

Clarence W. Rowley

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Research Interests

My interests involve modeling and control of complex systems, particularly fluids systems. Specific areas of interest include:

- Modeling and model reduction for bifurcation analysis and control.
- Numerical methods, both for fluids simulations, and analysis of dynamical systems.
- Applications of geometric methods in fluid mechanics.

Education

- **California Institute of Technology**, Pasadena, CA 91125
Ph.D. in Mechanical Engineering, Aug. 2001
Thesis: Modeling, simulation, and control of cavity flow oscillations
Advisors: Tim Colonius and Richard M. Murray
- **California Institute of Technology**
M.S. in Mechanical Engineering, June 1996
- **Princeton University**, Princeton, NJ 08544
B.S.E. *Magna cum laude* in Mechanical and Aerospace Engineering, June 1995

Positions Held

- **Princeton University**, Jul. 2007–present
Associate professor, Department of Mechanical and Aerospace Engineering
- **Princeton University**, Apr. 2006–present
Associated faculty member, Program in Applied and Computational Mathematics
- **Princeton University**, Sep. 2001–Jun. 2007
Assistant professor, Department of Mechanical and Aerospace Engineering
- **California Institute of Technology**, Sep. 1995–Aug. 2001
Graduate research assistant

Honors and Awards

- Institute for Defense Analysis, Defense Science Study Group member, 2008–present.
- Princeton Engineering commendation list for outstanding teaching, for MAE 433, Spring 2007.
- AFOSR Young Investigator Award, 2006.
- Excellence in Teaching Award, Princeton Engineering Council, for MAE 433, Spring 2006.
- NSF CAREER Award, 2004.
- Howard B. Wentz Jr. Award for excellence in teaching and scholarship, Princeton University, 2003.
- Excellence in Teaching Award, Princeton Engineering Council, for MAE 433, Fall 2002.
- Princeton University Research Board, Assistant in Research Tuition Award, 2002, 2003.
- Chapman Award for distinguished research in hydrodynamics, California Institute of Technology, June 2002.
- National Science Foundation Graduate Research Fellowship, 1996–1999.
- Guggenheim Fellowship, California Institute of Technology, 1995.
- Donald Janssen Dike Award for Excellence in Undergraduate Research; 3rd place, Princeton University, 1995.
- John Marshall II Memorial Prize; honorable mention, Princeton University, 1995.
- Member, Sigma Xi, Scientific Research Society, 1995.
- Member, Tau Beta Pi, National Engineering Honorary Society, 1995.

Publications

Refereed Journals

Papers submitted and in review:

1. M. Wei and C. W. Rowley. Low-dimensional models of a temporally evolving free shear layer. Submitted to *Journal of Fluid Mechanics*, 2008.
2. Z. Ma, C. W. Rowley, and G. Tadmor. Snapshot-based balanced truncation for linear time-periodic systems. Submitted to *IEEE Transactions on Automatic Control*, 2007.
3. L. N. Cattafesta III, Q. Song, D. R. Williams, C. W. Rowley, and F. S. Alvi. Active control of flow-induced cavity oscillations. Submitted to *Progress in Aerospace Sciences*, 2007.

Papers in press or that have appeared:

4. M. Ilak and C. W. Rowley. Modeling of transitional channel flow using balanced proper orthogonal decomposition. *Physics of Fluids*, to appear, Feb. 2008.
5. M. A. Green, C. W. Rowley, and G. Haller. Detection of Lagrangian coherent structures in 3D turbulence. *Journal of Fluid Mechanics*, 572:111–120, Feb. 2007.
6. S. Ahuja, I. G. Kevrekidis, and C. W. Rowley. Template-based stabilization of relative equilibria in systems with continuous symmetry. *Journal of Nonlinear Science*, 17(2):109–143, 2007.
7. J. B. Melli, C. W. Rowley, and D. S. Rufat. Motion planning for an articulated body in a perfect planar fluid. *SIAM Journal on Applied Dynamical Systems*, 5(4):650–669, Nov. 2006.
8. C. W. Rowley and D. R. Williams. Dynamics and control of high-Reynolds-number flow over open cavities. *Annual Reviews of Fluid Mechanics*, 30:251–276, Jan. 2006.
9. C. W. Rowley, D. R. Williams, T. Colonius, R. M. Murray, and D. G. MacMynowsky. Linear models for control of cavity flow oscillations. *Journal of Fluid Mechanics*, 547:317–330, Jan. 2006.
10. E. Kanso, J. E. Marsden, C. W. Rowley, and J. Melli-Huber. Locomotion of articulated bodies in a perfect fluid. *Journal of Nonlinear Science*, 15(4):255–289, July 2005.
11. C. W. Rowley. Model reduction for fluids using balanced proper orthogonal decomposition. *International Journal of Bifurcation and Chaos*, 15(3):997–1013, Mar. 2005.
12. C. W. Rowley, T. Colonius, and R. M. Murray. Model reduction for compressible flows using POD and Galerkin projection. *Physica D*, 189(1–2):115–129, Feb. 2004.
13. C. W. Rowley, I. G. Kevrekidis, J. E. Marsden, and K. Lust. Reduction and reconstruction for self-similar dynamical systems. *Nonlinearity*, 16:1257–1275, Aug. 2003.

14. C. W. Rowley, T. Colonius, and A. J. Basu. On self-sustained oscillations in two-dimensional compressible flow over rectangular cavities. *Journal of Fluid Mechanics*, 455:315–346, Mar. 2002.
15. C. W. Rowley and J. E. Marsden. Reconstruction equations and the Karhunen-Loève expansion for systems with symmetry. *Physica D*, 142:1–19, Aug. 2000.
16. C. W. Rowley and T. Colonius. Discretely nonreflecting boundary conditions for linear hyperbolic systems. *Journal of Computational Physics*, 157(2):500–538, Jan. 2000.

Book Chapters

Submitted and under review:

1. C. W. Rowley and B. Batten. Dynamic and closed-loop control. In R. D. Joslin and D. N. Miller, editors, *Fundamentals and Applications of Active Flow Control*, in review, 2008.

Appeared:

2. C. W. Rowley. Model reduction for fluids using balanced proper orthogonal decomposition. In *Modeling and Computations in Dynamical Systems: In Commemoration of the 100th Anniversary of the Birth of John von Neumann*, editors E. J. Doedel, G. Domokos, and I. G. Kevrekidis, World Scientific Series on Nonlinear Science, Series B, Vol. 13, 2006.

Note: this article also appeared as reference [11] above.

Refereed Conference Publications

1. T. Colonius, C. W. Rowley, G. Tadmor, D. R. Williams, K. Taira, W. B. Dickson, M. Gharib, and M. Dickinson. Closed-loop control of leading-edge and tip vortices for small UAV. In *Proceedings of the First Berlin Conference on Active Flow Control*, Sep. 2006.
2. D. R. Williams, D. Cornelius, and C. W. Rowley. Supersonic cavity response to open-loop forcing. In *Proceedings of the First Berlin Conference on Active Flow Control*, Sep. 2006.
3. C. W. Rowley and M. Ilak. Reduced-order models of linearized channel flow using balanced truncation. In *14th Mediterranean Conference on Control and Automation*, Ancona, Italy, June 2006.
4. S. Ahuja, I. G. Kevrekidis, and C. W. Rowley. Template-based control of relative equilibria in systems with symmetry. In *Proceedings of the American Controls Conference*, Minneapolis, MN, USA, June 2006.
5. C. W. Rowley and V. Juttijudata. Model-based control and estimation of cavity flow oscillations. In *Proceedings of the 44th IEEE Conference on Decision and Control*, Seville, Spain, Dec. 2005.
6. C. W. Rowley and J. E. Marsden. Variational integrators for degenerate Lagrangians, with application to point vortices. In *Proceedings of the 41st IEEE Conference on Decision and Control*, Las Vegas, NV, USA, Dec. 2002.

7. T. Colonius, C. W. Rowley, J. B. Freund, and R. M. Murray. On the choice of norm for modeling compressible flow dynamics at reduced-order using the POD. In *Proceedings of the 41st IEEE Conference on Decision and Control*, Las Vegas, NV, USA, Dec. 2002.

Other Conference Publications

8. S. Ahuja and C. W. Rowley. Low-dimensional models for feedback stabilization of unstable steady states. AIAA Paper 2008-553, 46th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2008.
9. S. L. Brunton, C. W. Rowley, K. Taira, T. Colonius, J. Collins, and D. R. Williams. Unsteady aerodynamic forces on small-scale wings: experiments, simulations, and models. AIAA Paper 2008-520, 46th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2008. (invited)
10. S. Ahuja, C. W. Rowley, I. G. Kevrekidis, M. Wei, T. Colonius, and G. Tadmor. Low-dimensional models for control of leading-edge vortices: Equilibria and linearized models. AIAA Paper 2007-709, 45th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2007.
11. K. Taira, W. B. Dickson, T. Colonius, M. H. Dickinson, and C. W. Rowley. Unsteadiness in flow over a flat plate at angle-of-attack at low Reynolds numbers. AIAA Paper 2007-710, 45th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2007.
12. D. R. Williams, D. Cornelius, and C. W. Rowley. Closed-loop control of linear supersonic cavity tones. AIAA Paper 2007-4226, June 2007.
13. M. Ilak and C. W. Rowley. Reduced-order modeling of channel flow using traveling POD and balanced POD. AIAA Paper 2006-3194, 3rd AIAA Flow Control Conference, June 2006.
14. M. Wei and C. W. Rowley. Low-dimensional models of a temporally evolving free shear layer. AIAA Paper 2006-3228, 36th AIAA Fluid Dynamics Conference and Exhibit, June 2006.
15. D. R. Williams and C. W. Rowley. Recent progress in closed-loop control of cavity tones. AIAA paper 2006-0712, 44th AIAA Aerospace Sciences Meeting, Jan. 2006. (invited)
16. C. W. Rowley, V. Juttijudata, and D. R. Williams. Cavity flow control simulations and experiments. AIAA Paper 2005-0292, 43rd AIAA Aerospace Sciences Meeting, Jan. 2005.
17. L. Cattafesta, D. R. Williams, C. W. Rowley, and F. Alvi. Review of active control of flow-induced cavity resonance. AIAA Paper 2003-3567, AIAA Fluid Dynamics Conference, June 2003.
18. C. W. Rowley and D. R. Williams. Control of forced and self-sustained oscillations in the flow past a cavity. AIAA Paper 2003-0008, 41st AIAA Aerospace Sciences Meeting, Jan. 2003.
19. D. R. Williams, C. W. Rowley, D. Fabris, T. Colonius, and R. M. Murray. Model-based control of cavity oscillations, Part I: Experiments. AIAA Paper 2002-0971, 40th AIAA Aerospace Sciences Meeting, Jan. 2002.

20. C. W. Rowley, D. R. Williams, T. Colonius, R. M. Murray, D. G. MacMartin, and D. Fabris. Model-based control of cavity oscillations, Part II: System identification and analysis. AIAA Paper 2002-0972, 40th AIAA Aerospace Sciences Meeting, Jan. 2002.
21. C. W. Rowley, T. Colonius, and R. M. Murray. Dynamical models for control of cavity oscillations. AIAA Paper 2001-2126, 7th AIAA/CEAS Aeroacoustics Conference, May 2001.
22. T. Colonius, C. W. Rowley, and V. Theofilis. Global instabilities and reduced-order models of cavity flow oscillations. In *First Symposium on Global Flow Instability and Control*, Crete, Greece, 2001.
23. C. W. Rowley, T. Colonius, and R. M. Murray. POD based models of self-sustained oscillations in the flow past an open cavity. AIAA Paper 2000-1969, 6th AIAA/CEAS Aeroacoustics Conference, June 2000.
24. T. Colonius, A. Basu, and C. W. Rowley. Computation of sound generation and flow/acoustic instabilities in the flow past an open cavity. FEDSM99-7228, 3rd ASME/JSME Joint Fluids Engineering Conference, July 1999.
25. T. Colonius, A. J. Basu, and C. W. Rowley. Numerical investigation of the flow past a cavity. AIAA Paper 99-1912, 5th AIAA/CEAS Aeroacoustics Conference, May 1999.
26. C. W. Rowley and T. Colonius. Numerically nonreflecting boundary conditions for multidimensional aeroacoustic computations. AIAA Paper 98-2220, 4th AIAA/CEAS Aeroacoustics Conference, June 1998.
27. M. L. Baumgartner, A. J. Smits, T. Nau, and C. W. Rowley. A new hypersonic boundary layer facility. AIAA Paper 95-0787, 33rd AIAA Aerospace Sciences Meeting, Jan. 1995.

Invited Lectures

Seminars

1. New Mexico State University, Mechanical Engineering seminar, “Simple dynamics from complex data: Model reduction for control of fluids,” Apr 2007.
2. Royal Institute of Technology (KTH), Stockholm, Sweden, Linné flow seminar, “Model reduction for control of fluids, using balanced truncation,” Mar 2007.
3. New Jersey Institute of Technology, Mathematical Sciences Department seminar, “Simple dynamics from complex data: Model reduction for control of fluids,” Feb 2007.
4. Princeton University, Program in Integrative Information, Computer and Application Sciences (PICASso), Interdisciplinary Computational Seminar, “Simple dynamics from complex data: Model reduction for control of fluids,” Dec 2006.
5. Princeton University, Mechanical and Aerospace Engineering seminar, “Recent progress in modeling and control of fluids,” Oct 2006.
6. University of Bielefeld, Germany, Mathematics seminar, “Template-based methods for model reduction and control of systems with symmetry,” July 2006.
7. Caltech, Mechanical Engineering seminar, “Advances in low-dimensional modeling of fluids: cavities, channels, and airfoils,” Apr 2006.
8. Princeton University, Program in Applied and Computational Mathematics seminar, “Low-order models for control of fluids,” Oct 2005.
9. City College of New York, Mechanical Engineering seminar, “Low-order models for control of fluids,” Sep 2005.
10. Clarkson University, Department of Mathematics and Computer Science seminar, “Low-order models for control of fluids,” May 2004.
11. Harvard University, Division of Engineering and Applied Sciences seminar, “Low-order models for control of fluids,” Apr 2004.
12. Massachusetts Institute of Technology, Mechanical Engineering seminar, “Low-order models for control of fluids,” Apr 2004.
13. Tufts University, Department of Mechanical Engineering seminar, “Low-order models for control of fluids,” Apr 2004.
14. University of Illinois, Urbana-Champaign, Department of Theoretical and Applied Mechanics seminar, “Low-order models for control of fluids,” Apr 2004.
15. Science on Saturday lecture series, Princeton Plasma Physics Laboratory, “Flow control: from quiet airplanes to robotic fish”, Feb 2004.

16. Caltech Center for Integrative Multiscale Modeling and Simulation seminar, “Links between POD and balanced truncation,” Aug 2003.
17. Ohio State University, Mechanical Engineering seminar, “Modeling techniques for control of cavity flow oscillations,” May 2003.
18. Princeton University, School of Engineering and Applied Science junior faculty lunch seminar, “Quieter airplanes, better simulations: the integration of fluid mechanics and control theory,” Dec 2002.
19. Princeton University, AIAA student section seminar, “Control in an information-rich world,” Nov 2002.
20. Illinois Institute of Technology, Department of Mechanical, Materials, and Aerospace Engineering, “Low-order modeling and control of cavity flow oscillations,” Oct 2002.
21. Princeton University, Information Sciences and Systems seminar, “Coherent structures in fluids,” Oct 2002.
22. University of Maryland, Department of Aerospace Engineering, “Advances in low-dimensional modeling for control of fluids,” Feb 2002.
23. Caltech Center for Integrative Multiscale Modeling and Simulation seminar, “Reduction and reconstruction for self-similar dynamical systems,” Jan 2002.
24. University of California Santa Barbara, Mechanical Engineering seminar, “Advances in low-dimensional modeling for compressible flows,” Mar 2001.
25. Princeton University, Mechanical and Aerospace Engineering seminar, “Advances in low-dimensional modeling, with application to flow control,” Feb 2001.
26. Stanford University, Mechanical Engineering seminar, “Advances in low-dimensional modeling with application to flow control,” Dec 2000.
27. Princeton University, Dynamical Systems and Nonlinear Science seminar, “The Karhunen-Loève expansion for systems with symmetry, and low-order models of an oscillating cavity flow,” Mar 2000.
28. United Technologies Research Center, “The Karhunen-Loève expansion for systems with symmetry, and low-order models of an oscillating cavity flow,” Feb 2000.

Invited conference and workshop presentations

29. SIAM Conference on Control and its Applications, invited presentation, “Closed-loop control of channel flow using balanced proper orthogonal decomposition,” with M. Ilak, June 2007.
30. SIAM Dynamical Systems Meeting, invited presentation, “Model reduction near unstable equilibria in fluid flows, using approximate balanced truncation,” with S. Ahuja and M. Ilak, May 2007.

31. SIAM Dynamical Systems Meeting, invited presentation, “A hierarchy of models for control of fish-like locomotion,” with J. Melli, May 2007.
32. IEEE Mediterranean Conference on Control and Automation, invited presentation, “Reduced-order models of linearized channel flow using balanced truncation,” Ancona, Italy, June 2006.
33. AIAA Flow Control Conference, invited presentation, “Sensing and estimation for feedback control of unstable flows,” with D. Williams, G. Tadmor, June 2006.
34. Mathematics Institute, Oberwolfach, Germany, invitation-only workshop on Dynamical Systems Methods in Fluid Mechanics, “Low-order models for control of fluids,” Aug 2005.
35. MIT Conference on Computational Fluid and Solid Mechanics, invited presentation, “Coherent structures and low-order models of transitional and turbulent channel flow,” June 2005.
36. SIAM Dynamical Systems Meeting, invited presentation, “Reduced models for fishlike swimmers,” with J. Melli, E. Kanso, May 2005.
37. SIAM Dynamical Systems Meeting, invited presentation, “Control-oriented models of channel flow,” May 2005.
38. First International Workshop on Closed Loop Flow Control, invitation-only workshop, “The role of reduced-order models in closed-loop flow control,” Jackson, Wyoming, July 2005.
39. American Physical Society, Division of Fluid Dynamics meeting, invited lecture for the minisymposium on Reduced-order Modeling for Feedback Flow Control, “Control-oriented models of channel flow,” Nov 2005.
40. AFOSR contractor’s meeting, “Model-based feedback control of cavity resonance: experiments and computations,” with D.R. Williams, Long Beach, CA, Aug 2005.
41. AFOSR contractor’s meeting, “Model-based feedback control of cavity resonance,” with D.R. Williams, Denver, CO, Aug 2004.
42. John von Neumann workshop on Modeling and Computations in Dynamical Systems, invitation-only workshop, “Model reduction for fluids, using Proper Orthogonal Decomposition and Balanced Truncation,” Budapest, Hungary, Oct 2003.
43. SIAM Dynamical Systems Meeting, invited presentation “Links between POD and balanced truncation,” Snowbird, UT, May 2003.
44. SIAM Dynamical Systems Meeting, invited presentation “Variational integrators for interacting point vortices,” with J.E. Marsden, Snowbird, UT, May 2003.
45. SIAM Dynamical Systems Meeting, invited presentation “Reduction and reconstruction for self-similar dynamical systems,” with I.G. Kevrekidis, J.E. Marsden, and K. Lust, Snowbird, UT, May 2003.
46. AIAA Flow Control Architectures and Algorithms working group, invited lecture, “Model-based control and the cavity problem,” Reno, NV, Jan 2002.

47. American Physical Society, Division of Fluid Dynamics meeting, invited lecture in the minisymposium on Flow Control, “Modeling and control of oscillations in the flow past a cavity,” San Diego, CA, Nov 2001.

Invited session and minisymposium organization

1. SIAM Dynamical Systems meeting, organizer of minisymposium “Dynamical systems methods in fluid and statistical mechanics,” Snowbird, Utah, May 2007.
2. SIAM Dynamical Systems meeting, organizer of minisymposium “Dynamics and control of biomorphic aquatic locomotion,” Snowbird, Utah, May 2007.
3. IEEE Mediterranean Conference on Control and Automation, organizer of invited session “Closed-loop control of fluids,” Ancona, Italy, June 2006.
4. IEEE Conference on Decision and Control, organizer of minisymposium “Design-oriented modeling and model-based control of fluids,” with G. Tadmor, Seville, Spain, Dec 2005.
5. SIAM Dynamical Systems meeting, organizer of minisymposium “Dynamics and Control of Fish-like Locomotion”, with S. Kelly, Snowbird, Utah, May 2005.
6. SIAM Dynamical Systems meeting, organizer of minisymposium “Reduced-order dynamics of fluids and flames,” Snowbird, Utah, May 2003.

Other contributed lectures (abstract only, no paper)

1. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, “Low-dimensional modeling for both temporally and spatially developing free shear layers,” with M. Wei, Nov 2007.
2. SIAM Dynamical Systems meeting, contributed lecture, “Development of Variational Lie-Poisson Integrators,” with Z. Ma, May 2007.
3. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, “Low-dimensional models of a temporally evolving free shear layer using template-based methods,” with M. Wei, Nov 2006.
4. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, “Detection of Lagrangian Coherent Structures in 3D Turbulence,” with M.A. Green, G. Haller, Nov 2006.
5. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, “Control-oriented models of linearized channel flow using balanced proper orthogonal decomposition,” with M. Ilak, Nov 2006.
6. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, “Dynamics of separation over airfoils at low Reynolds numbers, Part I: 2D equilibria and reduced-order models,” with S. Ahuja, M. Wei, I.G. Kevrekidis, and T. Colonius, Nov 2006.

7. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Dynamics of separation over airfoils at low Reynolds numbers, Part II: Three-dimensional effects," with K. Taira, T. Colonius, and W.T. Joe, Nov 2006.
8. EUROMECH Nonlinear Oscillations Conference, contributed lecture, "Linear and nonlinear mechanisms for transition to turbulence," Eindhoven, Netherlands, Aug 2005.
9. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Control and estimation of oscillating cavity flows," with V. Juttijudata, Nov 2004.
10. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Locomotion of articulated bodies in a perfect fluid," with E. Kanso, J.E. Marsden, and J. Melli, Nov 2004.
11. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Numerical model for fish-like locomotion in potential flow," with J. Melli, D. Rufat, E. Kanso, and J.E. Marsden, Nov 2004.
12. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Reduced-order linear models of channel flow using POD and balanced truncation," Nov 2003.
13. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Excitation of cavity oscillations through random and periodic forcing," with S. Solovitz, Nov 2003.
14. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Reduction and reconstruction for self-similar dynamical systems," with I.G. Kevrekidis, J.E. Marsden, K. Lust, Nov 2002.
15. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Reconstruction equations and POD for systems with symmetry," with J. Marsden, Nov 2000.
16. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Proper Orthogonal Decomposition of 2D Compressible DNS of the Flow over a Rectangular Cavity," with T. Colonius, R.M. Murray, G. Hernandez, Nov 1999.
17. American Physical Society, Division of Fluid Dynamics meeting, contributed lecture, "Self-sustained oscillations in the flow past an open cavity," with A.J. Basu, T. Colonius, Nov 1998.

Professional Activities

1. Managing editor, *Journal of Nonlinear Science*, Jan 2006–present; editorial board member, 2003–Dec 2005
2. Instructor, AIAA¹ professional development course “Specialist’s Course on Flow Control,” January 2008.
3. Organized workshop on “Interactive Undergraduate Fluid Dynamics,” Princeton, January 2008.
4. Member, AIAA Fluid Dynamics Technical Committee, Jan 2006–present
5. Member, AIAA working group on Recommended Practices for Flow Control Studies, June 2006–present
6. Served on NSF review panels, June 2007 (Control systems), May 2006 (Control systems), Feb 2006 (Graduate fellowships), Feb 2004 (Mathematics of fluids), Feb 2003 (Mathematics of fluids)
7. Instructor, AIAA professional development course “Specialist’s Course on Flow Control,” June 2006
8. Member, AIAA working group on Flow Control Architectures and Algorithms, 2002–2004
9. International Program Committee, IEEE² Mediterranean Conference on Control and Automation, June 2006
10. Senior Member, AIAA
11. Member, APS³, SIAM⁴, ASME⁵, Sigma Xi.
12. In 2006, refereed 18 journal papers and 13 conference papers, in addition to editorial responsibilities for 84 papers for *J. Nonlinear Science*. In the past 5 years, have reviewed articles for *AIAA J.*, *Automatica*, *Computers and Fluids*, *European J. Control*, *Experiments in Fluids*, *IEEE Transactions on Circuits and Systems*, *IEEE Transactions on Robotics*, *International J. of Computer Mathematics*, *International J. on Control*, *International J. of Heat and Mass Transfer*, *International J. on Robust and Nonlinear Control*, *J. Applied Mechanics*, *J. Computational Physics*, *J. Fluid Mechanics*, *J. Fluids Engineering*, *J. Fluids and Structures*, *J. Geophysical Research*, *J. Nonlinear Science*, *J. Propulsion and Power*, *J. Sound and Vibration*, *J. Theoretical Biology*, *J. Turbulence*, *Mathematical and Computer Modeling*, *Physical Review E*, *Physical Review Letters*, *Physics of Fluids*, *SIAM J. Applied Dynamical Systems*, *SIAM J. Control and Optimization*, *SIAM J. Numerical Analysis*, *SIAM Review*, and AIAA, IEEE (ACC, CDC, and MED), and ICTAM conferences.

¹American Institute of Aeronautics and Astronautics

²Institute of Electrical and Electronics Engineers

³American Physical Society

⁴Society for Industrial and Applied Mathematics

⁵American Society of Mechanical Engineers

13. Served as a book reviewer for Princeton University Press, and Wiley-VCH.
14. Session chair at numerous conferences for AIAA, SIAM, APS, CDC, ACC.

Funded Projects

Current

- Principal investigator, AFOSR Young Investigator Program
“Unsteady Aerodynamic Models for Flight Control of Agile Micro Air Vehicles,”
\$320,350 for the period 1/2/07 – 1/1/10
- Co-principal Investigator, AFOSR MURI (Air Force Office of Scientific Research, Multidisciplinary University Research Initiative)
“Closed-Loop Control of Vortex Formation in Separated Flows with Application to Micro Air Vehicles”
with T. Colonius (PI), M. Dickinson, M. Gharib (Caltech); D. Williams (Illinois Institute of Technology); and G. Tadmor (Northeastern)
\$243,667 (Princeton portion) for the period 5/1/05 – 4/30/08
- Principal Investigator, National Science Foundation
“Interactive Undergraduate Fluid Dynamics”
Co-principal Investigator: C. Rogers (Tufts)
\$20,000 for the period 10/1/06–9/30/08
- Co-principal Investigator, NJCST (New Jersey Commission on Science & Technology) Entrepreneurial Partnering Fund
“Algorithm Research and Testing for a High-Efficiency Solar Power Conversion Technology”
with E. Limpaecher (Princeton Power Systems), S. Kulkarni (Princeton ELE)
\$70,000 (Princeton portion) for the period 7/1/06 – 6/30/08
- Principal Investigator, NSF (National Science Foundation) CAREER Award
“Model Reduction for Control of Fluids”
\$400,037 for the period 3/1/04 to 2/28/09
+\$9,800 supplement for Research Experience for Undergraduates

Previous

- Principal Investigator, AFOSR grant
“Unsteady Aerodynamic Models for Control of Agile Micro Air Vehicles”
\$64,700 for the period 4/1/06 – 2/28/06
- Principal Investigator, AFOSR grant
“Model-Based Feedback Control of Cavity Resonance: An Experimental and Computational Approach”
with D. Williams (PI from Illinois Institute of Technology)
\$275,055 (Princeton portion) for the period 2/1/03 – 1/31/06
- Co-principal investigator, ONR (Office of Naval Research) grant
“Underwater Glider Networks for Adaptive Ocean Sampling”
N. E. Leonard (PI, Princeton) and J. E. Marsden (Caltech)
\$1,060,426 (total) for the period 7/1/02 – 6/30/05

- Lead investigator from Princeton, Department of Education FIPSE (Fund for the Improvement of Post-Secondary Education) US-Brazil Higher Education Consortia Program
“Control and Dynamical Systems in Science and Engineering”
Principal Investigators: R. Murray (Caltech—lead institution) and M. Teixeira (Universidade Estadual de Campinas, Brasil)
Other institutions: Caltech, UC Santa Barbara, and three Brazilian institutions
\$200,000 (total), for the period 7/1/02 – 6/30/06

Summary of Teaching Activities

I have taught courses in Control Theory, Dynamical Systems, Classical Mechanics, Geometric Mechanics, and Applied Mathematics. Specific courses I have taught at Princeton are listed below:

Undergraduate courses:

- MAE 433: Automatic control systems
Fall 2001, with M. Littman; Spring 2004, Spring 2005, Spring 2006, Spring 2007
- MAE 434: Modern control
Spring 2002 (then numbered MAE 444), Spring 2003

Graduate courses:

- MAE 501/APC 501: Mathematical methods of engineering analysis I (Fall 2005, Fall 2007)
- MAE 541/APC 571: Applied dynamical systems (Fall 2004, with P. Holmes; Fall 2006)
- MAE 542: Advanced dynamics (Fall 2003)
- MAE 549: Special topics: Model reduction and robust control (Fall 2002)
- MAE 549: Special topics: Geometric mechanics (Fall 2004, with N. Leonard)

Professional development courses. In addition to my teaching at Princeton, I have volunteered to help teach professional development courses run by the American Institute of Aeronautics and Astronautics (AIAA). Specifically, I worked with Prof. Lou Cattafesta (University of Florida) to develop one of the lectures (Closed-loop control) in the short course “Modern Flow Control,” which he delivered in June 2004 and January 2006. I also wrote and delivered three of the 13 lectures in the follow-up course “Modern Flow Control II: Specialist’s Course” given in June 2006 and again in January 2008. All of the instructors in these courses are leading researchers in control of fluids, from both academia and industry, including Belinda Batten (Chair of Mechanical Engineering, Oregon State), David Williams (IIT), Lou Cattafesta (U Florida), Tom Bewley (UCSD), Andrzej Banaszuk (United Technologies Research Center), Rudibert King (TU Berlin), and Daniel Miller (Lockheed Martin). All of these lectures were very well received by the attendees, who were mostly practicing engineers in industry.

Teaching highlights.

- Received an E-Council Excellence in Teaching Award my first semester at Princeton, for MAE 433, co-taught with M. Littman in Fall 2001.
- I have consistently received excellent reviews from students, as reflected in numerical ratings of my courses, and in the written comments.

- The graduate courses I have taught have had unusually large enrollments from students outside the MAE department (in particular, in Fall 2004, MAE 541 drew students from MAE, PACM, PHY, CHE, and an auditor from Math; in Fall 2005, MAE 501 drew 11 students from outside the department, from CEE, CHM, ELE, MOL, and a Math undergraduate).
- Designed a new laboratory for MAE 444 in Spring 2002, with a series of labs around stabilizing an inverted pendulum. These labs have been integrated into 433 labs since Spring 2004.
- In Spring 2004, M. Littman and I redesigned MAE 433, incorporating material from both classical and modern control. The goal was to incorporate the most important concepts of control theory in a single course, while prior to this these were split between two courses (MAE 433, classical; and MAE 444, modern).
- In addition to my classroom teaching, I have been heavily involved in an outreach program called Princeton Engineering Education for Kids (PEEK), which I am the faculty advisor for, in which Princeton undergraduates give engineering lessons in elementary school classrooms. This program was inspired by the Center for Engineering Education and Outreach at Tufts (run by Prof. Chris Rogers), and the program has flourished. In recent years, we have given sequences of at least 5 hands-on engineering lessons in every single classroom (K–5th grade) at Riverside elementary school. In addition, we run after-school programs (“Engineering nights”) at many different local elementary schools, as well as various events on the Princeton University campus, for Alumni Day, Take-Your-Child-To-Work Day, etc. We have worked with the Society of Women Engineers, the National Society of Black Engineers, and the eating clubs’ Prospect Alliance for Community Action (PACA) to run several Saturday-afternoon engineering contests for economically disadvantaged middle-school and high-school students from Trenton. For more information about PEEK, see <http://www.princeton.edu/~peek>.

Advising

• Postdoctoral Scholar Supervisor

1. Mingjun Wei, Jan 2005–Aug 2006
Currently Assistant Professor at New Mexico State University, Department of Mechanical Engineering.
2. Eva Kanso, Mar 2004–May 2004
Currently Assistant Professor at the University of Southern California, Department of Aerospace and Mechanical Engineering.
Eva was a postdoc for Jerrold Marsden at Caltech, and spent two months at Princeton while Prof. Marsden was on sabbatical.
3. Vejapong Juttijudata, Feb 2004–Jan 2005
Currently faculty at Kasetsart University, Thailand, Department of Aerospace Engineering.
4. Stephen Solovitz, Feb 2003–Sep 2003
Currently Mechanical Engineer, General Electric Global Research, Niskayuna, NY.

• Graduate Research Advisor

1. Juan Melli — post-generals Ph.D. Student (6th-year), expected graduation date May 2008.
 - NSF Graduate Research Fellowship, 2003
 - NDSEG Fellowship (Department of Defense), 2003
 - Teagle Foundation Scholarship, 2003
 - Won best poster prize, workshop on Dynamical Systems Methods in Fluid Dynamics, Oberwolfach, Germany, Aug 2005
2. Melissa Green (co-supervising with A. Smits) — post-generals Ph.D. student (5th-year), expected graduation date June 2008.
 - NSF Graduate Research Fellowship, 2004
 - Won 2nd prize, Art of Science contest, Princeton University, May 2006
 - Won Larisse Rosentweig Klein Memorial Award, MAE Department, Princeton, Sep 2006.
Awarded annually to a female student who has made outstanding research achievements by her third year of enrollment.
3. Sunil Ahuja — post-generals Ph.D. student (5th-year), expected graduation date Aug 2008
 - Best paper presentation in “Algebraic and Geometric Methods” session at American Controls Conference, June 2006.
 - Won Phillips Second Year Fellowship, MAE Department, Princeton, Sep 2004.
4. Zhanhua Ma — post-generals Ph.D. student (4th-year), expected graduation date June 2009

- Won Athena Feron Prize, MAE Department, Princeton, Sep 2006.
Awarded annually to a 2nd year student who has objectively embraced and completed substantially more mathematical subjects than the strictly required minimum and obtained outstanding marks in those courses.
 - Won Guggenheim Second Year Fellowship, MAE Department, Princeton, Sep 2005.
5. Milos Ilak — post-generals Ph.D. student (4th-year)
 6. Peter Norgaard — post-generals Ph.D. student (4th-year)
 - DOE Computational Science Graduate Fellowship, 2005.
 7. Steven Brunton — post-generals Ph.D. student (2nd-year)