Curriculum Vitae

Bruce E. Turkington
Department of Mathematics and Statistics
University of Massachusetts
Amherst, MA 01003

Education:

- B.S., University of Victoria, Canada, 1974
- M.S., Stanford University, 1976
- Ph.D., Stanford University, 1978

Professional Experience:

- Assistant Professor, Northwestern University, 1978-84
- Visiting Scientist, Mathematical Research Center, University of Wisconsin at Madison, September 1981 - August 1982
- Associate Professor, University of Massachusetts, 1984-90
- Professor, University of Massachusetts, 1990 - present
- Visiting Scientist, Mathematical Institute, Oxford University, January - July 1991
- Director, Center for Applied Mathematics, University of Massachusetts, 1991 - 1996
- Director, Master's Degree Program in Applied Mathematics, University of Massachusetts, 1992 - 2002
- Visiting Scientist, Lawrence Berkeley National Laboratory, University of California, Berkeley, January - July 1998 and June - July 1999.
- Department Head, 2002-2005

Honors and Awards:

- Governor General's Gold Medal (for highest rank in graduating class), University of Victoria, 1974
- Imperial Oil Graduate Research Fellowship and National Research Council of Canada Postgraduate Fellowship (for graduate study at Stanford University), 1974-1978
- College Outstanding Teacher Award, Natural Sciences and Mathematics, University of Massachusetts, 1997

Research Interests:

- Nonlinear partial differential equations and their applications in continuum mechanics, especially fluid dynamics
- Statistical theories of turbulence, vortex motion, geophysical fluid dynamics, and magnetohydrodynamics
- Numerical analysis and scientific computation, especially optimization methods for variational problems

Research Support (during past ten years):

- National Science Foundation grants, sole Principal Investigator:
  - 1989-91, DMS-8903172 ($43,889)
  - 1991-92, DMS-9103976 ($19,541)
  - 1993-96, DMS-9307644 ($60,000)
  - 1996-99, DMS-9600060 ($67,900)
  - 1999-02, DMS-9971204 ($105,000)
  - 2002-05, DMS-0207064 ($261,173)
- NATO travel grant, Co-Principal Investigator with G. Majda (Ohio State) and C. Bardos (Paris): 1996-98, Collaborative Research Grant ($6,000)
- National Science Foundation group grant, Co-Principal Investigator with M. Weinberg and three other UMass-NSM faculty: 1999, EIA-9977540 ($250,560)
- Department of Energy grant, Co-Principal Investigator with R. S. Ellis: 1999-02, DE-FG02-99ER25376 ($315,091)

Professional Service:

- Referee for research papers submitted to various journal publications in applied mathematics and fluid mechanics (several reports each year)
- Reviewer of grant proposals submitted to the National Science Foundation and the Department of Energy (several reports each year)
- Member of the Fluids Panel, Applied Mathematics Program of the National Science Foundation: 1997, 1998, 2000
- Member of the Director's Review Panel for Computing Sciences, Lawrence Berkeley National Laboratory, 1998
- Member of the Organizing Committee for the NSF-sponsored Workshop on Research Opportunities in the Mathematical Geosciences, 2001

Invited Presentations (since 1990)

- 1990-1991
  - Magneto-fluid Dynamics Seminar, Courant Institute, New York University
  - Applied Mathematics Seminar, Mathematical Institute, Oxford University
  - Analysis Seminar, University of Bath
  - Applied Mathematics Seminar, DAMTP, University of Cambridge
  - Applied Mathematics Seminar, Imperial College, London
  - Atomic Energy Authority Fusion Theory Colloquium, Culham Laboratory, U.K.
  - Mathematics Colloquium, Heriot-Watt University, Edinburgh
  - Fluid Mechanics Seminar, University of Cambridge
  - Applied Mathematics Seminar, University of Sussex
- 1991-1992
  - Seminar, Institute for Advanced Study, Princeton
- 1992-1993
  - Partial Differential Equations Seminar, Brown University
  - Analysis Seminar, Duke University
  - Lecture, Minisymposium on Applied Mathematics in Plasma Physics, SIAM Annual Meeting, Philadephia
  - Lecture, International Conference on Advances in Geometric Analysis and Continuum Mechanics, Stanford University
  - Three lectures in Ph.D. course on Variational Methods in Fluid Dynamics, University of Twente, the Netherlands
- 1993-1994
  - Lecture, IMACS Workshop on Computational and Theoretical Aspects of Turbulence, Rutgers University
- 1994-1995
  - Lecture, Second International Workshop on Vortex Flows and Related Numerical Methods, St. Sauveur, Quebec
- 1995-1996
  - Seminar, Rensselaer Polytechnic Institute
  - Seminar, Universite de Lyon
  - Seminar, Ohio State University
  - Lecture, International Workshop on Theoretical and Numerical Fluid Mechanics, Vancouver, B.C.

- 1996-1997
  - Lecture, Workshop on Statistics of Vortices in Geophysical Flows, Newton Institute, Cambridge, U.K.
  - Applied Mathematics Seminar, Courant Institute, New York University
  - Lecture, Minisymposium on Magnetohydrodynamics, SIAM Annual Meeting, Stanford
- 1997-1998
  - Lecture, Quatrieme ecole d'ete, Problems de couches limites, phenomenes de charge d'espace et applications, Saint Pierre d'Oleron, France
  - Applied Mathematics Seminar, University of Michigan, Ann Arbor
  - Three lectures, Numerical Analysis Seminar, Lawrence Berkeley National Laboratory, Berkeley
  - Applied Mathematics Seminar, University of California, Berkeley
- 1998-1999
  - Lecture, Second DOE-MICS Workshop on Predictability in Complex Systems, Sandia National Laboratories, Albuquerque
  - Colloquium, Rensselaer Polytechnic Institute
  - Applied Mathematics Seminar, Lawrence Berkeley National Laboratory, Berkeley
  - Panel presentation and session lecture, 1998 AMS-MER-SIAM Workshop on Master's Programs in Mathematics: Exploring Options in Graduate Education, Courant Institute, New York University
- 1999-2000
  - Lecture, Third DOE-MICS Workshop on Predictability in Complex Systems, Los Alamos National Laboratory
  - Lecture, Clifford Lectures and Conference, Tulane University
  - Lecture, Special Session on Vortex Motion, AMS Regional Meeting, Lowell, MA
  - Lecture, IUTAM Symposium on Mathematical Modelling of Ocean and Atmosphere Dynamics, Limerick, Ireland
  - Lecture, AMS-IMS-SIAM Joint Summer Research Conference on Dispersive Wave Turbulence, South Hadley, MA
  - Lecture, Summer Workshop on Industrial Mathematics, Worcester Polytechnic Institute
- 2000-2001
  - Lecture, Workshop on Analytical and Statistical Approaches to Fluid Models, Mathematisches Forschungsinstitut, Oberwolfach, Germany
  - Partial Differential Equations Seminar, Brown University

  - Special Session on New Frontiers in Mathematical Geoscience, Spring Meeting of the American Geophysical Union, Boston, MA, June 2001.

- 2001-2002
  - Minisymposium on Statistical Mechanics Models of Atmosphere and Oceans, First SIAM-EMS Conference, Berlin, Germany, Sept 2001.
  - Lecture, Workshop on Subgrid-scale Phenomena in Atmospheric and Oceanic Flow, Institute of Pure and Applied Mathematics, U.C.L.A.
  - Applied Mathematics Seminar, Courant Institute of Mathematical Sciences, N.Y.U.
  - Lecture, Workshop on Mathematical Theory and Modeling in Atmosphere-Ocean Science, Mathematisches Forschungsinstitut, Oberwolfach, Germany.

- 2002-2005
  - Lecture, Minisymposium on Vorticity Dynamics and Turbulence, First Joint Meeting of CAIMSA and SIAM, Montreal, June 2003.
  - Organizer and Lecture, Minisymposium on Coherent Structures for the Atmosphere and Oceans, SIAM Conference on Nonlinear Waves and Coherent Structures, Orlando, FL, October 2004.
  - Lecture, Workshop on Representing Unresolved Degrees of Freedom for the Atmosphere and Ocean, University of Montreal, Quebec, March 2-4, 2004.

Graduate Advising:

Doctoral students: Sheng Wang (1991), Brian Morris (1991), Richard Jordan (1994), Joseph Heisler (1997), Zhi Liang (2001), Adam Eisner (2004), Viswesvaran Nageswaran (2006).

Master's students (Applied Mathematics Program):

1993 Jennifer Cox, Galina Dinovetsky, Adam Eisner, Ralf Huber, Lori Mastromatteo

1994 Donna Bedinelli, Yaniris Fernandez, Frank Maurer, Mark Stowell

1995 Alison Calderara, Jie Huang, Paul Swaida, Thorsten Zoerner

1996 Jonathan Fienup, Steven Kusiak, Phumaron Nuon

1997 Glenn Fawcett, Steven Huang, Ken Brumer, Claudia Kulesh

1998 Jose Cruz, Greg Streletz, Matthew Tagliani

1999 Christopher Cortese, Sasha Engelbrecht, Brian Kavanagh

2000 Paula Dirubbo, Daniel Holz, Dhanesh Patel, Sebastian Ritterbusch, Markus Stark

2001 Jeff Gagnon, Lixiong Guo, William Morrisey, Zhongwei Yang, Tao Zhu

Publications:

1. Height estimates for exterior problems of capillarity-type, *Pacific Journal of Mathematics* **88**, 517-540, 1980.

2. Asymptotic estimates for an axisymmetric rotating fluid (with A. Friedman), *Journal of Functional Analysis* **37**, 136-163, 1980.

3. The oblateness of an axisymmetric rotating fluid (with A. Friedman), *Indiana University Mathematics Journal* **29**, 777-792, 1980.

4. Existence and dimensions of a rotating white dwarf (with A. Friedman), *Journal of Differential Equations* **42**, 414-437, 1981.

5. Vortex rings: existence and asymptotic estimates (with A. Friedman), *Transactions of the American Mathematical Society* **268**, 1-37, 1981.

6. On steady vortex flow in two dimensions, I, *Communications in Partial Differential Equations* **8(9)**, 999-1030, 1983.

7. On steady vortex flow in two dimensions, II, *Communications in Partial Differential Equations* **8(9)**, 1031-1071, 1983.

8. Steady flow with vorticity, in *Free-boundary problems: theory and applications, vol. 1*, A. Fasano and M. Primicerio, editors, Pitman, 48-51, 1983.

9. Corotating steady vortex flows with N-fold symmetry, *Journal of Nonlinear Analysis: Theory, Methods and Applications* **9(4)**, 351-369, 1985.

10. On the evolution of a concentrated vortex in an ideal fluid, *Archive for Rational Mechanics and Analysis* **97**, 75-87, 1987.

11. Nonlinear steady waves in planetary vortex dynamics, *Indiana University Mathematics Journal* **36**, 811-841, 1987.

12. On the computation of nonlinear planetary waves (with A. Eydeland), *Studies in Applied Mathematics* **76**, 37-67, 1987.

13. A computational methods of solving free boundary problems in vortex dynamics (with A. Eydeland), *Journal of Computational Physics* **78**, 194-214, 1988.

14. An iterative method for computing steady vortex flow systems (with A. Eydeland), in *Mathematical Aspects of Vortex Dynamics*, R. Caflisch, editor, SIAM (Philadelphia) 80-87, 1988.

15. A variational approach to computing plasma equilibria (with A. Eydeland and J. Spruck), in *Proceeding of Workshop on MHD Computations and Torus Confinement Plasmas*, Seiunso in Hakone, Japan, 1988.

16. Vortex rings with swirl: Axisymmetric solutions of the Euler equations with nonzero helicity, *SIAM Journal of Mathematical Analysis* **20**, 57-73, 1989.

17. Computational method for multiconstrained variational problems arising in equilibrium magnetohydrodynamics (with A. Eydeland and J. Spruck), *Proceeding of the Fifth International Symposium on Numerical Methods in Engineering,* Vol. 2, R. Gruber, J. Periaux and R. P. Shaw, eds., Springer-Verlag (Berlin), 1989.

18. Two approaches to computing solutions of stationary problems in fluid dynamics and magnetohydrodynamics (with A. Eydeland), in *Mathematical Analysis of Fluid and Plasma Dynamics*, RIMS Kokyuroku 734, Kyoto University, 1-7, 1990.

19. Multiconstrained variational problems of nonlinear eigenvalue type: new formulations and algorithms (with A. Eydeland and J. Spruck), *Mathematics of Computation* **55**, 509-535, 1990.

20. Numerical test of 3-D vortex methods using a vortex ring with swirl (with J. T. Beale and A. Eydeland), in *Vortex Dynamics and Vortex Methods*, Lectures in Appl. Math. (A.M.S.) **28**, 1-10, 1991.

21. Multiconstrained variational problems in magnetohydrodynamics: equilibrium and slow evolution (with A. Eydeland, A. Lifschitz and J. Spruck), *Journal of Computational Physics* **106**, 269-285, 1993.

22. Maximum entropy states for rotating vortex patches, (with N. Whitaker), *Phys. Fluids A* **6(12)**, 3963-3973, 1994.

23. Turbulent relaxation of a magnetofluid: a statistical equilibrium model, (with R. Jordan), in *Advances in Geometric Analysis and Continuum Mechanics*, International Press (Boston), 124-138, 1995.

24. Maximum entropy states and coherent structures in magnetohydrodynamics (with R. Jordan), in *Maximum Entropy and Bayesian Methods*, K.M. Hanson and R.N. Silver, eds., 347-353, Kluwer Academic Publishers (the Netherlands), 1996.

25. Statistical equilibrium computations of coherent structures in a turbulent shear layer (with N. Whitaker), *SIAM Journal of Scientific Computing* **17(6)**, 1414-1433, 1996.

26. Ideal magnetofluid turbulence in two dimensions (with R. Jordan), *Journal of Statistical Physics* **87(3/4)**, 661-695, 1997.

27. Statistical mechanics of organized structures in two-dimensional magnetofluid turbulence (with R. Jordan), *Nonlinear Analysis: Theory, Methods, and Applications* **30**, 3629-3636, 1997

28. Prototype geophysical vortex structures via large-scale statistical theory (with M. DiBattistia and A. Majda), *Geophysical and Astrophysical Fluid Dynamics* **89**, 235-283, 1998.

29. Statistical equilibrium measures and coherent states in two-dimensional turbulence, *Communications in Pure and Applied Mathematics* **52**, 781-809, 1999.

30. Spatializing random measures: doubly-indexed processes and the large deviation principle (with C. Boucher and R.S. Ellis), *Annals of Probability* **27**, 297-324, 1999.

31. Derivation of maximum entropy principles in two-dimensional turbulence via large deviations (with C. Boucher and R.S. Ellis), *Journal of Statistical Physics* **98**, 1235-1278, 2000.

32. A mean-field statistical theory for the nonlinear Schrödinger equation (with R. Jordan and C. Zirbel), *Physica D* **137**, 353-378, 2000.

33. Large deviation principles and complete equivalence and nonequivalence results for pure and mixed ensembles (with R.S. Ellis and K. Haven), *Journal of Statistical Physics* **101**, 999-1064, 2000.

34. Statistical equilibrium theories for the nonlinear Schrödinger equation (with R. Jordan), *Proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Dispersive Wave Turbulence, June 2000,* P.A. Milewski et al., eds. *Contemporary Mathematics* **283**, 27-39, A.M.S., 2001.

35. A statistical equilibrium model of zonal shears and embedded vortices in a Jovian atmosphere. *Proceedings of the IUTAM Symposium on Advances in Mathematical Modeling of Atmosphere and Ocean Dynamics, Limerick, Ireland, July 2000,* P.F. Hodnett, ed., pp. 271-278, Kluwer, 2001.

36. Statistical equilibrium predictions of jets and spots on Jupiter (with A. Majda, K. Haven and M. DiBattista), *Proceedings of the National Academy of Sciences U.S.A.* **98**, 12346-12350, 2001.

37. Nonequivalent statistical equilibrium ensembles and refined stability theorems for most probable flows (with R.S. Ellis and K. Haven), *Nonlinearity* **15**, 239-255, 2002.

38. Analysis of statistical equilibrium models of geostrophic turbulence (with R. S. Ellis and K. Haven), *Journal of Applied Mathematics and Stochastic Analysis*, **15**, 341-361, 2002.

39. A statistical approach to the asymptotic behavior of a class of generalized nonlinear Schrödinger equations (with R. S. Ellis and R. Jordan), *Communications in Mathematical Physics* **244**, 187-208, 2004.

40. Thermodynamic versus statistical nonequivalence of ensembles for the mean-field Blume-Emery-Griffiths model (with R.S. Ellis and H. Touchette), *Physica A 335*, 518-538, 2004.

41. An introduction to the thermodynamic and macrostate levels of nonequivalent ensembles (with H. Touchette and R.S. Ellis), *Physica A* **340**, 138-146, 2004.

42. The generalized canonical ensemble and its universal equivalence with the microcanonical ensemble (with R.S. Ellis, H. Touchette and M. Costeniuc), *Journal of Statistical Physics* **119**, 1283-1329, 2005.

Submitted for publication:

1. Nonequilibrium statistical behavior of nonlinear Schrödinger equations (with A. Eisner). *Physica D*, 2005.