

CURRICULUM VITAE: Nancy Kopell

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Cambridge, MA 02140
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Born November 8, 1942, New York City
Married

EDUCATION

9/67 University of California at Berkeley, Ph.D.
Specialty: Dynamical Systems
6/65 University of California at Berkeley, M.A.
6/63 Cornell University, Ithaca, N.Y., A.B.

PROFESSIONAL EXPERIENCE

9/13- Secondary Appointment, Dept of Pharmacology, Medical School, BU.
9/11- Co-Director, Center for Computational Neuroscience and Neural Technology,
Boston University
7/09- William Fairfield Warren Distinguished Professor, Boston University
6/08- Visiting Senior Fellow, Institute for Mind and Biology, University of Chicago
9/07- Executive Committee, Center for Neuroscience, Boston University
1/07 - Secondary appointment, Department of Biomedical Engineering.
11/01-08 Co-Director, Burroughs Wellcome Training Program in Mathematical and
Computational Neuroscience (PMCN), Boston University
4/00-6/09 William Goodwin Aurelio Professor of Mathematics and Science, BU
1/08 - Founder and Director, Cognitive Rhythms Collaborative
9/97- 8/11 Co-Director, Center for BioDynamics, Boston University
10/92 Ordway Visiting Professor, University of Minnesota
9/86- Professor of Mathematics, Boston University
7/78-8/86 Professor of Mathematics, Northeastern University
5/80-6/84 Consultant, Scientific Systems, Inc.
10/79 Consultant, Math Research Center, Madison
9/76 Visiting Senior Research Scientist, Science Research Council (England)
9/76-1/77 Visiting Scholar, M.I.T.
4/76-6/76 Visiting Scholar, California Institute of Technology
1/75-6/75 Visiting Associate Professor of Applied Math., M.I.T.
7/72-6/78 Associate Professor of Mathematics, Northeastern University
3/70-6/70 Fellow, Centre Nationale de la Recherche Scientifique
9/69-6/72 Assistant Professor of Mathematics, Northeastern University
9/67-6/69 C.L.E. Moore Instructor of Mathematics, M.I.T.
9/66-6/67 Director, High School Students' and Teachers' Regional
Mathematics Program (Sponsored by the NSF)
9/65-9/66 Assistant Director, same program

HONORS

Elected to

National Academy of Sciences, 1996
American Academy of Arts and Sciences, 1996
Honorary Membership of London Mathematical Society (one or two such awarded worldwide/year) 2011

Fellowships and Honorary Degrees

SIAM Fellow, 2009
Massachusetts Academy of Sciences, Fellow, 2008
Weldon Memorial Prize, Oxford University, 2006
Honorary Doctorate, New Jersey Institute of Technology, May 2006
John D. and Catherine T. MacArthur Fellow, 1990-1995
J. S. Guggenheim Fellowship, 1984-1985
Alfred P. Sloan Fellow, 1975-1977
N.S.F. Graduate Fellow, 1963-1967
Woodrow Wilson Fellow (honorary), 1963-1964

Special Invited Lectures

Moser Prize Lecture, SIAM Annual Meeting, Snowbird 2013
Irene McCulloch Lecturer in Science and Engineering, Distinguished Lecturer, USC, 2011
Weldon Memorial Prize lecture, Oxford, 2008
Von Neumann Prize/Lecture, SIAM annual meeting, Zurich, 2007
Shih-I Pai Lecture, University of Maryland, 2006
Distinguished Lecturer, University of California, Irvine, 2006
Roslyn Silver Science Lecture, Barnard, 2004
Conference in honor of my 60th birthday, Boston University, 2003
Rainich Lectures, University of Michigan, Ann Arbor, 2003
Wasow Memorial Lectures, University of Wisconsin, Madison, 2003
Plenary Speaker, International Congress of Industrial and Applied Math, Australia, 2003
Invited Speaker, International Congress of Mathematics, China, 2002
H. Dudley Wright Prize, Harvey Mudd College, 2001
Plenary Speaker, Annual Meeting of SIAM, San Juan, 2000
NSF Distinguished Lecturer, Washington D.C., 2000
Josiah Willard Gibbs Lecturer, Annual Meeting of the AMS, San Antonio, 1999
Invited Speaker, Annual Meeting of AMS, San Diego, 1997
Issues in Modern Biology: Distinguished Lecture Series, Los Alamos National Lab., 1995
Plenary Speaker, SIAM Meeting on Dynamical Systems, Snowbird, 1995
Class of '27 Lecturer, Rensselaer Polytechnic Institute, 1995
Matthew Vassar Lecturer, Vassar College, 1994
Distinguished Lecturer, Fields Institute, 1994
University Lecturer, Boston University, 1993
KAC Memorial Lectures, CNLS, Los Alamos National Lab, 1992
Emmy Noether Lecture, AMS Annual Meeting, Baltimore 1992
Vollmer Fries Memorial Lecture, Rensselaer Polytechnic Institute, 1991

Plenary Speaker, Canadian Math Society Annual Meeting, 1990
Plenary Speaker, Annual Meeting of SIAM, Chicago, 1990
Plenary Speaker, SIAM Meeting on Dynamical Systems, Orlando, 1990
Lecturer, R. Bowen Memorial Lectures, Berkeley, 1986
Invited Speaker, International Congress of Mathematicians, 1983
University Lecturer, Northeastern University, 1980

In addition, I have given 8-12 invited talks per year at conferences, symposia and department colloquia [mathematics, physics, physiology, neurobiology]

Research Support

NSF Individual Grants, 1967 -
University Research Initiative Award, AFOSR, 1986-1989
AFOSR Support, 1984-1990
NIMH Support, 1990 -2002
NINDS Support, 2002-2007
P.I., Group Infrastructure Grant (interdisciplinary training group), NSF, 1996-2001
P.I, Support for the Center for BioDynamics, NSF, 2001-2006
P.I., Research Training Grant, NSF, 2006-2011
P.I. Burroughs Wellcome Training Program in Mathematical and Computational Neuroscience 2001- 2007
Co-PI, CRCNS Grant 2005-2009
P.I, Research Training Grant, Boston University, 2006-2010
P.I., NSF SGER Grant, 2008-2010
P.I, CRCNS (NINDS) Grant, 2009-2014
P.I., ARRA (NIH-NINDS) Grant 2009- 2011
P.I., Cognitive Rhythms Collaborative: A Discovery Network; NSF, 2010-2014

Undergraduate Honors

Phi Beta Kappa (junior year)
Graduation from Cornell U. with Distinction in All Subjects and High Honors in Math
Class Marshall of School of Arts and Sciences at Cornell Graduation (salutatorian)

PROFESSIONAL SERVICE

Advisory boards/workshops

Discussant, BRAIN workshop, advisory committee to NIH on BRAIN initiative.
Mathematical Biosciences Institute, Board of Advisors 2012-
Panelist for working group on “Advancing Diagnoses and Treatment of Psychiatric and Neurological Disorders: Moving Functional Imaging Into the Clinic” NIH/NSF/DOD 2012-21013.
Panelist for “Maturation of Functional Brain Networks: Insights into the Origins and Course of Mental Disorders”, NIH 2011
Advisory Committee, Burroughs Wellcome Fund Career Awards at the Scientific Interface, 2007-2014; Co-Chair 2011-2013
Advisory Board, Miller Institute for Basic Research in Science, UC Berkeley, 2005-7

Advisory Board, Center for Theoretical Biological Physics, UC San Diego, 2003-6
Math Advisory Board, Carnegie Mellon University, 2003
Advisory Board, Banff International Research Station, 2002-2010
NIH Planning Workshop on Multi-Electrode Data, 2002
NIAAA Workshop on Alcohol/Neuroscience/Bioinformatics, 2001
NRC Committee Bio 2010: Undergraduate Biology Education to Prepare Research Scientists for the 21st Century; Chair of Math Sub-Panel, 2000-2
Workshop on Intellectual Opportunities in Mathematics, NSF, 2000
DARPA Focus 2000; Chair of Neurobiology Section, 2000
DARPA Workshop on Funding in the Area of Nonlinear Dynamics, 1998
Advisory Board on Interfaces between the Physical, Chemical, Computational Sciences and Biological Sciences, Burroughs Wellcome Fund, 1995-1999
Scientific Advisory Board, Fields Institute, 1995-6
Advisory Committee for Mathematical and Physical Sciences, NSF, 1992-4
Board of Science Advisors, Santa Fe Institute, 1991 - 2001; 2002-
Board of Trustees, Math Sciences Research Institute, 1990-5
Board of Governors, Institute for Mathematics and its Applications, 1986-9;
Chairman, 1988/89
Advisory Committee for Mathematical Sciences, NSF, 1983-1986; Chairman, 1985-6
Advisory Committee for Mathematical and Information Sciences, Air Force Office of Scientific Research, 1986-7
Mathematical Sciences in the Year 2000 Oversight Committee (a Committee of the National Research Council), 1988-90
NSF Workshop on the Interface of Mathematics and Biology, 1990

Panels, Committees

Committee of Visitors , NSF 2013.
Prize Committees: Von Neumann Prize (2011, 2012) SIAM Fellows (2011, 2012), Norbert Wiener Prize (AMS, 2009), Swartz Prize in Computational Neuroscience (SFN 2008-2010), Moser Prize (SIAM 2008), Winfree Prize (SMB 2008)
Review Panel, NSF 2011
Review Panel, NSF, Science of Learning Center at UCSD, 2008
Special Emphasis Panel on Predictive Multiscale Modeling of the Physiome in Health and Disease, NIH2008
Ad-hoc review panel, NIH2004
Computational Neuroscience Review Panel, NSF, 2000
Ad-hoc Member, Board of Scientific Counselors NIDDK, NIH, 1995
Ad-hoc Review Panel, NIH, 1994
ONR Review Panel on Future Research Options, 1993
Ad-hoc Member, Board of Scientific Counselors, NIDDK, NIH, 1992
Ad-hoc Review Panel, NIH, 1991
Site Review Panel, NSF Biology Research Centers, 1988
Site Review Panel, NIMH Training Grant, 1988
Selection Panel, Mathematical Sciences Section, Presidential Young Investigators Award, 1984
Applied Math Review Panel, NSF, 1980

Organizing Activities

- Organizer and current Director, Cognitive Rhythms Collaborative (group of over 30 labs in the Boston area interested in brain dynamics. See cogrhythms .bu.edu).
- Organizer, international conference on Brain Rhythms and Cognition. Cambridge 2013
- Organizing Committee, "Toward Mathematical Modeling of Neural Disease", Fields Institute, 8 workshops June 2012
- Organizer, Mini-symposium on Beta Rhythms and Cognition, Boston 2012
- Co-Organizer, Workshop on Linking Neural Dynamics and Coding, Banff International Research Station, 2010
- Organizer, Short Course, Society for Neuroscience, 2009
- Organizing Committee, Conference in Honor of John Rinzel, NYU, 2009
- Co-Organizer, Workshop on Brain Rhythms and Speech, Boston University, 2008
- Organizing Committee, Workshop on Computational Neuroscience, Institute for Mathematics and Its Application, 1998
- Co-Organizer, Workshop on Interaction of the Nervous System and Biomechanics, Santa Fe Institute, 1998
- Organizing Committee, Computational Neuroscience (CNS*95), Monterey, 1995 (CNS*96), Boston, 1996
- Organizer, Workshop on Neural Oscillations: Implications in Human Health and Disease, Santa Fe Institute, 1995
- Organizing Committee of 1995 International Congress of Applied Mathematics
Committee to choose applied math speakers for 1994 International Congress of Mathematicians
- Organizer, Program on Dynamic Regulation in Neural Systems, Santa Fe Institute, 1993
- Organizer, 6 week Program in Mathematical Physiology, Mathematical Sciences Research Center, Summer 1992
- Organizer, Annual Workshops on Central Pattern Generators, 1987-1992
- Organizing Committee, Conference in Honor of S. Smale, "From Topology to Computation: Unity and Diversity in the Mathematical Sciences," 1990
- Vice Chairman, Gordon Conference on Theoretical Biology and Biomathematics, 1984

Editorial Work

- Advisory Board, J. Math. Biol. 1984-1999
- Editorial Board, SIAM J. Appl. Math, 1976-1979, 1985-1992
- Action Editor, Neural Networks 1990-
- Advisory Board, CHAOS, 1991-1993
- Executive Board, Network 1993-1995
- Editorial Board, Journal of Nonlinear Science/Nonlinear Science Today, 1994-
- Action Editor, Journal of Computational Neuroscience, 1999 -
- Action Editor, Proc. Nat. Acad. Sci, 1996 -

Professional Societies

- Society for Math. Biol., Board of Directors, 1988-1991

SIAM Council, 1982-1984

Committee on Human Rights, SIAM, 1983-; Chairman, 1983-1986

Graduate Students Advised: R. Ault, R. Langer, S. Laederich, W. Zhang, F. Nadim, D. Somers, C. Soto-Trevino, T. LoFaro, J. Ritt, S. R. Jones, G. Medvedev, A. Sereney, M. McCarthy, D. Vierling-Claassen, C. Diniz Behn, C. Acker, T. Kispersky, B. Hedinsson, P. Malerba, S. Lee, J. Cannon, C. Moore-Kochlacs, N. James (8 female)

Postdocs Sponsored/Advised: S. Strogatz, C. Chow, J. Karbowski, A. Bose, C. Bodelon, D. Pinto, M. Olufsen, K. Josic, D. McMillen, H. Rotstein, S. Epstein, S. Kunec, D. Pervouchine, R. Clewley, T. Netoff, A. Kuznetsov, C. Mitchell, E. Sivan, G. Soto, J. Jalics, N. Popovic, S. Folias, M. Kramer, J. Brea, A. Tort, M. McCarthy, D. Vierling-Claassen, M. Shamir, R. Osan, E. Sherwood, E. Munro, S. Ching, A. Barakat, J. Lee, S. Vijayan, J. Lee (7 female).

Undergrad: S. Jativa (female)

PUBLICATIONS

1. N. Kopell, Commuting diffeomorphisms. In *Global Analysis*, Symposia in Pure Mathematics, American Mathematical Society, Providence, 1970;**14**:165-84.
2. N. Kopell and L.N. Howard, Horizontal bands in the Belousov reaction. *Science*, 1973; **180**:1171-3. PMID: 17743601
3. N. Kopell and L.N. Howard, Plane wave solutions to reaction diffusion equations. *Studies in Appl. Math.*, 1973;**52**:291-328.
4. N. Kopell, Discussion paper: Dissipative and non-dissipative structure. *Ann. of the N.Y. Acad. Sciences*, 19974;**231**:106-7. PMID: 4522887
5. N. Kopell and L.N. Howard, Bifurcation under non-generic conditions. *Adv. in Math.*, 1974;**13**:274-83.
6. N. Kopell and L.N. Howard, Pattern formation in the Belousov reaction. *Lectures on Mathematics in the Life Sciences*, 1974;**7**:201-16.
7. L.N. Howard and N. Kopell, Wave trains, shock structures and transition layers in reaction-diffusion equations. In *Mathematical Aspects of Chemical and Biochemical Problems and Quantum Chemistry*, AMS-SIAM Proceedings, American Mathematical Society, Providence, 1974;**8**:274-83.
8. N. Kopell and L.N. Howard, Bifurcations and trajectories joining critical points. *Adv. in Math.*, 1975;**18**:306-58.
9. N. Kopell and G. Stolzenberg, Commentary on Bishop's talk. *Historia Mathematica*, 1975;**2**:519-21.
10. L.N. Howard and N. Kopell, Translation, with editorial comments, of E. Hopf's Abzweigung einer periodischen Lösung von einer stationären Lösung eines Differentialsystems. In *The Hopf Bifurcation and its Applications*, Applied Mathematical Sciences, J. Marsden and M. McCracken, eds., Springer-Verlag, New York, 1978;**19**: 163-205.

11. L.N. Howard and N. Kopell, Slowly varying waves and shocks in reaction-diffusion equations. *Studies in Appl. Math.*, 1977;**56**:95-145.
12. N. Kopell, Waves, shocks and target patterns in an oscillating chemical reagent. In *Nonlinear Diffusion*, Research Notes in Mathematics, 1977;**14**:129-54, Pitman.
13. N. Kopell, Pattern formation in chemistry and biology: A mini-survey of mechanisms. In *Psychology and biology of language and thought: Essays in honor of Eric Lenneberg*, G. Miller, ed., Academic Press, New York, 1978;65-85.
14. N. Kopell, Reaction-diffusion equations and pattern formation. In *Studies in mathematical biology*, S. Levin, ed. MAA Studies in Mathematics, Mathematical Association of America, 1978;**15**:191-205.
15. N. Kopell, A geometric approach to boundary layer problems exhibiting resonance. *SIAM J. Appl. Math.*, 1979;**37**:436-58.
16. N. Kopell, Time periodic but spatially irregular solutions to a model reaction-diffusion equation. In *Nonlinear dynamics*, R. Helleman, ed., N.Y. Academy of Sciences, New York, 1980;397-409.
17. N. Kopell, The singularly perturbed turning point problem: A geometric approach. In *Singular perturbations and asymptotics*, R. Meyer, ed., Academic Press, New York, 1980; 173-90.
18. N. Kopell and L.N. Howard, Target patterns and horseshoes from a perturbed central force problem: Some temporally periodic solutions to reaction-diffusion equations, *Studies in Appl. Math.*, 1981;**64**:1-56.
19. N. Kopell and S. Parter, A complete analysis of a model nonlinear equation having a continuous locus of turning points. *Advances in Appl. Math.*, 1981;**2**:212-38.
20. N. Kopell and L.N. Howard, Target patterns and spiral solutions to reaction-diffusion equations with more than one space dimension. *Adv. Appl. Math.*, 1981;**2**:417-49.
21. N. Kopell, Target pattern solutions to reaction-diffusion equations in the presence of impurities. *Adv. Appl. Math.*, 1981;**2**:389-99.
22. N. Kopell and R. Washburn, Chaotic motions in the two-degree of freedom swing equations. *IEEE Transactions on Circuits and Systems*, Special Issue on Power Systems, Vol. CAS-29, 1982;**11**:738-46.
23. N. Kopell, Frequency plateaus in a chain of weakly coupled oscillators. In *Nonlinear partial differential equations*, Contemporary Mathematics, J. Smoller, ed., American Mathematical Society, Providence, 1982;**17**:401-4. (This is an exposition of the ideas in 25.)
24. N. Kopell and G.B. Ermentrout, Coupled oscillators and mammalian small intestines. In *Oscillation in mathematical biology*, Lecture Notes in Biomathematics, J.P.E. Hodgson, ed., Springer-Verlag, New York, 1982;**51**:24-36.
25. G.B. Ermentrout and N. Kopell, Frequency plateaus in a chain of weakly coupled Oscillators. *SIAM J. on Math. Anal.*, 1984;**15**:215-37.
26. N. Kopell, Forced and coupled oscillators in biological applications. Proc. of the 1983 International Congress, Warsaw, North Holland, Amsterdam, 1984;1645-60.
27. N. Kopell, Symmetry and coherence in a chain of coupled oscillators. In *Chaos in nonlinear dynamical systems*, J. Chandra, ed., SIAM, Philadelphia, 1984;86-93.

28. N. Kopell, Invariant manifolds and the initialization problem for some atmospheric equations. *Physica D*, 1985;**14**:203-15.
29. G.B. Ermentrout and N. Kopell, Parabolic bursting in an excitable system coupled with a slow oscillation. *SIAM J. Appl. Math.*, 1986;**46**:233-53.
30. N. Kopell and G.B. Ermentrout, Subcellular oscillations and bursting. *Math. Biosciences*, 1986;**78**:265-91.
31. N. Kopell and D. Ruelle, Bounds on complexity in reaction-diffusion systems. *SIAM J. Appl. Math.*, 1986;**46**:68-80.
32. N. Kopell, Phase methods for coupled oscillators and related topics: An annotated Bibliography. *J. Statistical Physics*, 1986;**44**:1035-42.
33. N. Kopell, Coupled oscillators and locomotion by fish. In *Nonlinear oscillations in biology and chemistry*, H. Othmer, ed., Lecture Notes in Biomathematics, Springer-Verlag, New York, 1986;**66**:166-74.
34. N. Kopell, Modelling C.P.G.'s: A robust approach, in *Neurobiology of vertebrate locomotion*, S. Grillner, P.S.G. Stein, D.G. Stuart, H. Forssberg, and R. Herman, eds., Wenner-Grenn Center International Symposium Series, Macmillan, London, 1986;**45**: 383-5.
35. N. Kopell and G.B. Ermentrout, Symmetry and phaselocking in chains of weakly coupled Oscillators. *Comm. Pure Appl. Mathematics*, 1986;**39**:623-60.
36. N. Kopell, Toward a theory of modelling central pattern generators. In *Neural control of rhythmic movements*, A. Cohen, S. Grillner, S. Rossignol, eds., J. Wiley, New York, 1987;369-413.
37. N. Kopell and G.B. Ermentrout, Coupled oscillators and the design of central pattern Generators. *Math. Biosciences*, 1988;**90**:87-109.
38. N. Kopell, Chains of oscillators and the effects of multiple coupling. Appendix to studies of the lamprey central pattern generator for locomotion: A close relationship between modeling and experimentation, by A.H. Cohen, in *Dynamic patterns in complex systems*, S. Kelso, ed., World Scientific Publishers, 1988;156-161.
39. G.B. Ermentrout and N. Kopell, Some mathematical questions concerning central pattern generators. In *Theoretical models of cell signalling*, A. Goldbeter, ed., Academic Press, New York, 1989;89-98.
40. N. Kopell and G.B. Ermentrout, Structure and function in an oscillating neural network. In *Computational neuroscience*, E. Schwartz, ed., MIT Press, Boston, 1990;201-9.
41. G.B. Ermentrout and N. Kopell, Oscillator death in systems of coupled neural oscillators. *SIAM J. Appl. Math.*, 1990;**50**:125-46.
42. N. Kopell and G.B. Ermentrout, Phase transitions and other phenomena in chains of oscillators. *SIAM J. Appl. Math.*, 1990;**50**:1014-52.
43. D.G. Aronson, G.B. Ermentrout and N. Kopell, Amplitude response of coupled Oscillators. *Physica D*, 1990;**41**:403-49.

44. N. Kopell, W. Zhang and G.B. Ermentrout, Multiple coupling in chains of oscillators. *SIAM J. Math. Anal.*, 1990;**21**:935-53.
45. T. Williams, K. Sigvardt, N. Kopell, G.B. Ermentrout, and M. Remler, Forcing of coupled nonlinear oscillators: Studies of intersegmental coordination in the lamprey locomotor central pattern generator. *Journal of Neurophysiology*, 1990;**64**:862-71. PMID: 2230930
46. G.B. Ermentrout and N. Kopell, Multiple pulse interactions and averaging in coupled neural oscillators. *Journal of Math. Biol.*, 1991;**29**:195-217.
47. N. Kopell, G.B. Ermentrout and Thelma Williams, On chains of neural oscillators forced at one end. *SIAM J. Appl. Math.*, 1991;**51**:1397-17.
48. C. Jones, N. Kopell and R. Langer, Construction of the FitzHugh-Nagumo pulse using differential forms. In *Pattern and dynamics in reactive media*, IMA Volumes in Mathematics and its Applications, H. Swinney, G. Aris and D. Aronson, eds., Springer-Verlag, New York, 1991;**37**:101-16.
49. A.H. Cohen, G.B. Ermentrout, T. Kiemel, N. Kopell, K. Sigvardt, and T. Williams, Modelling of intersegmental coordination in the lamprey central pattern generator for Locomotion. *Trends in Neurosciences*, 1992;**15**:434-438. PMID: 1281350
50. N. Kopell, Dynamical systems and the geometry of singularly perturbed equations. In *From topology to computation: Proceedings of the Smalefest*, Springer-Verlag, New York, 1993;.
51. D. Somers and N. Kopell, Rapid synchronization through fast threshold modulation. *Biol. Cybern.*, 1993;**68**:393-407. PMID: 8476980
52. E. Marder, L. Abbott, A. Sharp, and N. Kopell, Electrical coupling in networks containing oscillators. In *Neuroscience: From neural networks to artificial intelligence*, Research notes in neural computing, M. Arbib, P. Rudomin, and F. Cervantes, eds., Springer Verlag, New York, 1993;33-42.
53. N. Kopell, Rhythms and clues: Mechanisms of self-organization in nature, 1993 University Lecture, Boston University, Boston MA, 1994.
54. C. Jones and N. Kopell, Tracking invariant manifolds with differential forms in singularly perturbed equations. *J. Diff. Equa.*, 1994;**108**:64-88.
55. T. LoFaro, N. Kopell, E. Marder, and S. Hooper, Subharmonic coordination in networks of neurons with slow conductances. *Neural Computation*, 1994;**6**:69-84.
56. G.B. Ermentrout and N. Kopell, Inhibition-produced patterning in chains of coupled nonlinear oscillators. *SIAM J. Appl. Math.*, 1994;**54**:478-507.
57. G.B. Ermentrout and N. Kopell, Learning of phase-lags in coupled neural oscillators. *Neural Computation*, 1994;**6**:225-41.

Comment [1]: What are the page numbers for this chapter?

58. F. Skinner, N. Kopell and E. Marder, Mechanisms for oscillation and frequency control in networks of mutually inhibitory relaxation oscillators. *J. Computational Neuroscience*, 1994;**1**:69-87. PMID: 8792226
59. F. Skinner, S. Gramoll, R. Calabrese, N. Kopell, and E. Marder, Frequency control in biological half-center oscillators. In *Computations in neurons and neural systems*, F.H. Eeckman, ed., Kluwer, Boston, 1994;223-8.
60. T. LoFaro, N. Kopell, E. Marder, and S. Hooper, The effect of i_h bursting patterns of pairs of coupled neurons. In *Computations in neurons and neural systems*, F.H. Eeckman, ed., Kluwer, Boston, 1994;15-20.
61. N. Kopell and G. LeMasson, Rhythmogenesis, amplitude modulation and multiplexing in a cortical architecture. *Proc. Nat. Acad. Sci. U.S.A.*, 1994;**91**:10586-90. PMID: 7937997
62. S.K. Tin, N. Kopell and C.K.R.T. Jones, Invariant manifolds and singularly perturbed boundary value problems. *SIAM J. Num. Anal.* (special volume in honor of S. Parter), 1994;**31**:1558-76.
63. N. Kopell and D. Somers, Anti-phase solutions in relaxation oscillators coupled through excitatory interactions. *J. Math. Biol.*, 1995;**33**:261-80. PMID: 7897329
64. N. Kopell, Chains of coupled oscillators. In *Handbook of brain theory and neural networks*, M. Arbib, ed., MIT Press, Cambridge, 1995;178-83.
65. N. Kopell and M. Landman, Spatial structure of the focusing singularity of the nonlinear Schrodinger equation: A geometric analysis. *SIAM J. Appl. Math.*, 1995;**55**:1297-323.
66. D. Somers and N. Kopell, Waves and synchrony in arrays of oscillators of relaxation and non-relaxation type. *Physica D*, 1995;**89**:169-83.
67. N. Kopell, Global center manifolds and singularly perturbed equations. A brief guide to the literature. In *Lectures in applied math*, American Mathematical Society, Providence, 1996;**31**:47-50.
68. C. Jones, T. Kaper and N. Kopell, Tracking invariant manifolds up to exponentially small errors. *SIAM J. Math. Anal.*, 1996;**27**:558-77.
69. C. Soto-Trevino, N. Kopell and D. Watson, Parabolic bursting revisited. *J. Math. Biol.*, 1996;**35**:114-28. PMID: 9002243
70. D. Terman, A. Bose and N. Kopell, Functional reorganization in thalamocortical networks: Transition between spindling and delta sleep rhythms. *Proc. Nat. Acad. Sci. U. S. A.*, 1996;**93**:15417-22. PMID: 8986826
71. N. Kopell, Oscillating networks of neurons: Mathematics and function. In *Proc. of The legacy of Norbert Wiener: A centennial symposium*, American Mathematical Society, Providence, 1997.
72. J.M. Weimann, P. Skiebe, H. Heinzel, C. Soto, N. Kopell, J.C. Jorge-Rivera, and E. Marder, Modulation of oscillator interactions in the crab stomatogastric ganglion by crustacean cardioactive peptide. *J. Neurosci.*, 1997;**17**:1748-60. PMID: 9030633
73. F. Skinner, N. Kopell and B. Mulloney, How does the crayfish swimmeret system work: Insights from nearest-neighbor coupled oscillator models. *J. Comp. Neurosci.*, 1997;**4**:151-60.

74. E. Marder, N. Kopell and K. Sigvardt, How computation aids in understanding biological networks. In *Neurons, networks and motor behavior*, P.S.G. Stein, S. Grillner, A.I. Selverston, and D.G. Stuart, eds., MIT Press, Cambridge, MA, 1998;139-50.
75. M. Hayes, T. Kaper, N. Kopell, and K. Ono, On the application of geometric singular perturbation theory to some classical two-point boundary value problems. *Intl. J. Bifurcations and Chaos*, 1998;**8**:189-209.
76. J. White, C. Chow, J. Ritt, C. Soto-Trevino, and N. Kopell, Synchronization and oscillatory dynamics in heterogeneous, mutually inhibited neurons. *J. Comput. Neurosci.*, 1998;**5**:5-16. PMID: 9580271
77. G.B. Ermentrout and N. Kopell, Fine structure of neural spiking and synchronization in the presence of conduction delays. *Proc. Nat. Acad. Sci. U. S. A.*, 1998;**95**:1259-64. PMID: 9448319
78. D. Terman, A. Bose, and N. Kopell, Dynamics of two mutually coupled slow inhibitory neurons. *Physica D*, 1998;**117**:241-75.
79. N. Kopell, L. Abbott and C. Soto-Trevino, On the behavior of a neural oscillator electrically coupled to a bistable element. *Physica D*, 1998;**121**:367-95.
80. C. Chow, J. White, J. Ritt, and N. Kopell, Frequency control in synchronized networks of inhibitory neurons. *J. Comput. Neurosci.*, 1998;**5**:407-20. PMID: 9877022
81. N. Kopell, Networks of neurons as dynamical systems: From geometry to biophysics. *Quarterly Appl. Math.*, 1998;**56**:707-18.
82. Y. Manor, F. Nadim, S. Epstein, J. Ritt, E. Marder, N. Kopell, Network oscillations generated by balancing graded asymmetric reciprocal inhibition in passive neurons. *J. Neurosci.*, 1999;**19**:1765-2779. PMID: 10087088
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Comment [2]: Page numbers? From Chapter 8?

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