

Shane D. Ross

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Professional Preparation:

- **California Institute of Technology**, B.S., Physics 1998
- **California Institute of Technology**, Ph.D., Control and Dynamical Systems 2004
- **University of Southern California**, NSF Mathematical Sciences Postdoc 2004-2006

Appointments:

- **Virginia Tech**
Assistant Professor of Dynamical Systems 2006-present
Department of Engineering Science and Mechanics 2007-present
School of Biomedical Engineering and Sciences, affiliate faculty 2011-present
Department of Mechanical Engineering, affiliate professor 2011-present

Significant Publications (1600+ citations, h-index 21 [Google]): shaneross.com/papers

1. A.J. Prussin, S.D. Ross, D.G. Schmale [2012] Application of Microsatellites to Track the Long Distance Movement of a Plant Pathogen from a Field-Scale Source of Inoculum, *Applied and Environmental Microbiology*, submitted.
2. B. Lin, A. BozorgMagham, S.D. Ross, D.G. Schmale [2012] Small fluctuations in the recovery of fusaria across consecutive sampling intervals with unmanned aircraft 100 m above ground level, *Aerobiologia*, accepted.
3. S.D. Ross, P. Tallapragada [2012] Detecting and exploiting chaotic transport in mechanical systems. In *Applications of Chaos and Nonlinear Dynamics in Science and Engineering*, Vol. 2, 348 pp. (eds. S. Banerjee, L. Rondoni, M. Mitra.), Springer.
4. D.G. Schmale, S.D. Ross, T.L. Fetters, P. Tallapragada, A.K. Wood-Jones, B. Dingus [2012] Isolates of *Fusarium graminearum* collected 40-320 meters above ground level cause *Fusarium* head blight in wheat and produce trichothecene mycotoxins, *Aerobiologia* **28**:1-11.
5. P. Tallapragada, S.D. Ross, D.G. Schmale [2011] Lagrangian coherent structures are associated with fluctuations in airborne microbial populations, *Chaos* **21**, 033122.
6. C.E. Bohland, D.G. Schmale, S.D. Ross [2011] Caging the Blob: Using a Slime Mold to Teach Concepts about Barriers that Constrain the Movement of Organisms, *American Biology Teacher* **73**(9), 537-541.
7. M.L. Tanaka, S.D. Ross [2011] Using topological equivalence to discover stable control parameters in biodynamic systems, *Computer Methods in Biomechanics and Biomedical Engineering*, published online, doi:10.1080/10255842.2011.565413
8. M.A. Stremler, S.D. Ross, P. Grover, P. Kumar [2011] Topological chaos and periodic braiding of almost-cyclic sets, *Physical Review Letters* **106**, 114101.

9. C. Senatore, S.D. Ross [2011] Detection and characterization of transport barriers in complex flows via ridge extraction of the finite time Lyapunov exponent field, *International Journal for Numerical Methods in Engineering* **86**, 1163-1174.
10. F. Lekien, S. Ross [2010] The computation of finite-time Lyapunov exponents on unstructured meshes and for non-Euclidean manifolds, *Chaos* **20**, 017505.
11. S.D. Ross, M.L. Tanaka, C. Senatore [2010] Detecting dynamical boundaries from kinematic data in biomechanics, *Chaos* **20**, 017507.
12. M.L. Tanaka, S.D. Ross, M.A. Nussbaum [2010] Mathematical modeling and simulation of seated stability, *Journal of Biomechanics* **43**, 906-912.
13. S. Jerg, O. Junge, S.D. Ross [2009] Optimal capture trajectories using multiple gravity assists, *Communications in Nonlinear Science and Numerical Simulations* **14**(12), 4168-4175.
14. P. Grover, S.D. Ross [2009] Designing trajectories in a planet-moon environment using the controlled Keplerian map, *Journal of Guidance, Control, and Dynamics* **32**(2), 436-443.
15. M.L. Tanaka, S.D. Ross [2009] Separatrices and basins of stability from time series data: an application to biodynamics, *Nonlinear Dynamics*, **58**(1-2), 1-21.
16. M.L. Tanaka, M.A. Nussbaum, S.D. Ross [2009] Evaluation of the threshold of stability for the human spine, *Journal of Biomechanics* **42**(8), 1017-1022.
17. P. Tallapragada, S.D. Ross [2008] Particle segregation by Stokes number for small neutrally buoyant spheres in a fluid, *Physical Review E* **78**, 036308.
18. W. Koon, M. Lo, J. Marsden, S.D. Ross [2008] *Dynamical Systems, the Three-Body Problem, and Space Mission Design*, Marsden Books, ISBN 978-0-615-24095-4.
19. J.A. Norris, A.P. Marsh, K.P. Granata, S.D. Ross [2008] Revisiting stability of 2D passive biped walking: local behavior, *Physica D: Nonlinear Phenomena*, **237**(23), 3038-3045
20. C. Senatore, S.D. Ross [2008] Fuel-efficient navigation in complex flows, *Proc. of 2008 American Control Conference*, 1244-1248.
21. S.D. Ross, D.J. Scheeres [2007], Multiple gravity assists, capture, and escape in the restricted three-body problem, *SIAM Journal on Applied Dynamical Systems* **6**(3), 576-596.
22. P. Newton, S.D. Ross [2006] Chaotic advection in the restricted four-vortex problem on a sphere, *Physica D: Nonlinear Phenomena* **223**, 36-53.
23. S.D. Ross [2006] Optimal flapping strokes for self-propulsion in a perfect fluid, *Proc. of 2006 American Control Conference*, 4118-4122.
24. S.D. Ross [2006] The interplanetary transport network, *American Scientist* **94**(3), 230-237.
25. J. Marsden, S.D. Ross [2006] New methods in celestial mechanics and mission design, *Bulletin of the American Mathematical Society* **43**(1), 43-73.
26. F. Gabern, W. Koon, J. Marsden, S. Ross, T. Yanao [2006] Application of tube dynamics to non-statistical reaction processes, *Few Body Systems* **38**, 167-172.
27. F. Gabern, W. Koon, J. Marsden, S. Ross [2005] Theory and computation of non-RRKM lifetime distributions and rates in chemical systems with three or more degrees of freedom, *Physica D: Nonlinear Phenomena*, **211**, 391-406.

28. M. Dellnitz, O. Junge, W. Koon, F. Lekien, M. Lo, J. Marsden, K. Padberg, R. Preis, S. Ross, B. Thiere [2005] Transport in dynamical astronomy and multibody problems, *Int. J. Bifurc. Chaos* **15**, 699–727.
29. M. Dellnitz, O. Junge, M. Lo, J. Marsden, K. Padberg, R. Preis, S. Ross, B. Thiere [2005] Transport of Mars-crossing asteroids from the quasi-Hilda region, *Physical Review Letters* **94**, 231102.
30. G. Gómez, W. Koon, M. Lo, J. Marsden, J. Masdemont, S. Ross [2004] Connecting orbits and invariant manifolds in the spatial three-body problem, *Nonlinearity* **17**, 1571–1606.
31. W. Koon, J. Marsden, S. Ross, M. Lo, D. Scheeres [2004] Geometric mechanics and the dynamics of asteroid pairs, *Annals of the New York Academy of Sciences* **1017**, 11–38.
32. R. Serban, W. Koon, M. Lo, J. Marsden, L. Petzold, S. Ross, R. Wilson [2002] Halo orbit mission correction maneuvers using optimal control, *Automatica* **38**, 571–583.
33. C. Jaffé, S. Ross, M. Lo, J. Marsden, D. Farrelly, T. Uzer [2002] Statistical theory of asteroid escape rates, *Physical Review Letters* **89**, 011101.
34. W. Koon, M. Lo, J. Marsden, S. Ross [2002] Constructing a low energy transfer between Jovian moons, *Contemporary Mathematics* **292**, 129–145.
35. W. Koon, M. Lo, J. Marsden, S. Ross [2001] Resonance and capture of Jupiter comets, *Celestial Mechanics and Dynamical Astronomy* **81**, 27–38.
36. W. Koon, M. Lo, J. Marsden, S. Ross [2001] Low energy transfer to the Moon, *Celestial Mechanics and Dynamical Astronomy* **81**, 63–73.
37. W. Koon, M. Lo, J. Marsden, S. Ross [2000] Heteroclinic connections between periodic orbits and resonance transitions in celestial mechanics, *Chaos* **10**, 427–469.

Awards, Prizes, and Recognition

- Faculty Fellow, Virginia Tech College of Engineering Dean’s Award
- 2012 Certificate of Teaching Excellence, Virginia Tech College of Engineering
- 2012 NSF CAREER Award
- 2011 Plenary Speaker on Computational Methods in Dynamics at Abdus Salam International Centre for Theoretical Physics, Trieste, Italy
- 2011 Keynote Speaker at Lorentz Centre Workshop on Coherent Structure and Dynamical Systems, Leiden, The Netherlands
- 2010 Virginia Tech College of Engineering Dean’s Award for Outstanding New Assistant Professor
- 2009 Invited Speaker at British Science Festival
- 2009 Virginia Tech Faculty Authors Recognition List
- 2008 Invited Speaker at Zurich Physics Colloquium
- 2008 Virginia Tech Faculty Scholar of the Week
- 2005 Recognized for interdisciplinary research accomplishments in NSF press release, Mathematics Unites the Heavens and the Atom (Sept 29, 2005)
- 2004-2006 NSF Mathematical Sciences Postdoctoral Research Fellow

- 2004 Everhart Lecture Series Award Winner, “The Interplanetary Transport Network”, Caltech, 2004
- 2003 NASA Space Act Award, for Low-Energy Interplanetary Transfers Using Lagrangian Points
- 2002 NASA Innovation Award, for Low-Energy Transfer from Near-Earth to Near-Moon Orbit
- 2001 Best Paper Award by American Astronautical Society/American Institute of Aeronautics and Astronautics Astrodynamics Specialist Conference, Quebec City, Canada
- 1998 NASA Innovation Award, for Planetary Capture and Interplanetary Transfer Using the Invariant Manifold Structures Around L1 and L2

Selected Publicity

- “Shane Ross Garners CAREER Award to Advance Understanding of Fluid Flows, from Blood Inside the Body to Oil Spills in Bodies of Water”, *TMC Net*, Feb 9, 2012
- “Microbes travel through the air; it would be good to know how and where”, *NSF Press Release, Science Daily, Newswise*, Sep 9, 2011
- *AAAS Eureka*, “Pollution dispersion research aids understanding of 2002 break-up of Antarctic ozone hole” May 24, 2010 — among the most popular AAAS news releases, with 30,000 hits as of mid-August
- *ABC News 7, KGO-TV San Francisco*, “New research could help model Gulf oil spill dispersion” May 24, 2010
- *The Times of London*, “Celestial ‘surfing’ offers hope of cheap and efficient space travel” Sep. 11, 2009
- *Telegraph*, “Scientists unveil plan designed to cut cost of space travel”, Sep. 10, 2009
- *Astronomy*, “How scientists discovered a solar system ‘superhighway’”, November 2008
- *Milwaukee Journal-Sentinel*, “Hitchhiking through space”, July 31, 2006
- *American Scientist*, “The Interplanetary Transport Network”, May-June 2006
- *New Scientist*, “Ride the celestial subway”, March 27, 2006
- *Science*, “Tube Route: Gravitational superhighway snakes through solar system”, November 18, 2005
- *Notices of the American Mathematical Society*, “Ground Control to Niels Bohr”, October 2005
- *Science Daily*, “Math Unites The Celestial And The Atomic”, September 28, 2005
- *Science News*, “Navigating Celestial Currents”, April 18, 2005

Selected Outreach and Professional Service:

- Gave several ‘popular science’ level presentations, including several to K-12 schoolchildren in southern California, underrepresented Math/Science Upward Bound high school students in the Los Angeles area, and an Everhart Distinguished Graduate Lecture on the future of space travel in 2004 in Pasadena, CA (available online as a video presentation). Based on these lectures, wrote a feature article in *American Scientist* (2006), disseminating to a large audience recent work on the ‘new’ mathematics of space travel, which incorporates ideas of transport from fluid dynamics and chemistry.

- Ongoing participation in several outreach activities in connection with dynamical systems theory and applications, including a multimedia web site (www.whydmath.org) that introduces mathematics and computational science topics at an upper high school / lower collegiate level. The web site focuses on exciting applications that showcase mathematics and computational science tools used to solve problems across a wide range of scientific and humanist disciplines.
- Co-coordinating and delivering an ambitious program at a local Virginia high-school called YEAH!-SEM (Youth Exploring the Atmosphere through Scanning Electron Microscopy), an innovative outreach program to attract and retain students at the interface of aerobiology and engineering.
- Invited participant in an NSF-sponsored retreat/workgroup in August 2007 on cognitive and behavioral dynamics, which brought together a handful of dynamical systems experts and experts in the cognitive and behavioral sciences.
- Panel reviewer for NSF and NASA (2008-present).
- Technical reviewer for journals *Physical Review Letters*, *Journal of the Royal Society Interface*, *Physical Review E*, *Chaos*, *Physica D*, *Nonlinear Dynamics*, *International Journal of Non-Linear Mechanics*, *Discrete and Continuous Dynamical Systems*, *Dynamical Systems: An International Journal*, *New Astronomy*, *Journal of Advanced Space Research*, *Celestial Mechanics and Dynamical Astronomy*.
- Minisymposium organizer, Pan American Congress on Applied Mechanics, Trinidad, 2012

Students Advised

Graduated 4 Ph.D. students and 2 M.S. students. Currently advising 5 Ph.D. students (Total advised: 11, all at Virginia Tech)

- Martin Tanaka, Ph.D. 2008, School of Biomedical Engineering and Sciences, currently an assistant professor at Western Carolina Univ.
- Jeffrey Twigg, M.S. 2009, Engineering Mechanics, currently at the Army Research Lab
- Carmine Senatore, Ph.D. 2010, Engineering Mechanics, currently a postdoctoral fellow at MIT
- Piyush Grover, Ph.D. 2010, Engineering Mechanics, currently at Mitsubishi Electronic Research Lab
- Phanindra Tallapragada, Ph.D. 2010, Engineering Mechanics, currently a postdoc at UNC Charlotte
- Tobias Dirksen, M.S. 2012, (co-advised with Mark Stremler, Hassan Aref, Tomas Bohr), Physics, Technical University of Denmark.
- Amir E. BozorgMagham, Ph.D. (co-chair with David Schmale), Engineering Mechanics, expected 2013
- Samuel Raben, Ph.D. (co-chair with Pavlos Vlachos), Mechanical Engineering, expected 2013
- Binbin Lin, Ph.D. (co-chair with David Schmale), Plant Pathology, Physiology and Weed Science, Virginia Tech, expected 2014
- Shibabrat Naik, Ph.D. Engineering Mechanics, expected 2014
- Aaron J. Prussin, Ph.D. (co-chair with David Schmale), Plant Pathology, Physiology and Weed Science, Virginia Tech, MultiSTEPS IGERT trainee, expected 2014

Courses Taught

Student teaching evaluation average of 3.67 out of 4, above Virginia Tech College of Engineering average

- ESM 3124, Undergraduate Intermediate Dynamics; Spring (2010, 2011,2012)
- ESM 5314, Graduate Intermediate Dynamics; Fall (2007, 2008, 2009, 2010, 2011)
- ESM 6314, Advanced Dynamics; Spring (2007, 2008, 2009, 2010, 2011,2012)

Selected Competitive Grants

PI/co-PI on externally sponsored research projects totaling \$6.30M, with a personal share of \$1.64M

- S.D. Ross (PI), CAREER: Integrating geometric, probabilistic, and topological methods for phase space transport in dynamical systems, NSF-Dynamical Systems, 6/1/2012–5/31/2017, \$419,953 (100%)
- S.D. Ross (PI), D.G. Schmale, “Dynamical Mechanisms Influencing the Population Structure of Airborne Pathogens: Theory and Observations”, NSF-Dynamical Systems, 9/1/2011–8/31/2014, \$429,931 (50% or \$214,965)
- S.D. Ross (PI), “Capture of an asteroid by way of a binary system”, Virginia Space Grant Consortium, 5/16/2011-5/11/2012, \$8,000 (100%)
- M. Stremmer, R. Davalos, J. Kuhn, S.D. Ross, P. Vlachos, “IGERT: Multi-Scale Transport in Environmental and Physiological Systems (MultiSTEPS)”, NSF, 7/1/2010 - 6/30/2015, \$3,000,000, (equally among 5 co-PIs, 20% or \$600,000)
- S.D. Ross, D.G. Schmale, PIs, “Atmospheric Transport Barriers and the Biological Invasion of Toxigenic Fungi in the Genus *Fusarium*”, NSF-Environmental Biology, 8/15/2009 - 7/31/2012, \$413,476, (50% or \$206,738)
- J. Socha, J. Harrison, M. Stremmer, R. Davalos, S.D. Ross, P. Vlachos, I. Puri, R. De Vita, A. Staples, M. Agah, “EFRI-BSBA: Complex microsystem networks inspired by internal insect physiology”, NSF, 1/1/2010 - 12/31/13, \$1,992,607, one of 10 co-PIs (8%, or \$159,409)