.), *Philosophy in Geography*, Dordrecht: Kluwer, pp. 379–386.
- [508] Toffoli, T.; Margolus, N. (1987). *Cellular Automata Machines – A New Environment for Modeling*. Cambridge, MA: MIT Press.
- [509] Tranquillo, R. T.; Alt, W. (1990). Glossary of terms concerning oriented movement. In: W. Alt; G. Hoffmann (eds.), *Biological Motion*, Berlin: Springer, vol. 89 of *Lecture Notes in Biomathematics*, pp. 510–517.
- [510] Tranquillo, R. T.; Alt, W. (1994). Dynamic morphology of leukocytes: Statistical analysis and a stochastic model for receptor-mediated cell motion and orientation. In: N. Akcas (ed.), *Biomechanics of Active Motion and Division of Cells*, New York: Springer, pp. 437–443.
- [511] Tranquillo, R. T.; Lauffenburger, D. (1987). Stochastic models of leukocyte chemosensory movement. *J. Math. Biol.* **25**, 229–262.
- [512] Tranquillo, R. T.; Zigmond, S. H.; Lauffenburger, D. A. (1988). Measurement of the chemotaxis coefficient for human neutrophils in the under agarose migration assay. *Cell Mot. Cytoskeleton* **11**/1, 1–15.
- [513] Troitzsch, K. G.; Mueller, U.; Gilbert, G. N.; Doran, J. E. (eds.) (1996). *Social Science Microsimulation*. Berlin: Springer.
- [514] Tsubaki, Y. (1981). Some beneficial effects of aggregation in young larvae of *Pryeria sinica* Moore (Lepidoptera: Zygaenidae). *Res. Population Ecol.* **23**, 156–167.
- [515] Tsubaki, Y.; Shiotsu, Y. (1982). Group feeding as a strategy for exploiting food sources in the Burnet moth *Pryeria sinica*. *Oecologia (Berlin)* **55**, 12–20.
- [516] Ulbricht, H.; Schmelzer, J.; Mahnke, R.; Schweitzer, F. (1988). *Thermodynamics of Finite Systems and the Kinetics of First-Order Phase Transitions*. Leipzig: Teubner.
- [517] Urban, C. (ed.) (2000). *Agent-Based Simulations. Workshop 2000*. Ghent: SCS European Publishing House.
- [518] Vallacher, R.; Nowak, A. (eds.) (1994). *Dynamical Systems in Social Psychology*. New York: Academic Press.

- [519] Varela, F.; Bourgine, P. (1992). *Toward a Practice of Autonomous Systems*. *Proc. 1st Eur. Conf. Artif. Life*. Cambridge, MA: MIT Press.
- [520] Veit, H.; Richter, G. (2000). The FTA design paradigm for distributed systems. *Future Generation Comput. Syst.* **16**(6), 727–740.
- [521] Venzl, G.; Ross, J. (1982). Nucleation and colloidal growth in concentration gradients (Liesegang rings). *J. Chem. Phys.* **77**/3, 1302–1307.
- [522] Vichniac, G. Y. (1984). Simulating physics with cellular automata. *Physica D* **10**, 96–116.
- [523] Vicsek, T. (1989). *Fractal Growth Phenomena*. Singapore: World Scientific.
- [524] Vicsek, T.; Shlesinger, M.; Matsushita, M. (eds.) (1994). *Fractals in Natural Sciences*. Singapore: World Scientific.
- [525] Wagner, G. P. (1995). Adaptation and the modular design of organisms. In: F. Moran; A. Moreno; J. Merelo; P. Chacon (eds.), *Advances in Artificial Life: Proc. 3rd Eur. Conf. Artif. Life*, Berlin: Springer, vol. 929 of *Lecture Notes in Artificial Intelligence*, pp. 317–328.
- [526] Wagner, H.; Baake, E.; Gerisch, T. (1998). Ising quantum chain and sequence evolution. *J. Stat. Phys.* **92**, 1017–1052.
- [527] Weber, A. (1909). *Über den Standort der Industrien, 1. Teil: Reine Theorie des Standortes*. Tübingen.
- [528] Wehner, R. (1987). Spatial organization of foraging behavior in individually searching desert ants, *Cataglyphis* (Sahara Desert) and *Ocymyrmex* (Namib Desert). In: J. M. Pasteels; J. L. Deneubourg (eds.), *From Individual to Collective Behavior*, Basel: Birkhäuser, pp. 15–42.
- [529] Wehner, R. (1992). Arthropods. In: F. Papi (ed.), *Animal Homing*, London: Chapman and Hall, pp. 45–144.
- [530] Wehner, R.; Menzel, R. (1990). Do insects have cognitive maps? *Annu. Rev. Neurosci.* **13**, 403–414.
- [531] Wehner, R.; Räber, R. (1979). Visual spatial memory in desert ants, *Cataglyphis bicolor* (Hymenoptera, Formicidae). *Experientia* **35**, 1569–1571.
- [532] Wehner, R.; Wehner, S. (1990). Path integration in desert ants. Approaching a long-standing puzzle in insect navigation. *Monitore Zool. Ital. (NS)* **20**, 309–331.
- [533] Wei-Bin, Z. (1991). *Synergetic Economics – Time and Change in Nonlinear Economics*. Berlin: Springer.
- [534] Weidlich, W. (1971). The statistical description of polarization phenomena in society. *Brit. J. Math. Stat. Psychol.* **24**, 51.
- [535] Weidlich, W. (1972). The use of statistical models in sociology. *Collective Phenomena* **1**, 51–59.
- [536] Weidlich, W. (1991). Physics and social science – The approach of synergetics. *Phys. Rep.* **204**, 1–163.
- [537] Weidlich, W. (1994). Settlement formation at the meso-scale. *Chaos, Solitons & Fractals* **4**, 507–518.
- [538] Weidlich, W. (1994). Synergetic modelling concepts for sociodynamics with application to collective political opinion formation. *J. Math. Sociol.* **18**, 267–291.
- [539] Weidlich, W. (1997). From fast to slow processes in the evolution of urban and regional settlement structures. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 475–488.
- [540] Weidlich, W. (1997). Sociodynamics applied to the evolution of urban and regional structures. *Discrete Dynamics Nature Soc.* **1**/2, 85–98.
- [541] Weidlich, W. (2000). *Sociodynamics. A Systematic Approach to Mathematical Modelling in the Social Sciences*. London: Harwood Academic Publishers.

- [542] Weidlich, W.; Braun, M. (1992). The master equation approach to non-linear economics. *J. Evol. Econ.* **2**, 233–265.
- [543] Weidlich, W.; Haag, G. (1983). *Concepts and Methods of a Quantitative Sociology: The Dynamics of Interacting Populations*. Berlin: Springer.
- [544] Weidlich, W.; Haag, G. (1987). A dynamic phase transition model for spatial agglomeration processes. *J. Reg. Sci.* **27/4**, 529–569.
- [545] Weidlich, W.; Haag, G. (eds.) (1988). *Interregional Migration – Dynamic Theory and Comparative Analysis*. Berlin: Springer.
- [546] Weidlich, W.; Munz, M. (1990). Settlement formation, I. A dynamic theory. *Ann. Reg. Sci.* **24**, 83–106.
- [547] Weiss, G. (ed.) (1999). *Multiagent Systems. A Modern Approach to Distributed Artificial Intelligence*. Cambridge, MA: MIT Press.
- [548] Wenzel, J. W. (1991). Evolution of nest architecture. In: K. G. Ross; R. W. Matthews (eds.), *Social Biology of Wasps*, Ithaca, NY: Cornell University Press, pp. 480–521.
- [549] White, D. J. (1982). The set of efficient solutions for multiple objective shortest path problems. *Comput. Operations Res.* **9/2**, 101–107.
- [550] White, R. (1977). Dynamic central place theory: Results of a simulation approach. *Geogr. Anal.* **9**, 227–243.
- [551] White, R. (1978). The simulation of central place dynamics: Two-sector systems and the rank-size distribution. *Geogr. Anal.* **10**, 201–208.
- [552] White, R.; Engelen, G. (1993). Cellular automata and fractal urban form: A cellular modelling approach to the evolution of urban land-use patterns. *Environ. Planning A* **25**, 1175–1199.
- [553] White, R.; Engelen, G. (1993). Cellular dynamics and GIS: Modelling spatial complexity. *Geogr. Syst.* **1**, 237–253.
- [554] White, R.; Engelen, G. (1994). Urban system dynamics and cellular automata: Fractal structures between order and chaos. *Chaos, Solitons & Fractals* **4/4**, 563–583.
- [555] White, R.; Engelen, G. (1997). Cellular automata as the basis of integrated dynamic regional modelling. *Environ. Planning B* **24/2**, 235.
- [556] White, R.; Engelen, G. (1997). Multi-scale spatial modelling of self-organizing urban systems. In: F. Schweitzer (ed.), *Self-Organization of Complex Structures: From Individual to Collective Dynamics*, London: Gordon and Breach, pp. 519–535.
- [557] Wilkinson, P. C. (1982). *Chemotaxis and Inflammation*. London: Churchill.
- [558] Willebrand, H.; Niedernostheide, F. J.; Ammelt, E.; Dohmen, R.; Purwins, H. G. (1991). Spatio-temporal oscillations during filament splitting in gas discharge systems. *Phys. Lett. A* **152**, 437–445.
- [559] Williams, H. C. W. L.; Wilson, A. G. (1980). Some comments on the theoretical and analytical structure of urban and regional models. *Sistemi Urbani* **2/3**, 203.
- [560] Wilson, A. G. (1978). Spatial interaction and settlement structure: toward an explicit central place theory. In: A. Karqvist; L. Lundqvist; F. Snickars; J. Weibull (eds.), *Spatial Interaction, Theory and Planning Models*, Amsterdam: North Holland, pp. 137–156.
- [561] Wilson, E. O. (1971). *The Insect Societies*. Cambridge, MA: Belknap.
- [562] Winter, P. (1987). Steiner problems in networks: A survey. *Networks* **17**, 129–167.
- [563] Wolfram, S. (1983). Statistical mechanics of cellular automata. *Rev. Mod. Phys.* **55(3)**, 601–644.
- [564] Wolfram, S. (1986). *Theory and Application of Cellular Automata*. Singapore: World Scientific.

- [565] Wooldridge, M.; Jennings, N. R. (1995). Intelligent agents: Theory and practice. *Knowledge Eng. Rev.* **10**(2), 115–152.
- [566] Yi-Der, C. (1997). Asymmetric cycling and biased movement of Brownian particles in fluctuating symmetric potentials. *Phys. Rev. Lett.* **79**/17, 3117–3120.
- [567] Yakhnin, V. Z.; Rovinsky, A. B.; Menzinger, M. (1994). Differential-flow-induced pattern formation in the exothermic A→B reaction. *J. Phys. Chem.* **98**, 2116–2119.
- [568] Yu, P. L. (1985). *Multiple-Criteria Decision Making*. New York: Plenum Press.
- [569] Zhou, H.; Chen, Y. (1996). Chemically driven motility of Brownian particles. *Phys. Rev. Lett.* **77**/1, 194–197.
- [570] Zigmond, S. H. (1977). Ability of polymorphonuclear leukocytes to orient in gradients of chemotactic factors. *J. Cell Biol.* **75**, 606–616.
- [571] Zipf, G. K. (1949). *Human Behavior and the Principle of Least Effort*. Reading, MA: Addison-Wesley.
- [572] Zürcher, U.; Doering, C. R. (1993). Thermally activated escape over fluctuating barriers. *Phys. Rev. E* **47**, 3862–3869.

Index

- acceleration 53
- activator 169, 172
- active particles 22, 51
- active walker 203
 - Boltzmann 206
 - probabilistic 207
- adaptation 9, 15, 253
- adaptive landscape 135, 136
- adaptivity 175
- adiabatic
- approximation 45, 65, 102, 105
- switching 102
- adsorption 165
- agent
 - activities 8
 - bounded rational 10
 - Brownian 12, 22, 23
 - complex 10
 - ecology 15
 - heterogeneous 14
 - internal structure 8
 - particle 22, 51, 133
 - rational 10
 - reactive 7, 12, 22, 133
 - reflexive 7, 22
 - representative 14
 - systems 6
- agent-based approach 19
- agglomeration
 - decentralized 326, 332
 - delocalized 259
 - economic 335
- aggregation 38, 146, 211, 225, 229, 231, 232, 320
 - biological 163
 - delocalized 38
 - urban 295
- algorithm 140, 141
 - evolutionary 269
 - Metropolis 271
 - particle-based 173
- amoeba
 - *Dictyostelium* 210
- amplitude-phase representation 99, 110
- angular momentum 129, 130
- ant 161, 214, 232
 - aggregation 162
 - group-raiding 233
- architecture
 - blackboard 20
 - flip-tick 21
- area-perimeter relation 306
- artificial intelligence 6, 7
- artificial life 13, 17
- artificial societies 15
- asymmetry
 - critical 85
 - parameter 86
- attraction 326
 - area 335
 - field 327, 330, 331
 - local 354
- attractiveness 258, 259, 266, 297
- attractor 87, 107, 111
- autonomy 8
- Avogadro number 41, 42
- avoidance maneuvers 248, 250, 265
- bacteria 16, 208, 209, 217
- bifurcation 5, 68, 71, 72, 369
- blackboard 30, 31
- branching 207, 242
- broadcast 21
- Brownian
 - machines 95
 - motion 39, 42
 - nonequilibrium motion 98
 - reactive agents 135
 - rectifiers 94
- burst of energy 112

- canonical-dissipative system 55, 115, 123
- causality 22
- cellular automata 17, 299
- central-place theory 297, 335, 354
- chemical
 - communication 239
 - signposts 237
- chemokinesis 239
- chemotactic
- coefficient 227
- response 238
- chemotaxis 15, 161
- circular causation 2, 137, 145, 178, 326, 339, 365
- clusters 146
- co-evolution 3, 138
- coagulation 312, 317
- coevolution 15
- coexistence 243, 353, 354
 - of different opinions 379
- colonization 382
- combinatoric explosion 11
- communication 21, 137
 - chemical 15, 160, 210
 - indirect 15, 28, 31, 159
 - point-to-point 21
- communication field 28, 29, 32, 363, 364
- competition 153, 159, 341, 342, 354
- complex systems 1
- compromise 258, 261, 280, 282, 290
- computer simulations 4
 - particle-based 5
- connections 179
- connectivity 190–192
 - global 187
 - local 187
- control parameters 3, 23, 26
- convergence velocity 274, 275
- correlation 92, 321
- coupling
 - global 137
- critical
 - distance 194, 354
 - temperature 167, 182, 186
- cross-flow reactor 171
- current reversal 86, 93
- DBM 318, 319
- decentralization 9
- dendritic
 - growth 318
- patterns 208
- density of states 291
- depletion zones 328, 330, 332
- desorption 165
- detour 260, 261
- Dictyostelium 217
- dielectric breakdown 207
- diffusion approximation 45
- diffusion coefficient 40
 - angular 99
 - critical 149, 373
 - effective 151, 153, 154, 159, 340
 - spatial 99
- disaggregation 295
- discretization 141
- dispersion relation 149, 166, 185, 373
- dissipation
 - function 116
 - internal 52
- dissipative force 24, 43
- distribution
 - angular momenta 125
 - one-peak 87
- drift term 96
- driven rotations 108
- dynamics
 - activator–inhibitor 169
- economic
 - centers 352
 - concentration 336
 - geography 335
 - efficiency 69, 70
 - eigenvalue 268, 274
 - electrochemical deposition 208
 - emergence 1, 31, 244, 245, 261
 - employment 339, 341, 349, 353, 354
 - energy
 - consumption 51
 - conversion 51
 - influx 114
 - internal 209
 - storage 51
 - supply 108
 - energy depot 22, 25, 51, 52
 - oscillations 112
 - energy sources
 - localized 111
 - separated 113
 - ensemble
 - microcanonical 98
 - enslaving principle 222
 - equipartition law 42, 44
 - excitable systems 169

- field
 - chemical 177, 180, 217
 - communication 372
 - effective 178
 - temperature 172
- fitness 157, 268, 272, 273, 341, 342
- global 157
- local 157
- fluctuation-dissipation theorem 43
- Fokker–Planck equation 47, 48, 96, 99, 117
- foraging 233
 - behavior 234
- forces
 - spatially uniform 93
- fractal
 - dimension 298, 304, 305
 - growth 206, 208, 319
 - morphology 298
 - structures 318
- friction
 - function 99
 - negative 54, 55
 - Rayleigh-type 100
 - space-dependent 60, 64
 - velocity-dependent 54–56, 64
- Frobenius–Perron equation 212
- frustrated problems 269
- functionality 9
- game
 - minority 10
 - theory 10, 26
- Gaussian white noise 43
- granulocytes 57, 217
- group feeding 161
- growth
 - central 324
 - direct 324
 - indirect 324
 - units 326–328, 330, 332
 - urban 295
 - zones 322, 323, 332
- Hamiltonian 116, 117
 - chaos 108
- heatbug 164
- hierarchy 3
- homing 233
 - strategies 232
- information 11, 29, 364
 - compression 2
 - exchange 248
- functional 30, 31
- global 270
- local 270, 338
- microscopic 5
- pragmatic 31
- storage 245
- structural 30, 31
- inhibition 169
 - local 324
- insect societies 15
- interaction
 - asymmetrical 14
 - collective 2
 - direct 8
 - evolution 14
 - global 7
 - hierarchical 28
 - indirect 8, 137
 - local 7
 - nonlinear 23
 - parallel 21
- knowledge 10
- land consumption 295
- landscape
 - adaptive 27, 28
 - optimization 289, 291
 - potential 27, 273
- lanes 250
- Langevin equation 43
- laser equation 96
- lifetime
 - mean 143
 - real 143
- limit cycle 61, 64, 76, 102, 106, 107, 124, 130
 - deterministic 103
 - stochastic 110
- link system
 - direct 280, 282
 - minimal 280, 282
- Ljapunov exponent 109
- localization 221
- majority 368–370
- master equation 46, 204, 278, 311, 359, 360, 362, 378
 - multivariate 138
- Maxwellian velocity distribution 49
- mean squared displacement 39, 40, 44, 57, 99, 122
 - granulocytes 58

- memory 9, 366
 - external 30, 138
- mesoscopy 13
- metastable 374
- micro-macro link 1
- micromotor 69
- migration 57, 336, 338, 339, 341, 349, 358, 362, 366, 374, 377
- minority 368–370
- mobility 8
- modes of activity 134
- modularity 8
- molecular dynamics 17
- molecular motors 69, 95
- morphological transition 298
- motion
 - active 51
 - active mode 67, 68, 71, 72, 74, 97
 - bounded 151, 153
 - chaotic 108
 - correlated 115
 - delocalized 77
 - directed 92
 - high velocity 71
 - nondirected 92
 - passive mode 56, 67, 68, 71, 97, 104
 - stable uphill 75
 - strongly overdamped 78
 - subcritical 104
 - undirected 57
 - weakly damped 78
- movement
 - directed 133
 - oriented 133
 - oscillating 111
- multiagent
 - features 8
 - systems 6
- multifractality 304
- multiple steady states 379, 382
- mutation 272, 275, 278
- myxobacteria 160, 223, 225, 226
- navigation
 - egocentric 232
 - geocentric 232
 - visual 233, 244
- net current 82, 83, 85, 86, 89
 - directed 92
 - maximum 90
- network
 - balanced 287
 - connectivity 182, 186
- frustrated 293
- neuronal 175
- optimized 290
- road 279
- self-assembling 180
- nonequilibrium 92
- nonlinear feedback 28
- nucleation 152
- obstacles 108, 113
- opinion
 - changes 375, 380
 - formation 358, 363
 - spatial separation 371
- optimization
 - biological strategies 269
 - dynamics 268
 - effort 292
 - evolutionary 267
 - frustrated 281
 - global 277
 - landscape 267
 - local 277
 - multicriteria 277
 - multiobjective 269
 - thermodynamic strategies 269
- order parameter 2, 365
- organization
 - hierarchical 304, 318
- orientation 119
- orientation relation 253, 254, 256, 257
- Ostwald ripening 146
- Pareto distribution 308, 311
- patterns
 - physicochemical 164
- pedestrian 247
 - crowds 249
- perception 254
 - angle 219–221, 226, 254
- percolation 321
- persistence 58, 212–214, 228, 231, 232, 255
 - index 216
 - time 215
- persuasion 375, 377, 380
- phase
 - separation 152
 - transition 5, 299
- phase-space trajectories 76, 77
- pheromone 233, 237, 253
- population
 - critical size 369
 - distribution 295, 296

- initial density 228
- potential
 - asymmetrical 76, 92
 - destination 256
 - dissipative 116, 126, 129
 - ground 252, 256
 - parabolic 101, 109, 129
 - ratchet 88, 92
 - scalar field 135
 - time-dependent 206
 - trail 254, 258
- precipitation 168, 383, 384
- proactivity 8
- production function 345–347
- production rate 177
- quasi-stationary
 - structure 221, 245
- radius of gyration 300, 302
- random walk
 - biased 212, 214, 215, 220, 236
 - reinforced 217, 226, 227
- rank-size distribution 296, 307, 312
- cluster 313
- ratchet 86, 92
 - asymmetry 91
 - correlation 93
 - diffusion 93, 94
 - flashing 92, 94
 - fluctuating 92
 - forced thermal 92
 - rocking 93
 - stochastic 92
- ratchet potential 75
- reaction
 - chemical 165
 - multicell systems 379
- reaction-diffusion equations 139
- reactivity 8
- recruitment 235, 236, 238, 239, 245
- reductions 5, 13
- redundancy 9
- relaxation time 274
- replication 169, 273, 342
- reproduction 267, 272, 276
 - self- 272
- rotation 110, 129, 130
- Schrödinger equation 268, 274
- scout 235, 237
- screening effect 180, 192
- segregation 18
- selection 278
- difference 276, 279
- equation 156, 159, 341
- pressure 157, 225, 243
- process 259
- tournament 276, 279
- self-assembly 175
- self-driven motion 51, 56
- self-organization 2, 3, 11, 13
- self-repair 175
- sensitivity 236, 239, 242, 245, 255, 270
- separatrix 78, 107, 110, 368
- settlement 295
 - effective radius 306
- simulated annealing 270, 272
- simulation
 - approaches 17
 - particle-based techniques 4
 - stochastic 141, 142
- social
 - force 247, 248
 - impact 358, 360, 361
 - temperature 360, 364, 373, 374
- socioconfiguration 357, 359
- sociodynamics 358
- spatial dispersion 120, 124
- spikes 167
- spinodal decomposition 375
- spirals 169, 170
- spots
 - traveling 170
- stability
 - analysis 146
 - stigmergy 16
- stochastic force 43
 - critical strength 89, 91
 - optimal strength 90, 91
- strategy
 - Boltzmann 272, 288
 - Darwinian 272, 275, 288
 - Fisher–Eigen 276
 - Haeckel 275
 - Lotka–Volterra 275
 - mixed 275, 276, 288
 - thermodynamic 272
 - tournament 276
- structure
 - dendritic 242
 - Turing 173
- subpopulation 262, 273, 336, 359, 367
 - critical size 370
- supersaturation 152
 - local 153
- swarm 16, 19, 115

- free 117
- harmonic 119, 120
- swarm intelligence 16
- swarming 231, 232
- switch 193
 - delay 198, 201
- symbolic reactions 25
- symmetry
 - breaks 180, 222, 250
- Synergetics 2
- taxis 133
- temperature
 - optimal 190
- threshold 186, 189, 196
- time
 - lag 105, 244
 - relaxation 247
- tracks 221, 222
- trail
 - human 247, 252, 255
 - system 245
- trajectory
- phase-space 103
- transport 92
- trunk trail 232, 235, 240, 242
- turning rate 216
- urban evolution 300, 329
- urbanization 295
- Van-der-Pol oscillator 63
- velocity distribution 59, 118
 - crater-like 97
 - Maxwellian 95–97
 - non-Maxwellian 100
 - unimodal 88, 97
- walker
 - communicating 209
 - orientation 212
- waves 170, 171
- way system
 - direct 261
 - minimal 260, 261