

G. Bard Ermentrout

### **Education**

- B.A. Mathematics, Johns Hopkins, 1975
- M.A. Mathematics, Johns Hopkins, 1975
- Ph.D. Biophysics and Theoretical Biology, Univ. Chicago, 1979

### **Employment**

- Staff Fellow, Math Research Branch, NIH, 1979-1982
- Assistant Professor of Mathematics, University of Pittsburgh, 1982-1986
- Associate Professor of Mathematics, University of Pittsburgh, 1986-1989
- Professor of Mathematics, University of Pittsburgh, 1989 - present

### **Fellowships and Honors**

Sloan Fellowship 1983 - 1985

### **Professional Service**

REVIEWING: Reviewer for NSF, NIH, AFOSR, ONR and over a dozen journals including Neural Computation, J. Neurophysiology, Nature and Science.

EDITING: Editor or on editorial board for : Journal of Computational Neuroscience, Chaos, Neural Computation, Neural Networks.

### **Interdisciplinary Work**

- Grants
  - Keck Foundation training grant in Computational Biology - developed a course “Mathematical Methods for Crystallographers”
  - Neural Processes in Cognition training grant (NSF) - developed a course “Computational Neuroscience”
  - Whittaker Foundation grant in Bioengineering - developed a course “Quantitative Cardio-vascular Physiology”
  - NSF summer undergraduate training program for the Center for the Neural Basis of Cognition.
- Conferences
  - Organized the Gordon Research Conference on Theoretical Biology 1996

- Co-organized the Special Year in Mathematical Biology at the Institute for Math and its Applications, 1998
- Invited handbook chapters
  - Handbook of Enzymology - “Biochemical Oscillations”
  - Handbook of Neural Networks - several chapters
  - Encyclopedia of Life Sciences - “Neural Oscillations”
  - Computational Biology (MIT Press, 2000) - “Averaging”

#### **Recent special invited talks**

- UC Davis, special year in Math Biology, 4 lectures, Oct 1997
- Caltech, course in Computational Biology, 3 lectures, Mar 1998
- Univ. British Columbia, special year in Math Biology, 3 lectures, June 1999

#### **Students**

- Joe Paultett, 1993, Assistant Professor, Penn State
- Liwei Ren, 1995, FORE Systems
- Zhixiong Chen, 1996
- David Pinto, 1997, Brown Univ (Connor lab)
- Sharon Crook, 1997, Montana State (Miller lab)
- Boris Gutkin, 1999, Paris (Fregnac lab)

#### **Software**

- PhasePlane - interactive solutions to ordinary differential equations (MS-DOS, 1989)
- XTC - solutions to continuum PDEs, integral equations in one spatial dimension (UNIX, 1993)
- XPPAUT - solutions to ordinary differential equations, delay equations, stochastic equations, differential algebraic equations, and functional equations plus bifurcation analysis (UNIX, Windows NT, 1995-present)

#### **Publications**

1. Ermentrout, G.-B.; Cowan, J.-D., Temporal oscillations in neuronal nets. *J.-Math.-Biol.* [Journal-of-Mathematical-Biology] 7 (1979), no. 3, 265–280.

2. Ermentrout,-G.-B.; Cowan,-J.-D., A mathematical theory of visual hallucination patterns. Biol.-Cybernet. [Biological-Cybernetics] 34 (1979), no. 3, 137–150.
3. Ermentrout,-G.-Bard; Rinzel,-John, One-dimensional  $\lambda - \omega$  target patterns: empirical stability tests J.-Math.-Biol. [Journal-of-Mathematical-Biology] 10 (1980), no. 1, 97–100.
4. Ermentrout,-G.-Bard, Small amplitude stable wavetrains in reaction-diffusion systems. Lecture Notes in Pure and Appl. Math., 54, Dekker, New York, 1980.
5. Ermentrout,-G.-B.; Cowan,-J.-D., Large scale spatially organized activity in neural nets. SIAM-J.-Appl.-Math. [SIAM-Journal-on-Applied-Mathematics] 38 (1980), no. 1, 1–21.
6. Ermentrout,-G.-B.; Cowan,-J.-D., Secondary bifurcation in neuronal nets. SIAM-J.-Appl.-Math. [SIAM-Journal-on-Applied-Mathematics] 39 (1980), no. 2, 323–340.
7. Ermentrout,-G.-Bard; Rinzel,-John, Waves in a simple, excitable or oscillatory, reaction-diffusion model. J.-Math.-Biol. [Journal-of-Mathematical-Biology] 11 (1981), no. 3, 269–294.
8. Ermentrout,-G.-Bard,  $n : m$  phase-locking of weakly coupled oscillators. J.-Math.-Biol. [Journal-of-Mathematical-Biology] 12 (1981), no. 3, 327–342.
9. Ermentrout,-G.-B., Asymptotic behavior of stationary homogeneous neuronal nets. Lecture Notes in Biomath., 45, Springer, Berlin-New York, 1982.
10. Kopell,-N., ; Ermentrout,-G.-B., Coupled oscillators and mammalian small intestines. Lecture Notes in Biomath., 51, Springer, Berlin-New York, 1983.
11. Ermentrout,-George-Bard; Kopell,-Nancy, Frequency plateaus in a chain of weakly coupled oscillators. I. 1984 SIAM-J.-Math.-Anal. [SIAM-Journal-on-Mathematical-Analysis] 15 (1984), no. 2, 215–237.
12. Ermentrout,-G.-Bard, Period doublings and possible chaos in neural models. SIAM-J.-Appl.-Math. [SIAM-Journal-on-Applied-Mathematics] 44 (1984), no. 1, 80–95.
13. Ermentrout-GB; Rinzel-J, Beyond a pacemaker's entrainment limit: phase walk-through. Am-J-Physiol. 1984 Jan; 246(1 Pt 2): R102-6

14. Ermentrout,-G.-B.; Hastings,-S.-P.; Troy,-W.-C., Large amplitude stationary waves in an excitable lateral-inhibitory medium. *SIAM-J.-Appl.-Math.* [SIAM-Journal-on-Applied-Mathematics] 44 (1984), no. 6, 1133–1149.
15. Ermentrout-B, A model for premigrainous auras, *The Neurobiology of Pain*, ed AH. Holden and W. Winlow, Manchester University Press, Manchester, 1985
16. Ermentrout-GB, The behavior of rings of coupled oscillators. *J-Math-Biol.* 1985; 23(1): 55-74 1985
17. Ermentrout,-G.-Bard, Synchronization in a pool of mutually coupled oscillators with random frequencies. *J.-Math.-Biol.* [Journal-of-Mathematical-Biology] 22 (1985), no. 1, 1–9.
18. Ermentrout,-G.-B.; Troy,-W.-C., Phaselocking in a reaction-diffusion system with a linear frequency gradient. 1986 *SIAM-J.-Appl.-Math.* [SIAM-Journal-on-Applied-Mathematics] 46 (1986), no. 3, 359–367.
19. Ermentrout,-Bard, Losing amplitude and saving phase. *Lecture Notes in Biomath.*, 66, Springer, Berlin-New York, 1986.
20. Kopell,-N.; Ermentrout,-G.-B., Symmetry and phaselocking in chains of weakly coupled oscillators. *Comm.-Pure-Appl.-Math.* [Communications-on-Pure-and-Applied-Mathematics] 39 (1986), no. 5, 623–660.
21. Ermentrout,-G.-B.; Kopell,-N., Parabolic bursting in an excitable system coupled with a slow oscillation. *SIAM-J.-Appl.-Math.* [SIAM-Journal-on-Applied-Mathematics] 46 (1986), no. 2, 233–253.
22. Kopell,-N.; Ermentrout,-G.-B., Subcellular oscillations and bursting. *Math.-Biosci.* [Mathematical-Biosciences.-An-International-Journal] 78 (1986), no. 2, 265–291.
23. Ermentrout-B; Campbell-J; Oster-G, A model for shell patterns based on neural activity. *Veliger* 28(4): 369-388 1986
24. Troy,-William-C.; Overman,-Edward-A., II; Ermentrout,-G.-B.; Keener,-James-P., Uniqueness of flow of a second-order fluid past a stretching sheet. *Quart.-Appl.-Math.* [Quarterly-of-Applied-Mathematics] 44 (1987), no. 4, 753–755.
25. Kopell,-N.; Ermentrout,-G.-B., Coupled oscillators and the design of central pattern generators. *Math.-Biosci.* [Mathematical-Biosciences.-An-International-Journal] 90 (1988), no. 1-2, 87–109.

26. Ermentrout,-G.-B., Discrete and continuous media in the presence of a frequency gradient. Kluwer Acad. Publ., Dordrecht, 1988.
27. Boland,-J.; Ermentrout,-G.-B.; Hall,-C.-A.; Layton,-W.; Melhem,-H., Numerical and analytical studies of natural convection problems. Ohio Univ. Press, Athens, OH, 1989.
28. Rinzel-J; Ermentrout-B, Analysis of neural excitability and oscillations, In “Methods in Neuronal Modelling: From synapses to Networks”, C. Koch and I. Segev, eds. 1989, MIT Press (revised 1998).
29. Ermentrout,-G.-Bard; Troy,-William-C., The uniqueness and stability of the rest state for strongly coupled oscillators. SIAM-J.-Math.-Anal. [SIAM-Journal-on-Mathematical-Analysis] 20 (1989), no. 6, 1436–1446.
30. Edelstein-Keshet,-Leah; Ermentrout,-Bard, Models for branching networks in two dimensions. SIAM-J.-Appl.-Math. [SIAM-Journal-on-Applied-Mathematics] 49 (1989), no. 4, 1136–1157.
31. Ermentrout-B; Kopell-N, Some mathematical problems concerning a central pattern generator, in “Theoretical models for Cell Signalling”, A. Goldbeter,ed. Academic Press, 1989
32. Ermentrout,-G.-B., Oscillator death in populations of “all to all” coupled nonlinear oscillators. Phys.-D [Physica-D.-Nonlinear-Phenomena] 41 (1990), no. 2, 219–231.
33. Edelstein-Keshet,-Leah; Ermentrout,-G.-Bard, Models for contact-mediated pattern formation: cells that form parallel arrays. J.-Math.-Biol. [Journal-of-Mathematical-Biology] 29 (1990), no. 1, 33–58.
34. Williams-TL; Sigvardt-KA; Kopell-N; Ermentrout-GB; Remler-MP, Forcing of coupled nonlinear oscillators: studies of intersegmental coordination in the lamprey locomotor central pattern generator. J-Neurophysiol. 1990 Sep; 64(3): 862-71
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37. Kopell,-N.; Zhang,-W; Ermentrout,-G.-B., Multiple coupling in chains of oscillators. SIAM-J.-Math.-Anal. [SIAM-Journal-on-Mathematical-Analysis] 21 (1990), no. 4, 935–953.

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40. Ermentrout-B, An adaptive model for synchrony in the firefly *Pteroptyx malacca*. Journal of Mathematical Biology 29(6): 571-585 1991
41. Caginalp,-G; Ermentrout,-G.-B., Numerical studies of differential equations related to theoretical financial markets. Appl.-Math.-Lett. [Applied-Mathematics-Letters.-An-International-Journal-of-Rapid-Publication] 4 (1991), no. 1, 35–38.
42. Ermentrout,-G.-B.; Kopell,-N., Multiple pulse interactions and averaging in systems of coupled neural oscillators. J.-Math.-Biol. [Journal-of-Mathematical-Biology] 29 (1991), no. 3, 195–217.
43. Ermentrout,-Bard, Stripes or spots? Nonlinear effects in bifurcation of reaction-diffusion equations on the square. Proc.-Roy.-Soc.-London-Ser.-A 434 (1991), no. 1891, 413–417.
44. Cohen-AH; Ermentrout-GB; Kiemel-T; Kopell-N; Sigvardt-KA; Williams-TL, Modelling of intersegmental coordination in the lamprey central pattern generator for locomotion. Trends-Neurosci. 1992 Nov; 15(11): 434-8
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46. Ermentrout-B, Complex dynamics in winner-take-all neural nets with slow inhibition. NEURAL NETWORKS 5(3): 415-431 1992
47. Ermentrout,-G.-Bard; McLeod,-J.-Bryce, Existence and uniqueness of travelling waves for a neural network. Proc.-Roy.-Soc.-Edinburgh-Sect.-A 123 (1993), no. 3, 461–478
48. Cordova-NJ; Ermentrout-B; Oster-GF, Dynamics of single-motor molecules: the thermal ratchet model. Proc-Natl-Acad-Sci-U-S-A. 1992 Jan 1; 89(1): 339-43
49. Ermentrout-GB; Edelstein-Keshet-L, Cellular automata approaches to biological modeling. J-Theor-Biol. 1993 Jan 7; 160(1): 97-133
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54. Gonzalez-Fernandez-JM; Ermentrout-B, On the origin and dynamics of the vasomotion of small arteries. *Math-Biosci.* 1994 Feb; 119(2): 127-67
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57. Paullet,-Joseph-E.; Ermentrout,-G.-Bard, Stable rotating waves in two-dimensional discrete active media. *SIAM-J.-Appl.-Math.* [SIAM-Journal-on-Applied-Mathematics] 54 (1994), no. 6, 1720–1744.
58. Ermentrout,-G.-Bard; Troy,-W.-C., Phaselocking in a reaction-diffusion equation with twist. *SIAM-J.-Math.-Anal.* [SIAM-Journal-on-Mathematical-Analysis] 25 (1994), no. 6, 1504–1520.
59. Ermentrout-B, Phaseplane analysis of neural nets, in (MA Arbib, ed) *Handbook of Brain Theory and Neural Networks*
60. Doering-C; Ermentrout-B; Oster-G, Rotary DNA motors. *Biophys-J.* 1995 Dec; 69(6): 2256-67
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62. Bauer-AJ; Ermentrout-B, Origin of pacemaker activity in the stomach wall and small intestine. In: *Pacemaker Activity and Intercellular Communication*, J.D. Huizinga (ed) CRC press pp 237-251 1995
63. Edelstein-Keshet-L; Watmouth-J; Ermentrout-G-B, Trail following in ants: Individual properties determine population behaviour. *Behavioral Ecology and Sociobiology*,1995 36(2): 119-133
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67. Ermentrout,-G.-Bard; Rinzel,-John, Reflected waves in an inhomogeneous excitable medium. 1996 *SIAM-J.-Appl.-Math.* [*SIAM-Journal-on-Applied-Mathematics*] 56 (1996), no. 4, 1107–1128.
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70. Harris-AE; Ermentrout-GB; Small-SL, A model of ocular dominance column development by competition for trophic factor. *Proc-Natl-Acad-Sci-U-S-A.* 1997 Sep 2; 94(18): 9944-9
71. Ermentrout-B; Lewis-M, Pattern formation in systems with one spatially distributed species. *Bulletin of Mathematical Biology* 59(3): 533-549,1997
72. Crook-SM; Ermentrout-GB; Vanier-MC; Bower-JM, The role of axonal delay in the synchronization of networks of coupled cortical oscillators. *J-Comput-Neurosci.* 1997 Apr; 4(2): 161-72
73. Ermentrout,-Bard; Chen,-Xinfu; Chen,-Zhixiong, Transition fronts and localized structures in bistable reaction-diffusion equations. *Phys.-D [Physical-D.-Nonlinear-Phenomena]* 108 (1997), no. 1-2, 147–167.
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75. Chen-Z; Ermentrout-B; Wang-XJ, Wave propagation mediated by GABAB synapse and rebound excitation in an inhibitory network: a reduced model approach. *J-Comput-Neurosci.* 1998 Mar; 5(1): 53-69
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86. Rinzel-J; Terman-D; Wang-X; Ermentrout-B, Propagating activity patterns in large-scale inhibitory neuronal networks. *Science.* 1998 Feb 27; 279(5355): 1351-5
87. Ermentrout-GB; Kopell-N, Fine structure of neural spiking and synchronization in the presence of conduction delays. *Proc-Natl-Acad-Sci-U-S-A.* 1998 Feb 3; 95(3): 1259-64
88. Ren,-Liwei; Ermentrout,-G.-Bard, Monotonicity of phase-locked solutions in chains and arrays of nearest-neighbor coupled oscillators. *SIAM-J.-Math.-Anal.* [SIAM-Journal-on-Mathematical-Analysis] 29 (1998), no. 1, 208-234

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92. Kopell N, Ermentrout GB, Whittington MA, et al. Gamma rhythms and beta rhythms have different synchronization properties P NATL ACAD SCI USA 97: (4) 1867-1872 FEB 15 2000
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96. Ren LW, Ermentrout B Phase locking in chains of multiple-coupled oscillators PHYSICA D 143: (1-4) 56-73 SEP 1 2000
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