

CURRICULUM VITAE

Michael Shearer

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North Carolina State University
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Education:

1969 - 1972 University of York, Heslington, York
B.A. Mathematics.
1972 - 1975 Wadham College and Mathematical Institute, Oxford
M.Sc., 1973, D. Phil., 1976

Experience:

Professor, North Carolina State University, 1988 - present.
Associate Professor, North Carolina State University, 1985 - 1988.
Assistant Professor, Duke University, 1979 - 1985.
Temporary Lecturer, University College London, 1978 - 1979.
Research Fellow, Fluid Mechanics Research Institute,
University of Essex, 1975 - 1978.

Graduate Students:

Yadong Yang (Ph.D. 1991); Rebecca Segal (Ph.D. 2002); Robert Wieman (Ph.D. 2003),
Rachel Levy (Ph.D. 2005); Lindsay May (Ph.D. 2009)
Ellen Peterson (Ph.D. 2010), Nicholas Giffen (Ph.D. 2010),
Doug Jacobs (MS, 1992), Alan Hoffer (MS, 1993), Sergey Myagchilov (MS, 1994),
Chris Wooten (MS, 1995), Matt Schulze (MS, 1996), Jonathan Rowell (MS 1997),
Quinton Anderson (MS 2002), Eddie Rowe (MS 2005), Terrence Ford (MS 2006)
Sarah Torres (MS 2008)

Current Ph.D. students: Kimberly Spayd (2012), Lake Bookman (2013), Kathy Varga (2014).

Postdoctoral scholars: Michael Gordon (1993-5, now faculty at State Univ. of West Georgia);
Joshua Bostwick (2011-)

Undergraduate Research:

Quinton Anderson (2000), Chris Flake (2002), Meghan McIntyre (2005),
Drumil Patel (2006), Kristoph Kleiner (2006), Nicole Kroeger (2008)
Allison McAllister (2009), Andrew Wright (2010).

Selected Professional Activities:

Editorial Boards: SIAM J. Math. Anal., 1990-present,
Applicable Analysis, 2010-present.
SIURO (SIAM Undergraduate Research Online) 2008-present.
SIAM Science Policy Committee, 2007-present.

SIAM Activity Group in Analysis of PDE: co-founder, 2002; vice-chair 2003-4; chair 2005-6.
 SIAM Committee on the Annual Meeting: 2001-3.
 SIAM Committee for SIAM participation in the Joint Mathematics Meetings, 2000-2002.
 Co-founder and Co-organizer, Graduate Student Applied Mathematics Seminar, NC State Univ.
 Co-founder and faculty advisor, NC State Univ. SIAM student chapter.
Co-organizer: Banff Workshops on Thin Liquid Films, Dec. 2003; Dec. 2012;
 Minisymposium on Thin Liquid Films, ICIAM 2011, Vancouver, July, 2011;
 Minisymposium on Hyperbolic PDE, SIAM Conference on Analysis of PDE,
 Houston, TX, December, 2004;
 3-part Minisymposium on Thin Liquid Films, SIAM Annual Meeting, Denver, CO, July 2009;
 The Geometry and Analysis of Dynamical Systems Conference to Celebrate the
 Mathematical Contributions of Xiao-Biao Lin and Stephen Schechter. February, 2008;
 IPAM Conference on Thin Liquid Films and Fluid Interfaces, January 2006.
Organizer: Nonlinear Differential Equations, Mechanics and Bifurcation: A Conference in Honor
 of David G. Schaeffer, Duke University, May 2002.
 SIAM Conference on Analysis of PDE. Boston, July 2006. Member, organizing committee.
Invited panelist: Promoting Diversity at the Graduate Level in Mathematics, MSRI, October, 2008;
Getting Undergraduates Involved in Research, Blackwell-Tapia Conference, SAMSI, November, 2008.
Prize committees: SIAM student paper prize, 2008; SIAM Analysis of PDE prize, 2009.

Edited Conference Proceedings:

Nonlinear Evolution Equations that Change Type (with B.L. Keyfitz)
 IMA Volumes in Mathematics and its Applications **27**. Springer, 1990.
Viscous Profiles and Numerical Methods for Shock Waves. SIAM, 1991.
Thin Liquid Films and Fluid Interfaces (with R. Behringer). Physica D, 2005.

Teaching Activities:

Duke Endowment Award for Teaching, 1985.
 NC State University Outstanding Teacher Award, 2006.
 LeRoy and Elva Martin Award for Teaching Excellence, 2006.
 Leader, Hewlett Challenge Project Mathematics Team, 2002-4.
 Microsoft Preparing the Future Professors Program, with Rachel Levy, 2003-4.
 NC State *Preparing the Professoriate Graduate Program*, faculty mentor,
 2001-2, 2004-5, 2007-8, 2009-10, 2010-11.
 Lecture notes: Graduate course in Partial Differential Equations.

Selected Publications:

1. Bifurcation from a multiple eigenvalue. *Proceedings of the 1976 Dundee Conference on Ordinary and Partial Differential Equations*. Springer Lecture Notes in Mathematics **564** (1976), 417-424.
2. Small solutions of a nonlinear equation in Banach space for a degenerate case, Proc. Roy. Soc. Edinburgh **79A** (1977), 35-49.
3. Bifurcation in the neighborhood of a non-isolated singular point, Israel J. Math. **30** (1978), 363-381.
4. On the null spaces of linear Fredholm operators depending on several parameters, Math. Proc. Camb. Phil. Soc. **84** (1978), 131-142.
5. Bifurcation of axisymmetric buckled states of a thin spherical shell J. Nonlinear Analysis - TMA. **4** (1980), 699-713.
6. Secondary bifurcation for one-parameter families of bifurcation problems, University of Essex Report No. 97, 1978.
7. Secondary bifurcation near a double eigenvalue, SIAM J. Math. Anal. **11** (1980), 365-389.
8. One parameter perturbations of bifurcation from a simple eigenvalue, Math. Proc. Camb. Phil. Soc. **88** (1980), 111-123.
9. (with I. C. Walton), On bifurcation and symmetry in Benard convection and Taylor vortices, Stud. Appl. Math. **65** (1981), 85-93.
10. Coincident bifurcation of equilibrium and periodic solutions of evolution equations, J. Math. Anal. Appl. **84** (1981), 113-132.
11. The Riemann problem for a class of conservation laws of mixed type, J. Differential Equations **46** (1982), 426-443.
12. Admissibility criteria for shock wave solutions of a system of conservation laws of mixed type, Proc. Roy. Soc. Edinburgh **93A** (1983), 233-244.
13. Elementary wave solutions of the equations describing the motion of an elastic string, SIAM J. Math. Anal. **16** (1985), 447-459.
14. The interaction of transverse waves for the vibrating string. *Physical Mathematics and Nonlinear Partial Differential Equations* (ed. J.H. Lightbourne, S.M. Rankin). Lecture Notes in Pure and Applied Mathematics, Vol. 102. Marcel Dekker, 1985.
15. The nonlinear interaction of smooth travelling waves in an elastic string. J. Wave Motion **7** (1985), 169-175.

16. (with D.G. Schaeffer) Three phase flow in a porous medium and the classification of non-strictly hyperbolic conservation laws. *Proceedings of the Third Army Conference on Applied Mathematics and Computing*, May 1985.
17. The Riemann problem for the planar motion of an elastic string. *J. Differential Equations*, **61** (1986), 149-163.
18. Nonuniqueness of admissible solutions of Riemann initial value problems for a system of conservation laws of mixed type. *Arch. Rat. Mech. Anal.*, **93** (1986), 45-59.
19. Shock waves and bifurcation. *Proceedings of the Brazilian National Colloquium* (ed. L. Gama) 1986.
20. (with D.G. Schaeffer), Recent developments in nonstrictly hyperbolic conservation laws. *Proceedings of the Fourth Army Conference on Applied Mathematics and Computing*, May 1986.
21. (with D.G. Schaeffer), Three phase flow in porous media-recent developments in nonstrictly hyperbolic conservation laws. *Advances in Multiphase Flow and Related Problems* (ed. G. Papanicolaou). SIAM 1986.
22. (with D. G. Schaeffer), The classification of 2×2 systems of non-strictly hyperbolic conservation laws, with application to oil recovery. *Comm. Pure Appl. Math.*, **40** (1987), 141-178.
23. (with D. G. Schaeffer, D. Marchesin and P. Paes-Leme), Solution of the Riemann problem for a prototype 2×2 system of non-strictly hyperbolic conservation laws. *Arch. Rat. Mech. Anal.* **97** (1987), 299-320.
24. Phase jumps near the Maxwell line. *Contemporary Mathematics* **60** (1987), 111-114.
25. (with D.G. Schaeffer), Riemann problems for nonstrictly hyperbolic 2×2 systems of conservation laws. *Trans. A.M.S.*, **301** (1987), 267-306.
26. Loss of strict hyperbolicity for the Buckley-Leverett equations of three phase flow in a porous medium. *Numerical Simulation in Oil Recovery* (ed. M. Wheeler). IMA Volumes in Mathematics and its Applications **11**. Springer, 1987.
27. (with J. Fehribach) The elastic string equations: numerical results using Glimm's method, and two new exact solutions. CRSC Report, NC State Univ., 1987.
28. Dynamic phase transitions in a van der Waals gas. *Quart. Applied Math.*, **46** (1988), 631-636.
29. (with J. Fehribach) Approximately periodic solutions of the elastic string equations. *Applicable Anal.*, **32** (1989), 1-14.

30. (with J. Trangenstein) Loss of real characteristics for models of three-phase flow in a porous medium. *Transport in Porous Media*, **4** (1989), 499-525.
31. (with S. Schechter) Riemann problems involving undercompressive shocks. *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.
32. The Riemann problem for 2x2 systems of hyperbolic conservation laws with case I quadratic nonlinearities. *J. Differential Equations*, **80** (1989), 343-363.
33. (with D.G. Schaeffer) The quasidynamic approximation in critical state plasticity. *Arch. Rat. Mech. Anal.*, **108** (1989), 267-280.
34. (with D.G. Schaeffer and E.B. Pitman) Instability in critical state theories of granular flow. *SIAM J. Appl. Math.*, **50** (1990), 33-47.
35. (with S. Schechter) Undercompressive shocks in systems of conservation laws. *Nonlinear Evolution Equations that Change Type* (eds. B.L. Keyfitz and M. Shearer). IMA Volumes in Mathematics and its Applications **27**. Springer, 1990.
36. (with D.G. Schaeffer) Loss of hyperbolicity in yield vertex plasticity models under nonproportional loading. *Nonlinear Evolution Equations that Change Type* (eds. B.L. Keyfitz and M. Shearer). IMA Volumes in Mathematics and its Applications **27**. Springer, 1990.
37. (with S. Schechter) Undercompressive shocks for systems of nonstrictly hyperbolic conservation laws. *J. Dynamics and Differential Equations*, **3** (1991), 199-271.
38. (with S. Schechter) Transversality for undercompressive shocks in Riemann problems. *Viscous Profiles and Numerical Methods for Shock Waves* (ed. M. Shearer). SIAM 1991.
39. (with D.G. Schaeffer) Scale invariant initial value problems for equations of elastoplasticity, with consequences for multidimensional dynamic plasticity. *European J. Applied Math.* **3** (1992), 225-254.
40. (with D.G. Schaeffer and S. Schechter) Nonstrictly hyperbolic conservation laws with a parabolic line. *J. Differential Equations*, **103** (1993), 94-126.
41. (with D.G. Schaeffer) The initial value problem for a system modelling unidirectional longitudinal elastic-plastic waves. *SIAM J. Math. Anal.*, **24** (1993), 1111-1144.
42. (with D.G. Schaeffer) Unloading near a shear band: a free boundary problem for the wave equation. *Comm. P.D.E.*, **18** (1993), 1271-1298.

43. (with D.G. Schaeffer) Unloading near a shear band in granular material. *Quart. Appl. Math.*, **52** (1994), 579-600.
44. (with F.X. Garaizar, D.G. Schaeffer and J. Trangenstein) Formation and development of shear bands in granular material. *Transactions of the 11th Army Conference on Applied Mathematics and Computing* (1994), 15-28.
45. (with Y. Yang) The Riemann problem for a system of conservation laws of mixed type with a cubic nonlinearity. *Proc. A, Royal Soc. Edinburgh*, **125A** (1995), 675-699.
46. (with D. Jacobs and W. McKinney) Travelling wave solutions of the modified Korteweg-deVries-Burgers Equation. *J. Differential Equations*, **116** (1995), 448-467.
47. (with D.G. Schaeffer) A class of fully nonlinear 2×2 systems of partial differential equations. *Comm. P.D.E.*, **20** (1995), 1105-1131.
48. (with D.G. Schaeffer) Fully nonlinear hyperbolic systems of partial differential equations related to plasticity. *Comm. P.D.E.*, **20** (1995), 1133-1153.
49. Fully nonlinear hyperbolic systems related to hypoplasticity. *Proc. Fifth Int. Conf. on Hyperbolic Problems: Theory, Numerics, Applications*, ed. J. Glimm, M.J. Graham, J.W. Grove, and B.J. Plohr. World Scientific, 1996.
50. (with D.G. Schaeffer) Riemann problems for 5×5 systems of fully nonlinear equations related to hypoplasticity. *Math. Methods in the Applied Sciences*, **19** (1996), 1433-1444.
51. (with D.G. Schaeffer) The influence of material nonuniformity preceding shear-band formation in a model for granular flow. *Euro. J. Applied Math.*, **8** (1997), 457-483.
52. (with F.X. Garaizar and M.K. Gordon) Formation of shear bands in models of granular materials. *Proc. IUTAM Symposium on Mechanics of Granular and Porous Materials*, (N.A. Fleck and A.C.F. Cocks, eds.). Kluwer, 1997.
53. (with M.K. Gordon and D.G. Schaeffer) Plane shear waves in a fully saturated granular medium with velocity and stress controlled boundary conditions. *Int. J. Nonlinear Mechanics*, **32** (1997), 489-503.
54. (with D.G. Schaeffer) Models of Stress Fluctuations in Granular Materials. *Proc. Powders and Grains*, ed. R.P. Behringer and J. Jenkins. Balkema, 1997.
55. (with D.G. Schaeffer) Stress fluctuations in granular materials. *Mechanics of Deformation and Flow of Particulate Materials*, ed. C.S. Chang, A. Misra, R.Y. Liang, and M. Babic. ASCE Publications, 1997.

56. (with F.X. Garaizar and M.K. Gordon) An Elastoplasticity Model for Antiplane Shearing with a Non-Associative Flow Rule: Genuine Nonlinearity of Plastic Waves. *J. Math. Anal. Appl.*, **219** (1998), 344–363.
57. (with L. Howle, D.G. Schaeffer and P. Zhong) Lithotripsy: The Treatment of Kidney Stones with Shock Waves. *SIAM Review*, **40** (1998), 356–371.
58. (with D.G. Schaeffer) A simple model for stress fluctuations in plasticity with application to granular materials. *SIAM J. Appl. Math.*, **58** (1998), 1791–1807.
59. (with Y. Horie and O.J. Schwarz) Discrete element investigation of stress fluctuation in granular flow at high strain rates. *Phys. Review E* **57** (1998), 2053–2061.
60. (with B.L. Hayes) Undercompressive shocks for scalar conservation laws with non-convex fluxes, *Proc. A Royal Soc. Edinburgh*, 129A (1999), 733–754.
61. (with M.R. Schulze) Undercompressive shocks for a system of hyperbolic conservation laws with cubic nonlinearity, *J. Math. Anal. Appl.* **229** (1999), 344–362.
62. (with A.L. Bertozzi and A. Münch) Undercompressive shocks in thin film flows. *Physica D*, **134** (1999), 431–464.
63. (with A.L. Bertozzi and A. Münch) Undercompressive shocks in thin film flow: Experiment, computation and theory. *AMS/IP Studies in Advanced Mathematics* **13** (1999), 43–68.
64. (with P. Gremaud and D.G. Schaeffer) Numerical determination of flow corrective inserts for granular materials in conical hoppers. *International Journal of Non-linear Mechanics*, **35** (2000), 869–882
65. (with P. Gremaud and J.V. Matthews) Similarity solutions for granular flows in hoppers. *Proceedings of the SIAM/AMS Conference on Nonlinear PDEs, Dynamics and Continuum Physics*, J. Bona, K. Saxton, R. Saxton, Eds., *AMS Contemporary Mathematics Series* **255** (2000), 79–95.
66. (with A.L. Bertozzi) Existence of undercompressive traveling waves in thin film equations. *SIAM J. Math. Anal.*, **32** (2000), 194–213.
67. (with R.A. Segal, X. Guan and T.B. Martonen) Mathematical model of airflow in the lungs of children I: Effects of tumor sizes and location. *J. Theoretical Medicine*, **2** (2000), 199–213.
68. (with R.A. Segal, X. Guan and T.B. Martonen) Mathematical model of airflow in the lungs of children II: Effects of ventilatory parameters. *J. Theoretical Medicine*, **3** (2000), 51–62.

69. (with B.L. Hayes) A nonconvex scalar conservation law with a trilinear flux. *Quart. Appl. Math.* **59** (2001), 615–635.
70. (with A.L. Bertozzi, A. Münch and K. Zumbrun) Stability of compressive and undercompressive thin film travelling waves. *European J. Applied Math.*, **12** (2001), 253-291.
71. (with T.P. Witelski and D.G. Schaeffer) A discrete model for an ill-posed nonlinear parabolic PDE. *Physica D*, **160** (2001), 189-221.
72. (with R.A. Segal, C.S. Kim and T.B. Martonen) Computer simulations of particle deposition in the lungs of chronic obstructive pulmonary disease patients. *Inhalation Toxicology*, **14** (2002), 705-720.
73. (with R. Buckingham and A.L. Bertozzi) Thin film traveling waves and the Navier slip condition. *SIAM J. Applied Math.* **63** (2003), 722-744.
74. (with T.P. Witelski and D.G. Schaeffer) Stability of shear bands in an elastoplastic model for granular flow: The role of discreteness. *Math. Models Methods Appl. Sciences.* **13** (2003), 1629-1671.
75. (with P.G. LeFloch) Nonclassical Riemann solvers with nucleation. *Proc. Roy Soc Edinburgh.*, **134A** (2004), 961-984.
76. (with R. Levy) Comparison of Dynamic Contact Line Models for Driven Thin Liquid Films. *Euro. J. Applied Math.*, **15** (2004), 625-642.
77. (with R. Levy) Kinetics and nucleation for driven thin film flow. *Physica D*, **209** (2005), 145-163.
78. (with J.M.N.T. Gray and A.R. Thornton) Time-dependent solutions for particle-size segregation in shallow granular avalanches. *Proc. Roy Soc.*, **462** (2006), 947-972.
79. (with R. Levy) The Motion of a Thin Liquid Film Driven by Surfactant and Gravity. *SIAM J. Applied Math.*, **66** (2006), 1588-1609.
80. (with R. Levy and T.P. Witelski) Growing Surfactant Waves in Thin Liquid Films Driven by Gravity. *AMRX* **2006** (2006), 1-21.
81. (with R. Levy and T.P. Witelski) The influence of insoluble surfactant on the flow of a thin liquid film down an inclined plane. *Euro. J. Appl. Math.* **18** (2007), 679-708.
82. (with T.P. Witelski and D.G. Schaeffer) Boundary-Value Problems for Hyperbolic Equations Related to Steady Granular Flow. *Mathematics and Mechanics of Solids* **12** (2007), 665-699.

83. (with R. Levy and P. Taylor) Automated Review of Prerequisite Material for Intermediate-level Undergraduate Mathematics, PRIMUS, **17** (2007), 167-180.
84. (with J.M.N.T. Gray and A.R. Thornton) Stable solutions of a scalar conservation law for particle-size segregation in dense granular avalanches. Euro. J. Appl. Math. **19** (2008), 61-86.
85. (with M. McIntyre, E.L. Rowe, J.M.N.T. Gray and A.R. Thornton) Evolution of a Mixing Zone in Granular Avalanches. Appl. Math. Research Express. (AMRX) **2008** (2008), article abm008, 12 pages.
86. (with E. R. Peterson, R. Levy, T. P. Witelski) Stability of Traveling Waves in Thin Liquid Films Driven by Gravity and Surfactant. Hyperbolic Problems (HYP2008), ed. E. Tadmor, J.-G. Liu, A. Tzavaras. AMS 2009.
87. (with P. Gremaud and K. Kleiner) Periodic motion of a mass-spring system. IMA J. Appl. Math. page hxp032, 2009.
88. (with N. Giffen) Shock Formation and Breaking in Granular Avalanches. Discrete and Continuous Dynamical Systems. **27** (2) (2010), 693-714.
89. (with L.B.H. May and K.E. Daniels) Scalar Conservation Laws with Nonconstant Coefficients with Application to Particle Size Segregation in Granular Flow. J. Nonlinear Science. DOI 10.1007/s00332-010-9069-7 **20** (2010), 689-707.
90. (with L.B.H. May, L. A. Golick, K. C. Phillips, and K. E. Daniels) Shear-driven size segregation of granular materials: modeling and experiment. Physical Review E, **81**(1) (2010), 051301.
91. (with L.B.H. May, N. Giffen, K.E. Daniels) The Gray-Thornton Model of Granular Segregation. Proc. Joint IUTAM-ISIMM Symposium on *Mathematical Modeling and Physical Instances of Granular Flows*. Eds. J.D. Goddard, J.T. Jenkins, P. Giovine. American Inst. Physics, 2010, 371-378.
92. (with C.M. Dafermos) Finite time emergence of a shock wave for scalar conservation laws. J. Hyperbolic Eqns. **7** (1) (2010), 107-116.
93. (with E.R. Peterson) Radial spreading of surfactant on a thin liquid film. Appl. Math. Res. Express (2010) doi: 10.1093/amrx/abq015
94. (with K. Spayd) The Buckley-Leverett equation with dynamic capillary pressure. SIAM J. Appl. Math., **71** (2011), 1088-1108
95. (with K. Spayd) Stability of plane waves in two phase porous media flow. Applicable Analysis, Applicable Analysis (2011) DOI:10.1080/00036811.2011.618128
96. (with E.R. Peterson) Simulation of surfactant spreading on a thin liquid film. Appl. Math. Comp. (2011) doi:10.1016/j.amc.2011.11.002