

Stephen Schecter
Professor of Mathematics
North Carolina State University

Education

B.A. (Philosophy), Antioch College, 1970.

M.A. (Mathematics), University of California at Berkeley, 1973.

Ph.D. (Mathematics), University of California at Berkeley, 1975.

- Advisor: Stephen Smale
- Thesis: “Smooth Pareto Economic Systems with Natural Boundary Conditions”

Professional Experience

University of California at Berkeley

- Teaching Assistant, 1972–1975

North Carolina State University

- Visiting Instructor, 1975–1976
- Assistant Professor, 1976–1982
- Associate Professor, 1982–1992
- Professor, 1992–present.
- Mathematics Department Director of Graduate Studies, 1995–1997.

Research Interests

Traveling waves and their stability, geometric singular perturbation theory, systems of conservation laws.

Invited Lectures (since 1982)

- (1) November 1982, University of North Carolina at Charlotte. “Vector fields in the plane with polynomial models” (colloquium).
- (2) August 1983, Special Session on Dynamical Systems at AMS summer meeting, Albany, NY. “Vector fields in the plane with polynomial models.”
- (3) February 1984, Montana State University. “Nonlinear programming with parameters” and “A singular perturbation problem in the plane.”
- (4) May 1985, 7th Symposium on Mathematical Programming with Data Perturbations, Washington, DC. “Structure of the Kuhn-Tucker sets in nonlinear programs with parameters.”

- (5) August 1985, Special Session on Dynamical Systems at AMS summer meeting, Laramie, WY. "Melnikov's method at a saddle-node and the dynamics of the Josephson junction."
- (6) October 1985, International Conference on Parametric Optimization, Plaue, East Germany. "Structure of the Kuhn-Tucker sets in nonlinear programs with parameters."
- (7) February 1986, Michigan State University. "Melnikov's method at a saddle-node and the dynamics of the Josephson junction."
- (8) July 1986, Canadian Mathematical Society International Conference on Differential Equations, Toronto. "Stable manifolds in the method of averaging."
- (9) March 1987, University of Miami. "Melnikov's method at a saddle-node and the dynamics of the Josephson junction."
- (10) August 1987, Conference on Generic Families of Vector Fields, University of Montreal. "Codimension three bifurcations occurring in the study of traveling wave solutions of a nonstrictly hyperbolic equation."
- (11) March 1988, Piedmont Dynamical Systems Conference, University of North Carolina at Charlotte. "Interaction of equilibrium and heteroclinic bifurcation for planar vector fields."
- (12) July 1988, International Conference on Bifurcation Theory and its Numerical Analysis, Xian, China. "Interaction of equilibrium and heteroclinic bifurcation for planar vector fields."
- (13) December 1988, Duke University. "Shocks, traveling waves, and heteroclinic bifurcation."
- (14) June 1989, Conference on the Qualitative Theory of Vector Fields, University of Montreal. "Shocks, traveling waves, and heteroclinic bifurcation."
- (15) May 1990, SIAM Conference on Dynamical Systems, Orlando. "Simultaneous equilibrium and heteroclinic bifurcation."
- (16) July 1991, Second Workshop on Partial Differential Equations, IMPA, Rio de Janeiro. "Heteroclinic bifurcation theory and shock waves."
- (17) June 1992, European Bifurcation Theory Group Conference on Bifurcations in Differentiable Dynamics, Diepenbeek, Belgium. "Rate of convergence of numerical approximations to homoclinic and heteroclinic bifurcation points."
- (18) November 1992, University of Houston. "Shock waves and heteroclinic bifurcations" and "Numerical computation of homoclinic orbits."

- (19) February 1993, Georgia Institute of Technology. “Shock waves and heteroclinic bifurcations” and “Numerical computation of homoclinic orbits.”
- (20) May 1993, Duke University. “Numerical computation of homoclinic and heteroclinic solutions.”
- (21) July 1993, Third Workshop on Partial Differential Equations, IMPA, Rio de Janeiro. “Riemann problems that are stable to perturbation.”
- (22) August 1993, Equadiff 8, Bratislava, Slovakia. “Riemann problems that are stable to perturbation.”
- (23) September 1993, European Bifurcation Theory Group Conference on Dynamics, Bifurcations, and Symmetries, Cargèse, Corsica. “Riemann problems that are stable to perturbation.”
- (24) July 1995, Conference on Problems and Methods in Singular Perturbations, CIRM, Marseilles. “Riemann problems of codimension 0 and 1.”
- (25) November 1995, University of North Carolina at Wilmington. “Structurally stable Riemann problem solutions.”
- (26) March 1996, Special Session on Current Issues in Nonlinear Conservation Laws, AMS Sectional Meeting, Iowa City. “Riemann problem solutions of codimensions 0 and 1.”
- (27) March 1996, Iowa State University. “Riemann problem solutions of codimensions 0 and 1.”
- (28) April 1996, Duke University. “Riemann problem solutions of codimensions 0 and 1.”
- (29) October 1997, Special Session on Nonlinear Dynamics and Applications, AMS Sectional Meeting, Atlanta. “Riemann problem solutions of codimensions 0 and 1.”
- (30) November 1997, Conference in Honor of Olga Oleinik, Iowa State University. “Traveling-wave solutions of convection-diffusion equations by center manifold reduction.”
- (31) September 1998, Third Americas Conference on Differential Equations and Nonlinear Analysis, Atlanta. “Traveling-wave solutions of convection-diffusion equations by center manifold reduction.”
- (32) March 1999, Technical University of Vienna. “Traveling-wave solutions of convection-diffusion equations by center manifold reduction.”
- (33) April 1999, University of Missouri. “Loss of normal hyperbolicity in geometric singular perturbation theory.”

- (34) August 2000, SIAM Pacific Rim Dynamical Systems Conference, Maui, HI. “Undercompressive shock waves and the Dafermos regularization.”
- (35) February 2001, University of Massachusetts at Amherst. “Undercompressive shock waves, the Dafermos regularization, and numerical computation of Riemann solutions.”
- (36) July 2001, VII Workshop on Partial Differential Equations: Theory, Computation and Applications, IMPA, Rio de Janeiro. “Transitional shock waves, the Dafermos regularization, and numerical computation of Riemann solutions” (45-minute talk).
- (37) April 2002, University of Kansas. “Numerical computation and stability of Riemann solutions via the Dafermos regularization” (colloquium).
- (38) May 2002, Fourth International Conference on Dynamical Systems and Differential Equations, University of North Carolina at Wilmington. “Computation and stability of Riemann solutions via the Dafermos regularization.”
- (39) July 2002, Special Session on Hyperbolic Systems of Conservation Laws, SIAM Annual Meeting, Philadelphia. “Numerical computation and stability of Riemann solutions via the Dafermos regularization.”
- (40) October 2002, Duke University. “The Dafermos regularization of a system of conservation laws” (seminar talk).
- (41) July 2003, Equadiff, Diepenbeek, Belgium. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”
- (42) October 2003, AMS sectional meeting, special session on nonlinear waves, Chapel Hill, NC. “Dafermos profiles for singular shocks.”
- (43) May 2004, Kyoto University dynamical systems seminar. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”
- (44) May 2004, International Workshop on Bifurcation Theory and Applications, Shanghai Jiao Tong University. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”
- (45) May 2004, Fudan University (Shanghai) partial differential equations seminar. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”

- (46) June 2004, Fifth International Conference on Dynamical Systems and Differential Equations, Pomona, California. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”
- (47) January 2005, Sixth Americas Conference on Differential Equations and Nonlinear Analysis, Santiago, Chile. “Combustion fronts in porous media with two layers.”
- (48) April 2005, Workshop on Structured Dynamical Systems, Lefschetz Center for Dynamical Systems, Brown University. “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws.”
- (49) May 2005, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah. “Combustion fronts in porous media with two layers.”
- (50) July 2006, SIAM Conference on Analysis of Partial Differential Equations. “Exchange Lemma for Nontrivial Slow Flows.”
- (51) November 2006, Boston University dynamical systems seminar. “Stability of patterns.”

Professional Service

- Organizing committee for Workshop on Viscous Profiles and Numerical Methods for Shock Waves, N.C. State University, May 1990.
- Co-organizer, Southeast Dynamical Systems Conference, N.C. State University, April 1992.
- Organizer, minisymposium on “Bifurcation Theory and Systems of Nonlinear Conservation Laws,” SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 1997.
- Co-organizer, minisymposium on “Conservation Laws: Traveling Waves and Other Self-similar Solutions,” SIAM Pacific Rim Dynamical Systems Conference, Lahaina, Hawaii, August 2000.
- Co-organizer, special session on “Traveling Waves and Shock Waves” (16 speakers), Fourth International Conference on Dynamical Systems and Differential Equations, University of North Carolina at Wilmington, May 2002.
- Co-editor, special issue on traveling waves and shock waves, Discrete and Continuous Dynamical Systems, June 2004.

Grants

- N. C. State University Engineering Foundation Grant, Summer 1976.

- N.S.F. Grant MCS-7902524, “Vector Fields in the Plane,” 1979–1981 (with Michael Singer).
- N.S.F. Grant DMS-9002803, “Theory and Applications of Homoclinic and Heteroclinic Bifurcation,” 1990-1992 (with Xiao-Biao Lin).
- N.S.F. Grant DMS-9205535, “Theory and Applications of Homoclinic and Heteroclinic Bifurcation,” 1992-1995 (with Xiao-Biao Lin).
- N.S.F. Grant DMS-9501255, “Singular Perturbation and Riemann Problems,” 1995–1999 (with Xiao-Biao Lin).
- N.S.F. Grant DMS-9973105, “Homoclinic and Heteroclinic Bifurcations, Shock Waves, and Singular Perturbations,” 1999–2003 (with Xiao-Biao Lin).
- N.S.F. Grant DMS-0406016, “The Dafermos regularization of a system of conservation laws,” 2004–2007 (with Xiao-Biao Lin).

Students

- Ph.D. Students: John Shutt (1994), Monique Taylor (current).
- M.S. student: Rebecca Krakowski (1995).

Publications in Refereed Journals

- (1) “Accessibility of optima in pure exchange economies,” *Journal of Mathematical Economics* **4** (1977), 197–216.
- (2) “Structure of the demand function and Pareto optimal set with natural boundary conditions,” *Journal of Mathematical Economics* **5** (1978), 1–21.
- (3) “On the structure of the equilibrium manifold,” *Journal of Mathematical Economics* **6** (1979), 1–5.
- (4) “Planar polynomial foliations” (with M. Singer), *Proceedings of the American Mathematical Society* **79** (1980), 649–656.
- (5) “Separatrices at singular points of planar vector fields” (with M. Singer), *Acta Mathematica* **145** (1980), 47–78; correction, *Acta Mathematica* **151** (1983), 297–298.
- (6) “Feuilletages de \mathbb{R}^3 définis par des équations de Pfaff polynomiales homogènes” (with C.F.B. Palmeira), *Annales de l’Institut Fourier* **32** (1982), 241–250.
- (7) “Applications of the blowing-up construction and algebraic geometry to bifurcation problems” (with M. Buchner and J. Marsden), *Journal of Differential Equations* **48** (1983), 404–433.

- (8) “Examples for the infinite dimensional Morse lemma” (with M. Buchner and J. Marsden), *SIAM Journal on Mathematical Analysis* **14** (1983), 1045–1055.
- (9) “A class of vectorfields on S^2 that are topologically equivalent to polynomial vectorfields” (with M. Singer), *Journal of Differential Equations* **57** (1985), 406–435.
- (10) “Persistent unstable equilibria and closed orbits of a singularly perturbed equation,” *Journal of Differential Equations* **60** (1985), 131–141.
- (11) “Structure of the first-order solution set for a class of nonlinear programs with parameters,” *Mathematical Programming* **34** (1986), 84–110.
- (12) “The saddle-node separatrix-loop bifurcation,” *SIAM Journal on Mathematical Analysis* **18** (1987), 1142–1156.
- (13) “Melnikov’s method at a saddle-node and the dynamics of the forced Josephson junction,” *SIAM Journal on Mathematical Analysis* **18** (1987), 1699–1715.
- (14) “Stable manifolds in the method of averaging,” *Transactions of the American Mathematical Society* **308** (1988), 159–176.
- (15) “Simultaneous equilibrium and heteroclinic bifurcation of planar vector fields via the Melnikov integral,” *Nonlinearity* **3** (1990), 79–99.
- (16) “Undercompressive shocks for nonstrictly hyperbolic conservation laws” (with M. Shearer), *Journal of Dynamics and Differential Equations* **3** (1991), 199–271.
- (17) “ C^p singularity theory and heteroclinic bifurcation with a distinguished parameter,” *Journal of Differential Equations* **99** (1992), 306–341.
- (18) “Heteroclinic bifurcation theory and Riemann problems,” *Matemática Contemporânea* **3** (1992), 165–189.
- (19) “Pitchfork bifurcation with a heteroclinic orbit: Normal form, recognition criteria, and universal unfolding,” *Journal of Differential Equations* **105** (1993), 63–93.
- (20) “Nonstrictly hyperbolic conservation laws with a parabolic line” (with D. Schaeffer and M. Shearer), *Journal of Differential Equations* **103** (1993), 94–126.
- (21) “Numerical computation of saddle-node homoclinic bifurcation points,” *SIAM Journal on Numerical Analysis* **30** (1993), 1155–1178.
- (22) “Riemann problem solutions that are stable to perturbation,” *Tatra Mountains Mathematical Publications* **4** (1994), 187–198.

- (23) “Rate of convergence of numerical approximations to homoclinic bifurcation points,” *IMA Journal of Numerical Analysis* **15** (1995), 23–60.
- (24) “Structurally stable Riemann solutions” (with D. Marchesin and B. J. Plohr), *Journal of Differential Equations* **126** (1996), 303–354.
- (25) “An organizing center for wave bifurcation in multiphase flow models” (with D. Marchesin and B. J. Plohr), *SIAM Journal on Applied Mathematics* **57** (1997), 1189–1215.
- (26) “Classification of codimension-one Riemann solutions” (with B. J. Plohr and D. Marchesin), *Journal of Dynamics and Differential Equations* **13** (2001), 523–588.
- (27) “Codimension-one Riemann solutions: classical missing rarefaction cases,” *Journal of Differential Equations* **157** (1999), 247–318.
- (28) “Codimension-one Riemann solutions: missing rarefactions in transitional wave groups,” *Advances in Differential Equations* **5** (2000), 929–975.
- (29) “Traveling-wave solutions of convection-diffusion systems by center manifold reduction,” *Nonlinear Analysis: Theory, Methods, and Applications* **49** (2002), 35–59.
- (30) “Codimension-one Riemann solutions: missing rarefactions adjacent to doubly sonic transitional waves,” *Journal of Dynamics and Differential Equations* **14** (2002), 295 - 348.
- (31) “Undercompressive shock waves and the Dafermos regularization,” *Nonlinearity* **15** (2002), 1361 - 1377.
- (32) “Geometric singular perturbation analysis of oxidation heat pulses for two-phase flow in porous media” (with D. Marchesin), *Bulletin of the Brazilian Mathematical Society* **32** (2002), 237–270.
- (33) “Oxidation heat pulses in two-phase expansive flow in porous media” (with D. Marchesin), to appear in *ZAMP* **54** (2003), 48–83.
- (34) “Stability of self-similar solutions of the Dafermos regularization of a system of conservation laws” (with X.-B. Lin), *SIAM J. Math. Anal.* **35** (2003), 884–921.
- (35) “Computation of Riemann solutions using the Dafermos regularization and continuation” (with B. Plohr and D. Marchesin), *Discrete and Continuous Dynamical Systems* **10** (2004), 965–986.
- (36) “Existence of Dafermos profiles for singular shocks,” *Journal of Differential Equations* **205** (2004), 185–210.

- (37) “Composite waves in the Dafermos regularization” (with P. Szmolyan), *Journal of Dynamics and Differential Equations* **16** (2004), 847–867.
- (38) “Eigenvalues of self-similar solutions of the Dafermos regularization of a system of conservation laws via geometric singular perturbation theory,” *J. Dynam. Differential Equations* **18** (2006), 53 - 101.
- (39) “Combustion fronts in a porous medium with two layers (with J. C. da Mota), *J. Dynam. Differential Equations* **18** (2006), 615 - 665.
- (40) “Exchange lemmas 1: Deng’s lemma, preprint, January 2007.
- (41) “Exchange lemmas 2: General exchange lemma, preprint, January 2007.
- (42) “Exchange lemmas 3: Rarefactions in the Dafermos regularization (with P. Szmolyan), preprint, January 2007.

Articles in Conference Proceedings

- (1) “Singular points of planar vector fields” (with M. Singer), *Global Theory of Dynamical Systems: Proceedings, Northwestern, 1979*, Springer-Verlag, 1980.
- (2) “Riemann problems involving undercompressive shocks” (with M. Shearer), *PDE’s and Continuum Models of Phase Transitions: Proceedings, Univ. of Nice, 1988* (eds. M. Rascle, D. Serre, M. Slemrod), Springer Lecture Notes in Physics **344** (1989), 187–200.
- (3) “Undercompressive shocks in systems of conservation laws” (with M. Shearer), *Nonlinear Evolution Equations that Change Type* (eds. B. L. Keyfitz and M. Shearer), IMA Volumes in Mathematics and its Applications **27**, Springer-Verlag, 1990.
- (4) “Transversality for undercompressive shocks in Riemann problems” (with M. Shearer), in *Viscous Profiles and Numerical Methods for Shock Waves* (M. Shearer, ed.), SIAM, 1991.

Chapters in Books

- (1) “Bifurcations with symmetry,” in J. Marsden and M. McCracken, *The Hopf Bifurcation*, Springer-Verlag, New York, 1976.