

BRUCE BARTLETT PECKHAM Curriculum Vitae March, 2011

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Birthdate: October 20, 1954
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EDUCATION

Ph. D. in mathematics, University of Minnesota August, 1988
Thesis Title: *The Closing of Resonance Horns for Periodically Forced Oscillators*
Thesis Advisor: Richard P. McGehee
Professional Degree: Associate in the Society of Actuaries (ASA) Completed May, 1981
A. B. with honors in mathematics, Hamilton College, Clinton, NY May, 1977

RESEARCH INTERESTS

Primary: Dynamical Systems \supset Bifurcation Theory \supset Resonance Phenomena
Forced and Coupled Oscillators, Noninvertible Maps, Ecological Modeling with Dynamical Systems
Secondary: Numerical Analysis, Mathematical Software, Curriculum Development

EXPERIENCE

Professor, Dept. of Mathematics and Statistics, U. Minn. Duluth Sept., 2009 – present
Director of Undergraduate Studies Sept. 2005 – present
Associate Professor, Dept. of Mathematics and Statistics, U. Minn. Duluth Sept. 1995 – Aug. 2009
Visiting Scholar, Dept. of Engineering Mathematics, U. of Bristol, England Sept. 2004 - Dec. 2004
Visiting Scholar, Dept. of Applied Mathematics, University of Colorado Feb. 1997 - April 1997
Visiting Scholar, Institute Nonlineare de Nice, France Sept. 1996 - Nov. 1996
Assistant Professor, Dept. of Mathematics and Statistics, U. Minn. Duluth Sept. 1990 - Aug. 1995
Visiting Assistant Professor, Dept. of Mathematics, Boston University Sept. 1988 - Aug. 1990

Collaborator, Center for Nonlinear Studies, Los Alamos National Lab 1987 - 1995
- involved with modeling and predicting behavior of low temperature helium dynamics

Teaching/Research Assistant, University of Minnesota Sept., 1982 - Aug., 1988
- special programs: UNITE - classes televised for area company employees
-University of Minnesota Talented (High School) Youth Mathematics Program

Teacher/Coach, Delbarton School, Morristown, N.J. Sept., 1979 - June, 1982
- taught Math, Physics, Computer Science
- coached soccer, hockey, lacrosse, the first two as head of the varsity

Actuarial Assistant/Research Analyst, The Paul Revere Life Insurance Company, Worcester, Ma.
July, 1977 - Aug., 1979
- performed all phases--especially design and programming--of computer related special projects
- passed first five actuarial exams (Associate in the Society of Actuaries)

TEACHING HIGHLIGHTS

New Courses Developed: Calculus for Life Sciences: Math 1290, Dynamical Systems: Math 5260, Modeling with Dynamical Systems: Math 5270, Fractal Geometry: Math 5295, Freshman Seminar: Dynamical Systems: Math 1234
Other Specialty Courses: Differential Equations: Math 3280, Real Variables: Math 5201, Real Analysis: Math 8201

PUBLICATIONS

1. Peckham B B, *The Closing of Resonance Horns for Periodically Forced Oscillators*, Thesis, University of Minnesota, 1988.
2. Peckham B B, "The Necessity of the Hopf Bifurcation in Families of Periodically Forced Oscillators," *Nonlinearity* (3), 261-280, 1990.
3. Peckham B B and Kevrekidis I G, "Period Doubling with Higher Order Degeneracies," with I. G. Kevrekidis, *SIAM J Math Analysis*, Vol. 22, No. 6, 1552-1574, November 1991.
4. McGehee R P and Peckham B B, "Resonance Surfaces for Forced Oscillators," Geometry Center Research Report GCG70, Feb. 1995, and *Experimental Mathematics*, Vol.3, No. 3, 221-244, 1994.
5. Peckham B B, Frouzakis C E and Kevrekidis I G, "Bananas and banana splits: A parametric degeneracy in the Hopf bifurcation for maps," with, *SIAM J Math Analysis*, Vol. 26, No. 1, 190-217, 1995.
6. McGehee R P and Peckham B B, "Determining the topology of resonance surfaces for periodically forced oscillators," *Normal Forms and Homoclinic Chaos*, Fields Institute Communications series, AMS, Vol. 4, 233 - 251, 1995.
7. McGehee R P and Peckham B B, "Arnold Flames and Resonance Surface Folds," Geometry Center Research Report GCG84, July 1995, and *International Journal of Bifurcation and Chaos*, Vol. 6, No. 2, 315-336, 1996.
8. Peckham B B, "Real perturbation of complex analytic families: points to regions," University of Colorado Department of Applied Mathematics preprint APPM 312, April 1997, and *International Journal of Bifurcation and Chaos*, Vol. 8, No. 1, 73-93, 1998.
9. Peckham B B, "Global Parametrization and Computation of Resonance Surfaces for Periodically Forced Oscillators," *Numerical Methods for Bifurcation Problems and Large-scale Dynamical Systems*, IMA Volumes in Mathematics and Applications, Volume 119, Springer-Verlag, 385-405, 2000.
10. Peckham B B and Montaldi James, "Real continuation from the complex quadratic family: fixed-point bifurcation sets," *International Journal of Bifurcation and Chaos*, Vol. 10, No. 2, 391-414, 2000.
11. Peckham B B and Kevrekidis I G, "Lighting Arnold Flames: Resonance in Doubly Forced Oscillators," Vol. 15, *Nonlinearity*, 405-428, 2002.
12. Pastor J, Peckham B B, Bridgham S, Weltzin J, and Chen J, "Plant community dynamics, nutrient cycling, and multiple stable equilibria in peatlands," *The American Naturalist*, Vol. 160, No. 5, 553-568, 2002.
13. Frouzakis C E, Kevrekidis I G and Peckham B B, "A route to computational chaos revisited: noninvertibility in the breakup of an invariant circle," *Physica D*, Vol. 177, 101-121, 2003.
14. Graves W G, Peckham B B and Pastor J, "A bifurcation analysis of a differential equations model for mutualism," *Bulletin of Mathematical Biology*, Vol. 68, no. 8, 1837-1850, 2006.
15. Schilder F and Peckham B B, "Computing Arnold Tongue Scenarios," *Journal of Computational Physics*, Vol. 220, 932-951, 2007.
16. Krauskopf, Osinga, and Peckham B B, "Unfolding the Cusp-cusp bifurcation of planar endomorphisms," *SIAM Journal on Dynamical Systems*, Vol. 6(2), 403-440, 2007.

17. Zimmermann L, Peckham B B, Pastor J and Stech H W, "A producer-consumer model with stoichiometric elimination mechanisms," University of Minnesota Duluth Department of Mathematics and Statistics Technical Report, 2008.
18. Lin L, Peckham B B, Stech H W and Pastor J, "A stoichiometric model of two producers and one Consumer," *Journal of Biological Dynamics*, first published: 24 January 2011 (iFirst), pp 1-20 and University of Minnesota Duluth Department of Mathematics and Statistics Technical Report TR-2010-3 (extended version of the paper published in JBD).

SOFTWARE DEVELOPED

"To Be Continued ...," a phase space and bifurcation continuation software package for discrete dynamical systems, continually under development since 1986. See http://www.d.umn.edu/~bpeckham/tbc_home.html.

OTHER PROFESSIONAL PRODUCTS

"Periodically forced oscillators and resonance surfaces," with R. P. McGehee, a 15 minute movie of resonance surfaces for periodically forced oscillators, made at the Geometry Center, Minneapolis, Minnesota, 1992.

EXTERNALLY SPONSORED RESEARCH - as Principal Investigator

National Science Foundation, "Noninvertible Dynamical Systems: A Computer-Assisted Study," Division of Mathematical Sciences, Computational Mathematics Program, Grant no. NSF/DMS-9973926, \$140,000, 1999--2004.

National Science Foundation, "Global Bifurcations of Forced Oscillator Systems," (renewal) Division of Mathematical Sciences, Applied Mathematics and Computational Mathematics, Grant no. NSF/DMS-9020220, \$60,000, 1995-2000.

National Science Foundation, "Global Bifurcations of Forced Oscillator Systems," Division of Mathematical Sciences, Applied Mathematics and Computational Mathematics, Grant no. NSF/DMS-9505051 \$40,000, 1992-95.

AWARDS AND FELLOWSHIPS (excluding NSF grants)

Citation for Excellence in Teaching (as grad. student)	Fall 1985
School of Mathematics Summer Fellowship (as grad. student)	1985, 1986, 1987
University of Minnesota Grant-in-Aid (\$21,000 for research equipment, RA)	1991-92
University of Minnesota Faculty Summer Research Fellowship	Summer 1991
University of Minnesota Single Quarter Leave	Fall Quarter 1992
Minnesota Supercomputer Center	1993-95
70 hours of supercomputing time (6 separate grants)	
University of Minnesota Grant-in-Aid (\$12,500 for Research Assistant)	1994-96
UMD Digital Imaging Lab Proposal: "Computation and Display of Global Bifurcation Surfaces" (for use of facilities)	2000-01
2010 UMD Blehart Distinguished Teaching Award	March, 2010
2010 UMD Swenson College of Science and Engineering Advising Award	March, 2010

LECTURES

1. "Global Properties of Resonance Horns," Fall Meeting of the Midwest Dynamical Systems Conference, Boston University, Boston, Ma., October, 1987.
2. "The Closing of Resonance Horns for Periodically Forced Oscillators," Colloque Bifurcations et Attracteurs, Sophia-Antipolis, France, September, 1988.

3. "A Topological Argument to Prove Existence of the Hopf Bifurcation for Periodically Forced Oscillators," Monday Dynamical Systems Seminar, Boston University, October, 1988.
4. "Closed Resonance Horns for Periodically Forced Oscillators," Colloquium, Worcester Polytechnic Institute, October, 1988.
5. "Closed Resonance Regions," Dynamical Systems Seminar, University of Colorado, Boulder, March 1989.
6. "The Necessity of the Hopf Bifurcation in Families of Periodically Forced Oscillators," International Conference on Dynamical Systems, Control Theory and Applications, Wright State University, June, 1989.
7. "Degenerate Period Doubling Bifurcations," Monday Dynamical Systems Seminar, Boston University, October, 1989.
8. "Bifurcation: Global pictures from local information," Summer Regional Institute in Dynamical Systems, Boston University, July 26, 1990.
9. "Some Bifurcations of Forced Oscillator Systems," Dynamical Systems Seminar, University of Colorado at Boulder, November 29, 1990.
10. "Life without chaos is death, Part I" UMD Undergraduate Colloquium, April 16, 1991.
11. "Life without chaos is death, Part II" UMD Undergraduate Colloquium, April 23, 1991.
12. "The Real Mandelbrot set vs. the real Mandelbrot set," UMD High School Math Contest, May 4, 1991.
13. "Resonance Surfaces and Arnold Horns," Catastrophe Theory Conference (part of Regional Geometry Institute), Boston University, July 1 1991.
14. "The chaos of multiplication by 2," UMD Undergraduate Colloquium, October 15, 1991.
15. "Multiplication by 2 and Chaos," Carleton College Mathematics Colloquium, September, 1992.
16. "Resonance Surfaces for Periodically Forced Oscillators," Dynamics and Mechanics Research Seminar, University of Minnesota, Minneapolis, Minnesota, October 1, 1992.
17. "Resonance Surfaces for Periodically Forced Oscillators," Midwest Dynamical Systems Conference, Fall Meeting, University of Michigan, Ann Arbor, Michigan, Nov. 6, 1992.
18. "Resonance City," Normal Forms and Homoclinic Chaos Workshop, Fields Institute, Waterloo, Ontario, November 12, 1992.
19. "A parametric degeneracy in the Hopf bifurcation for maps," Dynamics and Mechanics Research Seminar, University of Minnesota, Minneapolis, Minnesota, November 19, 1992.
20. "Arnold Flames," Dynamics Seminar, University of Texas, Austin, Texas, March 1, 1994.
21. "Computing Homoclinic Surfaces," Noninvertible Dynamical Systems Conference, Geometry Center, Minneapolis, Minnesota, March 14, 1995.
22. "Arnold Flames and Resonance Surfaces," SIAM Dynamical Systems Activity Group Conference, Snowbird, Utah, May 24, 1995.
23. "Life without chaos is death," UMD Graduate/Undergraduate Colloquium, October 26, 1995.
24. "Arnold Flames and Resonance Surface Folds," 1996 Spring Topology and Dynamics Conference, Ball State University, Muncie, Indiana, March 7, 1996.
25. "The topology and geometry of surfaces of periodic points" or "Handling Arnold flames," Dynamics and Mechanics Research Seminar, University of Minnesota, Minneapolis, Minnesota, April 18, 1996.
26. "Periodically forced oscillators and Circle Maps," Dynamics Seminar, Physiology Department, McGill University, Montreal, July 31, 1996.
27. "Periodically Forced Oscillators and Resonance Surfaces," Mathematics Research Seminar, Institute Non Linear de Nice, Sophia-Antipolis, France, Sept. 1996.
28. "Nonanalytic perturbations of $z^2 + C$ " or "Where are the Arnold tongues in the Mandelbrot set?," Geometry Center Seminar, The Geometry Center, Minneapolis, MN, Jan. 24, 1997.
29. "Periodically Forced Oscillators and Resonance Surfaces," Applied Math Colloquium, University of Colorado, Boulder, Colorado, Feb. 21. 1997.
30. "Real perturbation of the complex quadratic family," Dynamical Systems Research Seminar, Department of Applied Mathematics, University of Colorado, Boulder, CO, Feb. 27, 1997.
31. "Nonanalytic perturbation of complex analytic maps," Applications of Dynamical Systems, SIAM Dynamical Systems Activity Group Conference, Snowbird, Utah, May 18, 1997.
32. "Automatic computation of Resonance Surfaces," IMA Workshop on Numerical Methods for Bifurcation Problems, Sept. 18, 1997.
33. "Growing Arnold Tongues on the Mandelbrot Set," Midwest Dynamical Systems Conference Spring 1998 meeting: Global Analysis 30 Years Later, University of Cincinnati, Cincinnati OH, March 25-29, 1998.

34. "Only Chaos allows survival," UMD Undergraduate Colloquium, Department of Mathematics and Statistics, Jan. 14, 1999.
35. "Doubly Forced Oscillators," Applications of Dynamical Systems, SIAM Dynamical Systems Activity Group's Fifth Conference, Snowbird, Utah, May 23, 1999.
36. "The Breakup of Invariant Circles for Endomorphisms," with Christos E. Frouzakis, Swiss Federal Institute of Technology, Switzerland and I.G. Kevrekidis, Princeton University, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 20, 2001.
37. "A Differential Equations Model of Peatlands," UMD Undergraduate Colloquium, presented with coauthor John Pastor, April 19, 2001.
38. "Life without chaos is death," UMD Graduate/Undergraduate Colloquium, October 11, 2001.
39. "A Differential Equations Model of Peatlands," Gustavus Adolphus College Mathematics Colloquium, March 19, 2002.
40. "The chaos of multiplication by 2," St. Lawrence University Mathematics Colloquium, April 29, 2002.
41. "Chaos, fractals, and dynamics," Program for monthly meeting of Duluth Freethinkers' Society, Nov. 3, 2002.
42. "The chaos of multiplication by 2," UMD Undergraduate Colloquium, Department of Mathematics and Statistics, February 20, 2003.
43. "The breakup of an invariant circle in the presence of noninvertibility," Workshop on Codimension-two bifurcations in Piecewise Smooth Dynamical Systems, July 25-6, 2003, University of Bristol, Bristol, England, July 25, 2003.
44. "Euler's Method: How bad can it be?," UMD Graduate Colloquium, Department of Mathematics and Statistics, Duluth, MN, April 15, 2004.
45. "Noninvertible Arnold Tongues," Bristol Centre for Nonlinear Mathematics Seminar, University of Bristol, Bristol, UK, November 19, 2004. [invited presentation not published]
46. "Arnold tongue scenarios: from circle maps to noninvertible maps of the plane," Nonlinear Mathematics Seminar, University of Surrey, Guildford, Surrey, UK, Nov. 26, 2004.
47. "A differential equations model of mutualism," Mathematical Biology/Dynamics Seminar, Department of Mathematical Sciences, University of Loughborough, UK, December 1, 2004.
48. "A differential equations model of mutualism," Nonlinear Mechanics Seminar University of Bath, Bath, UK, December 14, 2004.
49. "Bifurcation Analysis of a Differential Equations Model for Mutualism," Population Dynamics and Epidemiology session, SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 23, 2005.
50. "Bifurcation Scenarios for maps of the plane," Applied Analysis Seminar, UMD November 3, 2005.
51. "Some differential Equations models for peatland ecology," invited hour presentation, Global Ecology Workshop, Mathematical Biosciences Institute, Ohio State University, Columbus, OH, June 27, 2006.
52. "peatland Models – Old and New," Applied Analysis Seminar, UMD, March 7, 2006.
53. "Stoichiometry Models," Applied Analysis Seminar, UMD March 21, 2006.
54. "Discussion of minisymposium talks," SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 30, 2007. (Session MS64: Modeling Nutrient Constraints: Stoichiometry of Cells Populations, and Ecosystems)
55. "Chaos in the plane: homoclinic tangles and loops," UMD Graduate Colloquium, Oct. 11, 2007.
56. "Bifurcations of noninvertible maps of the plane," Applied Analysis Seminar, UMD, October 16, 2007.
57. "The cusp-cusp bifurcation for noninvertible maps of the plane," Midwest Dynamical Systems Fall Seminar, University of Michigan, Ann Arbor, MI, October 21, 2007.
58. "Euler's Method: How bad can it be?," UMD Graduate Colloquium, Department of Mathematics and Statistics, Duluth, MN, March 11, 2010.

Conference Session Organized: "Modeling nutrient constraints: stoichiometry of cells, populations, and ecosystems," Session MS64, SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 30, 2007. Co-organized with I Loladze and J Pastor.

STUDENTS SUPERVISED

A. GRADUATE STUDENT ADVISEES

1. B J Olsen, "Bifurcations of Piecewise Continuous Functions: A computer-aided case study," M.S. thesis, graduated 1994.
2. Jason Puckett, "Computing Periodic Orbits," M.S. project, graduated 1995.
3. Colleen Frost, "A Comparison Study of the SIS and SIRS Epidemic Models," M.S. project, graduated 1996.
4. Zbigniew Wdowiak, "Newton's and Burgstahler's Root Finding Methods," M.S. project, graduated 1996.
5. Jonathan Drexler, "A Nonanalytic Perturbation of the Complex Quadratic Family of Maps," M.S. project, graduated 1996.
6. Diana Colt, "Modeling viral infections in insect populations," MS project, graduated 1999. (Coadvised with H. Stech.)
7. Angela Cates, "Modeling litter decay and root growth with dynamical systems," MS project, graduated 2000. (Coadvised with H. Stech.)
8. Cosmin Deciu, "Computation of Homoclinic Orbits for the Henon Map," MS thesis, graduated 2000.
9. Wendy Graves, "A Comparison of some Simple Models of Mutualism," MS thesis (but formally a project), graduated 2003.
10. Steve Law, "Computation of Lyapunov Exponents," MS project, graduated 2003.
11. Karl Kruppstadt, "Newton's method for Cubics," MS project, graduated 2004.
12. Laura Zimmermann, "A Producer-consumer model with stoichiometry," MS project, graduated 2006. (Coadvised with J. Pastor.)
13. Laurence Lin, "A stoichiometric model of two producers and one consumer with stoichiometry," MS thesis, graduated 2008. (Coadvised with H. Stech and J. Pastor.)
14. James Polsinelli, "Ergodic Theory and Dynamical Systems," MS project, graduated, 2010. (Coadvised with B. James.)
15. Garrett Taft, "Chaos, Attractors, and the Lorenz Conjecture: Noninvertible transitive maps of invariant sets are sensitive," MS thesis, graduated 2010.
16. Xinyuan Zhang, "Enrichment in a Producer-Consumer Model with varying rates of Stoichiometric Elimination," MS project, expected graduation Nov. 2010.

B. GRADUATE RESEARCH ASSISTANTS

1. Eric Nielsen, Dynamical systems software development, Research Assistant, 1992.
2. Cosmin Deciu, Dynamical Systems software and algorithm development, Research Assistant, 1999-2000.
3. Krishna Kotnana, Dynamical Systems software development and computer support, Research Assistant, 2002-3.
4. Joseph Erickson, Dynamical Systems software development and computer support, Research Assistant, 2004 and 2005.

C. UNDERGRADUATE RESEARCH PROJECTS

1. Zbigniew Wdowiak, "Newton's Method for Cubics," UROP project, 1992.
2. Ron Nelson, "Computing Fractal Basin Boundaries," UROP project, 1993.
3. Mircea Ungureanu, "Nonlinear Dynamics applied to Financial Markets," UROP project, 1999.
4. Tim Luthens, "Changing the topology of surfaces by folding the parameter space," related to NSF grant DMS-9020220, 1999.
5. Brian Ketelboeter, "The Cusp Bifurcation in Two Dimensions," UROP project, 2001.
6. Michael Dvorak, "Use of Dynamical Systems to Control Microorganism Populations," UROP project 2001.
7. Daniel Gastler, "The n-body problem," UROP project, 2002-4.
8. Joseph Erickson, Dynamical Systems software development and computer support, Research Assistant, 2003-4.
9. J P Mc Bride, "Software for Dynamical Systems," UROP project, 2006.
10. Seth Slettedahl, "Numerical study of the breakup of an invariant circle in a noninvertible map of the plane," UROP project, 2007.
11. Jacob Yunker, "Statistical analysis for a proposed mechanism of protein-membrane interactions," Honors Project 2010.

12. Brett Bozyk, "The spine of Newton's Method for Cubics," Honors Project 2010.

PROFESSIONAL SERVICE ACTIVITIES

Referee for the following Journals: *Nonlinearity*, *Chaos*, *International Journal of Bifurcation and Chaos*, *IMA Journal of Applied Mathematics*, *Physica D*, *SIAM J. on Applied Dynamical Systems*, *SIAM J. Math Anal.*, *SIAM J. Num. Anal.*, *IEEE Transactions on Circuits and Systems*, *Journal of Mathematical Analysis and Applications*, *Proceedings of the AMS*, *Math Monthly*, *Journal of Biological Dynamics*, *College Mathematics Journal*, *Advances in Difference Equations*

Referee for NSF proposals and NSERC (Canada) proposals.

Reviewer for *Math Reviews* and *Scholarpedia*.

PROFESSIONAL MEMBERSHIPS: American Mathematical Society, Mathematical Association of America, Society for Industrial and Applied Mathematics

UNIVERSITY SERVICE:

Department: Director of Undergraduate Studies (2005-present), Undergraduate Activities Committee, Scholarships and Awards Committee, Liberal/General Education committee, Bulletin committee, Constitution Committee, Webpage, Committee Math Club Advisor, Mathematical Contest in Modeling advisor, High School Math Contest organizer, New Faculty Mentor, Department Executive Committee

Campus: Campus Athletic Committee (chair), Liberal Education Subcommittee