

Bibliography

- Albano, E. V. (1996), ‘Self-organized collective displacements of self-driven individuals’, *Physical Review Letters* **77**(10), 2129–2132.
- Alt, W. (1995), ‘Elements of a systematic search in animal behaviour and model simulations’, *Bio Systems* **34**, 11–26.
- Anderson, C. (2002), ‘Self-organization in relation to several similar concepts: Are the boundaries to self-organization indistinct?’, *Biological Bulletin* **202**, 247–255.
- Anderson, T. W. (1958), *An Introduction to Multivariate Statistical Analysis*, John Wiley & Sons.
- Aoki, I. (1982), ‘A simulation study on the schooling mechanism in fish’, *Bulletin of the Japanese Society of Scientific Fisheries* **48**, 1081–1088.
- Arkin, R. C. (1998), *Behaviour-Based Robotics*, The MIT Press.
- Balescu, R. (1975), *Equilibrium and Non-equilibrium Statistical Mechanics*, Wiley-Interscience.
- Batschelet, E. (1981), *Circular Statistics in Biology*, Mathematics In Biology, Academic Press.
- Beecham, J. A. & Farnsworth, K. D. (1999), ‘Animal group forces resulting from predator avoidance and competition minimization’, *Journal of Theoretical Biology* **198**, 533–548.
- Beekman, M., Fathke, R. L. & Seeley, T. D. (2006), ‘How does an informed minority of scouts guide a honey bee swarm as it flies to its new home?’, *Animal Behaviour* **71**, 161–171.
- Beekman, M., Sumpter, D. J. T. & Ratnieks, F. L. W. (2001), ‘Phase transition between disordered and ordered foraging in pharaoh’s ants’, *Proceedings of the National Academy of Sciences of the United States of America* **98**(17), 9703–9706.
- Beekman, M., Sumpter, D. J. T., Seraphides, N. & Ratnieks, F. L. W. (2004), ‘Comparing foraging behaviour of small and large honey-bee colonies by decoding waggle dances made by foragers’, *Functional Ecology* **18**, 829–835.
- Bengtsson, G., Rydén, T., Öhrn, M. S. & Wiktorsson, M. (2002), ‘Statistical analysis of the influence of the conspecifics on the dispersal of soil collembola’, *Theoretical Population Biology* **61**, 97–113.
- Bernoulli, D. (1734), ‘Recherches physiques et astronomiques, sur le problème proposé pour la seconde fois par l’Académie Royale des Sciences de Paris’, *Recueil des pièces qui ont remporté le prix de l’Académie Royale des Sciences* **Tome III**, 95–134.
- Bonabeau, E., Theraulez, G., Deneubourg, J.-L., Aron, S. & Camazine, S. (1997), ‘Self-organization in social insects’, *Trends in Ecology and Evolution* **12**(5), 188–193.

- Bowers, J. A., Morton, I. D. & Mould, G. I. (2000), 'Directional statistics of the wind and waves', *Applied Ocean Research* **22**, 401–412.
- Box, G. E. P. & Draper, N. R. (1987), *Empirical model-building and response surfaces*, John Wiley & Sons.
- Boyce, W. E. & DiPrima, R. C. (1992), *Elementary Differential Equations and Boundary Value Problems*, 5th edn, John Wiley & Sons, Inc.
- Breder, C. M. (1951), 'Structure of a fish school.', *Bulletin of the American Museum of Natural History* **98**, 1–27.
- Breder, C. M. (1954), 'Equations descriptive of fish schools and other animal aggregations.', *Ecology* **35**, 361–370.
- Briggs, M. S. (1993), 'Dipole and quadrupole tests of the isotropy of gamma-ray burst locations', *Astrophysical Journal* **407**, 126–134.
- Brillinger, D. R., Preisler, H. K., Ager, A. A., Kie, J. G. & Stewart, B. S. (2002), 'Employing stochastic differential equations to model wildlife motion', *Bulletin Brazilian Mathematical Society* **33**(3), 385–408.
- Brunner, L. J. (1994), 'Nonparametric bayes methods for directional data', *Canadian Journal of Statistics* **22**, 401–412.
- Burger, W. C. (2003), *Perfect planet, clever species: how unique are we?*, Prometheus Books.
- Camazine, S., Deneubourg, J.-L., Franks, N. R., Sneyd, J., Theraulaz, G. & Bonabeau, E. (2001), *Self-Organization in Biological Systems*, Princeton University Press.
- Chang, T. (1993), 'Spherical regression and the statistics of tectonic plate reconstructions', *International Statistical Review* **61**, 299–316.
- Chen, F. F. (1984), *Introduction to plasma physics and controlled fusion*, 2nd edn, Plenum Press.
- Couzin, I. D. & Franks, N. R. (2003), 'Self-organized lane formation and optimized traffic flow in army ants', *Proceedings of the Royal Society of London B* **270**, 139–146.
- Couzin, I. D. & Krause, J. (2003), 'Self-organisation and collective behaviour in vertebrates', *Advances in the Study of Behaviour* **32**, 1–75.
- Couzin, I. D., Krause, J., Franks, N. R. & Levin, S. A. (2005), 'Effective leadership and decision-making in animal groups on the move', *Nature* **433**, 513–516.
- Couzin, I. D., Krause, J., James, R., Ruxton, G. D. & Franks, N. R. (2002), 'Collective memory and spatial sorting in animal groups', *Journal of Theoretical Biology* **218**, 1–11.
- Cox, M. D. & Blanchard, G. B. (2000), 'Gaseous templates in ant nests', *Journal of Theoretical Biology* **204**, 223–238.
- Crichton, M. (2002), *Prey*, Harper Collins.
- Czirók, A., Barabási, A.-L. & Vicsek, T. (1999), 'Collective motion of self-propelled particles: kinetic phase transition in one dimension', *Physical Review Letters* **82**(1), 209–212.
- Dal Passo, R. & de Mottoni, P. (1984), 'Aggregative effects for a reaction-advection equation', *Journal of Mathematical Biology* **20**, 103–112.
- de Vries, H. & Biesmeijer, J. C. (1988), 'Modelling collective foraging by means of individual behaviour rules in honeybees', *Behavioural Ecology and Sociobiology* **44**, 109–124.

- Donahoe, K., Lewis, L. & Schneider, S. (2003), 'The role of the vibration signal in the house-hunting process of the honey bee (*Apis mellifera*) swarms', *Behavioural Ecology and Sociobiology* **54**, 593–600.
- Fabi, M. (1998), *Worm*, Bantam Spectra.
- Fisher, N. I. (1985), 'Spherical medians', *Journal of the Royal Statistical Society B* **47**(2), 342–348.
- Fisher, N. I. (1987), 'Problems with the current definitions of the standard deviation of wind direction', *Journal of Climate and Applied Meteorology* **26**, 1522–1529.
- Fisher, N. I. (1989), 'Smoothing a sample of circular data', *Journal of Structural Geology* **11**, 775–778.
- Fisher, N. I. (1990), 'New statistical methods for directional data 1.: bootstrap comparison of mean directions and the fold test in paleomagnetism', *Geophysical Journal International* **101**, 305–313.
- Fisher, N. I. & Lee, A. J. (1983), 'A correlation coefficient for circular data', *Biometrika* **70**(2), 327–332.
- Fisher, N. I. & Lee, A. J. (1986), 'Correlation coefficients for random variables on a unit sphere or hypersphere', *Biometrika* **73**, 159–164.
- Fisher, N. I., Lewis, T. & Embleton, B. J. (1987), *Statistical Analysis of Spherical Data*, Cambridge University Press.
- Fisher, R. (1953), 'Dispersion on a sphere', *Proceedings of the Royal Society of London, Series A* **217**, 295–305.
- Flierl, G., Grünbaum, D., Levin, S. & Olsen, D. (1999), 'From individuals to aggregations: the interplay between behaviour and physics', *Journal of Theoretical Biology* **196**, 397–454.
- Gerhard, J. & Kirshner, M. (1997), *Cells, Embryos and Evolution*, Blackwell Science.
- Giurfa, M. (2003), 'The amazing mini-brain: lessons from a honey bee', *Bee World* **84**, 5–18.
- Gould, J. L. & Gould, C. G. (1988), *The Honey Bee*, Scientific American Library.
- Grünbaum, D. (1994), 'Translating stochastic density-dependent individual behaviour with sensory constraints to an Eulerian model of animal swarming', *Journal of Mathematical Biology* **33**, 139–161.
- Grünbaum, D. & Okubo, A. (1994), *Modelling Social Animal Aggregations*, Frontiers in Mathematical Biology, Springer-Verlag, pp. 296–325.
- Harraway, J. (1997), *Introductory statistical methods for biological, health and social sciences*, University of Otago Press.
- Helbing, D., Farkas, I. & Vicsek, T. (2000a), 'Freezing by heating in a driven mesoscopic system', *Physical Review Letters* **84**, 1240–1243.
- Helbing, D., Farkas, I. & Vicsek, T. (2000b), 'Simulating dynamical features of escape panic', *Nature* **407**, 487–490.
- Heppner, F. H. (1997), *Animal Groups in Three Dimensions*, Cambridge University Press., chapter Three-dimensional structure and dynamics of birds flocks.
- Holland, O. & Melhuish, C. (1999), 'Stigmergy, self-organization and sorting in collective robotics', *Artificial Life* **5**, 173–202.
- Huth, A. & Wissel, C. (1992), 'The simulation of the movement of fish schools', *Journal of Theoretical Biology* **156**, 365–385.

- Ikawa, T. & Okabe, H. (1997), *Animal Groups in Three Dimensions*, Cambridge University Press, chapter Three-dimensional measurements of swarming mosquitoes: a probabilistic model, measuring system, and example results.
- Janson, S., Middendorf, M. & Beekman, M. (2005), 'Honeybee swarms: How do scouts guide a swarm of uninformed bees?', *Animal Behaviour* **70**, 349–358.
- Krause, J. & Ruxton, G. D. (2002), *Living in Groups*, Oxford University Press.
- Kube, C. R. & Bonabeau, E. (2000), 'Cooperative transport by ants and robots', *Robotics and Autonomous Systems* **30**, 85–101.
- Lehn, J.-M. (2002a), 'Toward complex matter: supramolecular chemistry and self-organization', *Proceedings of the National Academy of Sciences* **99**(8), 4763–4768.
- Lehn, J.-M. (2002b), 'Toward self-organization and complex matter', *Science* **295**, 2400–2403.
- Lewis, M. A. & Bekey, G. A. (1992), The behavioural self-organization of nanorobots using local rules, in 'Proceedings of the 1992 IEEE/RSJ International Conference on Intelligent Robots and Systems', pp. 1333–1338.
- Lindauer, M. (1955), 'Schwarmbienen auf wohnungssuche', *Zeitschrift für vergleichende Physiologie* **37**, 263–324.
- Lindauer, M. (1971), *Communication Among Social Bees*, Harvard University Press.
- Maini, P. K. & Othmer, H. G. (2000), *Mathematical Models for Biological Pattern Formation*, Springer-Verlag.
- Manly, B. (1997), *Randomization, Bootstrap and Monte Carlo Methods in Biology*, Texts in Statistical Science, Chapman & Hall, London.
- Mardia, K. (1972), *Statistics of Directional Data*, Probability and Mathematical Statistics, Academic Press, New York.
- Mardia, K. V. (2002), 'Circular regression', *Biometrika* **89**, 683–697.
- Merrifield, A., Myerscough, M. R. & Weber, N. (2006), 'Statistical tests for analysing directed movement of self-organising animal groups', *Mathematical Biosciences* **203**, 64–78.
- Mimura, M. & Yamaguti, M. (1982), 'Pattern formation in interacting and diffusing systems in population biology', *Advances in Biophysics* **15**, 19–65.
- Mogilner, A. & Edelstein-Keshet, L. (1999), 'A non-local model for a swarm', *Journal of Mathematical Biology* **38**, 534–570.
- Mogilner, A., Edelstein-Keshet, L., Bent, L. & Spiros, A. (2003), 'Mutual interactions, potentials, and individual distance in a social aggregation', *Journal of Theoretical Biology* **47**, 353–389.
- Muhammad, A. & Egerstedt, M. (2003), Topology and complexity of formations, in 'Proceedings of the 2nd international workshop on the mathematics and algorithms of social insects', pp. 107–114.
- Myerscough, M. R. (2003), 'Dancing for a decision: a matrix model for nest site choice by honeybees', *Proceedings of the Royal Society of London B* **270**, 577–582.
- Nicholson, D. R. (1983), *Introduction to Plasma Theory*, Wiley Series In Plasma Physics, John Wiley & Sons.
- Niwa, H.-S. (1994), 'Self-organising dynamic model of fish schooling', *Journal of Theoretical Biology* **171**, 123–136.

- Niwa, H.-S. (1996), 'Newtonian dynamical approach to fish schooling', *Journal of Theoretical Biology* **181**, 47–63.
- Niwa, H.-S. (1998), 'School size statistics of fish', *Journal of Theoretical Biology* **195**, 351–361.
- Okubo, A. (1980), *Diffusion and Ecological Problems: Mathematical Models*, Springer Verlag, New York.
- Okubo, A. (1986), 'Dynamical aspects of animal groupings: swarms, schools, flocks and herds', *Advances in Biophysics* **22**, 1–94.
- Okubo, A. & Chiang, H. C. (1974), 'An analysis of the kinematics of swarming behavior of *anarete pritchardi* Kim (Diptera: Cecidomyiidae)', *Researches on Population Ecology* **16**, 1–42.
- Okubo, A. & Levin, S., eds (2001), *Diffusion and Ecological Problems*, Vol. 14 of *Interdisciplinary Applied Mathematics: Mathematical Biology*, 2 edn, Springer Verlag.
- Parr, A. E. (1927), 'A contribution to the theoretical analysis of the schooling behaviour of fishes', *Occasional Papers of the Bingham Oceanographic Collection* **1**, 1–32.
- Parrish, J. K. & Edelstein-Keshet, L. (1999), 'Complexity, pattern, and evolutionary trade-offs in animal aggregation', *Science* **284**, 99–101.
- Parrish, J. K., Viscido, S. V. & Grünbaum, D. (2002), 'Self organized fish schools: an examination of emergent properties', *Biological Bulletin* **202**, 296–305.
- Partridge, B. L. (1982), 'The structure and function of fish schools', *Scientific American* **246**(6), 90–99.
- Partridge, B. L. & Pitcher, T. J. (1980), 'The sensory basis of fish schools: relative role of lateral line and vision', *Journal of Comparative Physiology* **135**, 315–325.
- Passino, K. M. & Seeley, T. D. (2006), 'Modelling and analysis of nest-site selection by honeybee swarms: the speed and accuracy trade off', *Behavioural Ecology and Sociobiology* **59**, 427–442.
- Peck, S. L. (2004), 'Simulation as experiment: a philosophical reassessment for biological modelling', *Trends in Ecology and Evolution* **19**, 530–534.
- Pitcher, T. J. & Parrish, J. K. (1993), *The Behavior of Teleost Fishes*, Chapman & Hall, chapter The functions of shoaling behavior.
- Preisler, H. K. & Akers, R. P. (1995), 'Autoregressive-type models for the analysis of bark beetle tracks', *Biometrics* **51**, 259–267.
- Lord Rayleigh (1880), 'On the resultant of a large number of vibrations of the same pitch and of arbitrary phase', *Philosophical Magazine* **10**, 73–78.
- Lord Rayleigh (1919), 'On a problem of vibrations and of random flights in one, two and three dimensions', *Philosophical Magazine* **37**, 321–347.
- Rees, S. G. (2000), 'Can a minority of informed leaders determine the foraging movements of a fish shoal?', *Animal Behaviour* **59**, 403–409.
- Reuter, H. & Breckling, B. (1994), 'Selforganization of fish schools: an object-oriented model', *Ecological Modelling* **75**, 147–159.
- Reynolds, C. W. (1987), 'Flocks, herds and schools: a distributed behavioural model', *Computer Graphics* **21**(4), 25–34.
- Riley, J., Greggers, U., Smith, A., Reynolds, D. & Menzel, R. (2005), 'The flight paths of honeybees recruited by the waggle dance', *Nature* **435**, 205–207.

- Rivest, L.-P. (1982), 'Some statistical methods for bivariate circular data', *Journal of the Royal Statistical Society B* **44**(1), 81–90.
- Roberts, P. H. & Ursell, H. D. (1960), 'Random walks on a sphere and a Riemannian Manifold', *Philosophical Transactions of the Royal Society of London Series A, Mathematical and Physical Sciences* **252**, 317–356.
- Seeley, T. & Buhrman, S. (1999), 'Group decision making in swarms of honey bees', *Behavioural Ecology and Sociobiology* **45**, 19–31.
- Seeley, T. D. (1995), *The wisdom of the hive: the social physiology of honey bee colonies*, Harvard University Press.
- Seeley, T. D. (1998), 'Thoughts on information and integration in honey bees colonies', *Apidologie* **29**(1/2), 67.
- Seeley, T. D. (2002), 'When is self-organisation used in biological systems?', *Biological Bulletin* **202**, 314–318.
- Seeley, T. D., Morse, R. A. & Visscher, P. K. (1979), 'The natural history of the flight of honey bee swarms', *Psyche* **86**(2-2), 103–113.
- Shigesada, N. & Teramoto, E. (1978), 'A consideration on the environmental density', *Japanese Journal of Ecology* **28**, 1–8.
- Simpson, S. J., Despland, E., Hägele, B. F. & Dodgson, T. (2001), 'Gregarious behaviour in desert locusts is evoked by touching their back legs', *Proceedings of the National Academy of Sciences, USA* **98**, 3895–3897.
- Simpson, S. J., McCaffery, A. R. & Hägele, B. F. (1999), 'A behavioural analysis of phase change in the desert locust', *Biological Reviews* **74**, 461–480.
- Srinivasan, M. V., Poteser, M. & Kral, K. (1999), 'Motion detection in insect orientation and navigation', *Vision Research* **39**, 2749–2766.
- Stephens, M. A. (1962*a*), 'Exact and approximate tests for directions. i.', *Biometrika* **49**, 463–477.
- Stephens, M. A. (1962*b*), 'Exact and approximate tests for directions. ii.', *Biometrika* **49**, 547–55.
- Stephens, M. A. (1967), 'Tests for the dispersion and for the modal vector of a distribution on a sphere', *Biometrika* **54**, 211–223.
- Stephens, M. A. (1979), 'Vector correlation', *Biometrika* **66**, 41–48.
- Stöcker, S. (1999), 'Models for tuna school formation', *Mathematical Biosciences* (156), 167–190.
- Støretvedt, K. M. & Scheidegger, A. E. (1992), 'Orthogonal joint structures in the Bergen area, southwest Norway, and their regional significance', *Physics of the Earth and Planetary Interiors* **73**, 255–263.
- Sumpter, D. J. T. (2006), 'The principles of collective animal behaviour', *Philosophical Transactions of The Royal Society B* **361**, 5–22.
- Topaz, C. M., Bertozzi, A. L. & Lewis, M. A. (2005), 'A nonlocal continuum model for biological aggregation', *Bulletin of Mathematical Biology*. Preprint.
- Turchin, P. (1989), 'Population consequences of aggregative movement', *The Journal of Animal Ecology* **58**, 75–100.
- Turchin, P. (1998), *Quantitative Analysis of Movement: measuring and modelling population redistribution in animals and plants*, Sinauer Associates Inc.
- Uvarov, B. (1966), *Grasshoppers and Locusts*, Vol. 1, Cambridge University Press.
- Vaughan, R., Sumpter, N., Henderson, J., Frost, A. & Cameron, S. (2000), 'Experiments in automatic flock control', *Robotics and Autonomous Systems* **31**, 109–117.

- Vicsek, T., Czirók, A., Ben-Jacob, E., Cohen, I. & Shochet, O. (1995), 'Novel type of phase transition in a system of self-driven particles', *Physical Review Letters* **75**(6), 1226–4329.
- Viscido, S. V., Parrish, J. K. & Grünbaum, D. (2004), 'Individual behaviour and emergent properties of fish schools: a comparison of observation and theory', *Marine Ecology Progress Series* **273**, 239–249.
- Viscido, S. V., Parrish, J. K. & Grünbaum, D. (2005), 'The effect of population size and the number of influential neighbours on the emergent properties of fish schools', *Ecological Modelling* **183**, 347–363.
- von Frisch, K. (1967), *The Dance Language and Orientation of Bees*, Harvard University Press.
- Warburton, K. & Lazarus, J. (1991), 'Tendency-distance models of social cohesion in animal groups', *Journal of Theoretical Biology* **150**, 473–488.
- Watson, G. S. (1960), 'More significance tests on the sphere', *Biometrika* **47**, 87–91.
- Watson, G. S. (1983a), *Multivariate Analysis VI*, Academic Press.
- Watson, G. S. (1983b), *Statistics on Spheres*, John Wiley & Sons, Inc.
- Watson, G. S. & Williams, E. J. (1956), 'On the construction of significance tests on the circle and the sphere', *Biometrika* **43**, 344–352.
- Webb, B. (2000), 'What does robotics offer animal behaviour?', *Animal Behaviour* **60**, 545–558.
- Wiktorsson, M., Rydén, T. & Bengtsson, G. (2004), 'Modelling the movement of a soil insect', *Journal of Theoretical Biology* **231**, 497–513.
- Wilson, M., Melhuish, C. & Sendova-Franks, A. (2004), 'Algorithms for building annular structures with minimalist robots inspired by brood sorting in ant colonies', *Autonomous Robotics* **17**, 115–136.
- Wittenberger, J. (1981), *Animal Social Behaviour*, Duxberg Press, Boston.
- Woods, L. C. (2004), *Physics of Plasmas*, Wiley-VCH.