

Current and Previous Institution Affiliations:

Aug 2012- Present	Iowa State University , Department of Aerospace Engineering, <i>Assistant Professor</i>
July 2008- Aug 2012	North Carolina State University , Department of Mechanical and Aerospace Engineering, <i>Assistant Professor</i>
July 2005- July 2008	University of California Los Angeles , Department of Mathematics, <i>Postdoctoral Researcher</i>
Oct 2003- July 2005	Harvard University , School of Engineering and Applied Sciences, <i>Postdoctoral Researcher</i>
Jan 2001- Oct 2003	University of California Santa Barbara , Department of Mechanical Engineering, <i>Research Assistant</i>
Jan 2000- Jan 2001	Stanford University , Department of Chemical Engineering, <i>Research Assistant</i>

Degrees:

Jan 2001- Oct 2003	PhD, University of California Santa Barbara , Mechanical Engineering Thesis Advisor: G. M. 'Bud' Homsy
Sept 1999- Jan 2001	MS, Stanford University , Chemical Engineering
Aug 1994- Dec 1998	BS, Missouri University of Science & Technology , Chemical Engineering Cum Laude & High Honors <i>Minor: Applied Mathematics.</i>

Current research interests: A combination of experimental, computational and theoretical investigations of multiphase-microscale flow. Emphasis is given to mixing and transport phenomenon including heat and mass transfer in novel microfluidic devices. Other topics include electrohydrodynamics and granular/particle-laden flows.

Publications:

1. Madanu, S., Barbel, S. I. & Ward, T. 2016 Electrostatic and aerodynamic forced vibrations of a thin flexible electrode: Quasi-periodic vs. chaotic oscillations. **Chaos** 26, 063113.
2. White, A. R. & Ward, T. 2015 Pattern search methods for pendant drops: Algorithms for rapid determination of surface tension and surfactant transport parameters. **Colloids Surf., A: Physicochem. Eng. Aspects** 485, 1-10.
3. Wu, F., Vainchtein, D. & Ward, T. 2015 Perturbation analysis of steady and unsteady electrohydrodynamic chaotic advection inside translating drops. **Phys. Rev. E** 92, 023030.
4. Wang, Y.-L., White A. R. & Ward, T. 2015 Pressure-driven microfluidic flow-focusing of air through a surfactant-doped dilute polymer liquid. **Microfluid Nanofluid**, 18, 343-356.
5. Ward, T. & Walrath, M. 2015 Electro-capillary drop actuation and fingering instability in a planar Hele-Shaw cell. **Phys. Rev. E**, 91, 013012.
6. Joshi, A. & Ward, T. 2014 Batch sedimentation in an impulsively heated system. **J. Petrol. Sci. Eng.**, 118, 15-26.

7. White, A. R. & Ward, T. 2014 Constant pressure gas-driven displacement of a shear-thinning liquid in a partially filled radial Hele-Shaw cell: Thin films, bursting and instability. **J. Non-Newton. Fluid Mech.**, 206, 18-28.
8. Sullivan, M. T., Wilkins, D., Finley, E. S. & Ward, T. 2014 Gravity and capillary pressure-driven drainage in a vertical Hele-Shaw cell: thin film deposition. **Chem. Eng. Sci.**, 109, 147-157.
9. White, A. R. & Ward, T. 2012 CO₂ sequestration in a radial Hele-Shaw cell via an interfacial chemical reaction. **Chaos**, 22, 037114.
10. Thelen, J., Dickey, M. D. & Ward, T. 2012 A study of the production and reversible stability of EGaIn liquid metal microspheres using flow focusing. **Lab Chip**, 12, 3961-3967 (shared cover photo).
11. Ward, T. & Hourigan, W. 2012 Granular segregation in a tilted-rotating drum. **Powder Tech.**, 215-216, 227-234.
12. Ward, T. & White, A. R. 2011 Gas-driven displacement of a liquid in a partially filled radial Hele-Shaw cell. **Phys. Rev. E**, 83, 046316.
13. Ward, T. 2011 Capillary pressure driven adhesion of rigid-planar surfaces. **J. Colloid Interface Sci.** 354 (2), 816-824.
14. Ward, T., Faivre, M. and Stone, H. A. 2010 Drop production and tip-streaming phenomenon in microfluidic flow focusing device via an interfacial chemical reaction. **Langmuir** 26, 9233-9239.
15. Grunewald, N., Levy, R., Mata, M., Ward, T., and Bertozzi, A. L. 2010 Self-similarity in particle laden flows at constant volume. **J. Eng. Math** 66 (1-3) 53-63.
16. Ward, T and Hourigan, W. 2009 Experimental investigation of transition to laminar mixing of a homogeneous viscous liquid in a tilted-rotating tank. **Chem. Eng. Sci.** 64 (23), 4919-4928.
17. Ward, T., Wey, C., Glidden R., Hosoi, A. E., and Bertozzi, A. L. 2009 Experimental study of gravitational effects in the flow of a particle-laden thin film on an inclined plane. **Phys. Fluids** 21, 083305.
18. Ward, T. 2008 Electrohydrostatically driven flow and instability in a vertical Hele-Shaw cell. **Langmuir** 24, 3611-3620.
19. Ward, T. and Metchik, A. 2007 Viscous fluid mixing in a tilted rotating tank. **Chem. Eng. Sci.** 62 (12), 6274-6284.
20. Ward, T. 2007 Electrohydrostatic adhesion of rigid-planar electrodes. **J. Electrostat.** 65 (12), 742-749.
21. Ward, T. 2006 Radial spreading of a viscous drop between parallel-plane surfaces. **Phys. Fluids** 18, 093101.
22. Ward, T. 2006 Electrohydrostatic wetting of poorly-conducting liquids. **J. Electrostat.** 64 (12), 817-825.
23. Ward, T. & Homsy G. M. 2006 Electrohydrodynamically driven chaotic streamlines in a translating drop. **J. Fluid Mech.** 547, 215-230.
24. Ward, T, Faivre, M., Abkarian, M., & Stone, H. A. 2005 Drop size and scaling in microfluidic flow-focusing pressure vs. flow-rate driven pumping. **Electrophoresis** 26, 3716-3724.
25. Ward, T. & Homsy, G. M. 2003 Electrohydrodynamically driven chaotic mixing in a translating drop part II: Experiments. **Phys. Fluids** 15 (10), 2987-2994.
26. Ward, T. & Homsy, G. M. 2001 Electrohydrodynamically driven chaotic mixing in a translating drop. **Phys. Fluids** 13 (12), 3521-3525.

Book Chapters:

1. Ward, T. 2011 "Fluid stirring in a tilted-rotating tank". **Transport and Mixing in Laminar Flows: From Microfluidics to Oceanic Currents** Wiley-VCH, edited by Roman Grigoriev (ISBN-10: 3527410112).
2. Ward, T., Faivre, M., Abkarian, M., & Stone, H. A. 2005 "Drop size and scaling in microfluidic flow-focusing pressure vs. flow-rate driven pumping". **Microfluidic Application in Biology: From**

Technologies to Systems Biology Wiley-VCH, edited by Lion, Rossier and Girault (ISBN-10: 3527317619).

Invited Talks:

1. University of Chicago, Department of Physics, June 25, 2014.
2. Iowa State University, Department of Aerospace Engineering, Apr 27, 2012.
3. University of Maryland, Department of Mechanical Engineering (Burger's Lecture), Apr 6, 2012.
4. Duke University, Department of Mathematics, Apr 14, 2009.
5. North Carolina State University, Mechanical and Aerospace Engineering, Apr 15, 2008.
6. California Institute of Technology, Department of Mechanical Engineering, Feb 26, 2008.
7. Harvey Mudd College, Department of Mathematics, Jan 31, 2008.
8. University of California Merced, Department of Applied Mathematics, Nov 9, 2007.
9. University of California Los Angeles, Department of Mathematics, June 29, 2005.
10. Harvard University, Division of Engineering and Applied Sciences, June 2003.
11. Argonne National Labs, July 2003.

Professional Presentations:

1. "**Laminar flow over a thin film**" American Physical Society – Division of Fluid Dynamics Pittsburgh, PA Nov. 24-26, 2013.
2. "**Pulsatile gas injection in a radial Hele-Shaw cell**" Complex fluids & flows in Industry & Nature II Vancouver, BC, Canada July, 24-26, 2013.
3. "**Film formation in a vertical Hele-Shaw cell**" American Physical Society Annual Meeting of the Division of Fluid Dynamics San Diego, CA November 18-20, 2012.
4. "**Fluid stirring in a tilted rotating tank**" Meeting of the American Physical Society, Division of Fluid Dynamics. Baltimore, MD, November 20-22, 2011.
5. "**Fluid stirring in a tilted rotating tank**" SIAM Conference on Applications of Dynamical Systems. Snowbird, UT, May 22-26, 2011.
6. "**Droplet production in a microfluidic flow focusing device via interfacial saponification chemical reaction**" Banff International Research Station for Mathematical Innovation and Discovery. Banff, Alberta, Canada, February 7-12, 2010.
7. "**Viscous rivulet flow over topography**" Meeting of the American Physical Society, Division of Fluid Dynamics. Minneapolis, MN, November 21-24, 2009.
8. "**Experimental investigation of low Reynolds number and laminar mixing in a tilted-rotating tank**" Meeting of the American Physical Society, Division of Fluid Dynamics. San Antonio, TX, November 22-25, 2008.
9. "**Hydrodynamic instability of a homogeneous viscous fluid in a tilted rotating tank**" Annual Meeting of the American Institute of Chemical Engineers. Philadelphia, PA, November 16-21, 2008.
10. "**Electrohydrostatically driven flow and instability in a vertical Hele-Shaw cell**" Frontiers in Applied & Computational Mathematics. New Jersey Institute of Technology, NJ, May 19-21, 2008.
11. "**Electrohydrostatically driven flow and instability in a vertical Hele-Shaw cell**" Meeting of the American Physical Society, Division of Fluid Dynamics. Salt Lake City, UT, November 17-20, 2007.
12. "**Radial spreading of a viscous drop between plane-parallel walls**" Meeting of the American Physical Society, Division of Fluid Dynamics. Tampa Bay, FL, November 19-22, 2006.
13. "**Radial spreading of a viscous drop between plane-parallel walls**" Synergy between computation and experiments in nanoscale science. Harvard Center for Nanoscale Science. Cambridge, MA, May 31-June 4, 2006.
14. "**Radial spreading of a viscous drop between plane-parallel walls**" UCLA Applied Math Colloquium. Los Angeles, CA, March 28, 2006.

15. "**Hydrodynamic penetration of a viscous fluid**" Meeting of the American Physical Society, Division of Fluid Dynamics. Chicago, IL, November 20-22, 2005.
16. "**Stress measurement and particle trajectories for rods in confined flows**" Meeting of the American Physical Society, Division of Fluid Dynamics. Seattle, WA, November 21-23, 2004.
17. "**Laminar flow of a viscous jet into a viscous fluid**" Annual Meeting of the American Institute of Chemical Engineers. Austin, TX, November 7-12, 2004.
18. "**Electrohydrodynamically driven chaotic advection in a translating drop**" Self-Assembly in Biology, Chemistry and Hard Materials Workshop. Argonne National Labs, Argonne IL, July 28-31, 2003.
19. "**Electrohydrodynamically driven chaotic advection in a bounded Stokes flow**" SIAM Conference on Applications of Dynamical Systems. Snowbird, UT, May 27-31, 2003.
20. "**Steady chaotic advection in a translating drop with non-axial electric field**" Meeting of the American Physical Society, Division of Fluid Dynamics. Dallas, TX, November 24-26, 2002.
21. "**Electrohydrodynamically driven chaotic mixing in a translating drop**" Meeting of the American Physical Society, Division of Fluid Dynamics. San Diego, CA, November 18-20, 2001.
22. "**Electric field induced chaotic advection in a drop**" Meeting of the American Physical Society, Division of Fluid Dynamics. Washington, DC, November 19-21, 2000.

Posters:

1. "Electrohydrostatic wetting of poorly conducting fluids" Workshop on Thin Films and Fluid Interface. UCLA Institute for Pure and Applied Mathematics (IPAM), Los Angeles CA. Jan. 30-Feb. 2, 2006.
2. "Electrohydrodynamically driven chaotic advection in a translating drop" Technical Forum on Nanostructures and Nanomaterials. IBM Almaden Research Center, San Jose CA. August 7, 2003.

Teaching Experience:

1. **Incompressible flow.** Instructor, Fall 2014 ISU AerE 541. Graduate level incompressible flow/fluid mechanics course. Total enrollment: 20 students.
2. **Aerospace propulsion I.** Instructor, Spring 2014 ISU AerE 411. Senior level course on the thermodynamic analysis of aerospace propulsion systems. Total enrollment: 20 students.
3. **Aerodynamics.** Instructor, Fall 2012-Fall 2013 ISU AerE 310. Sophomore/Junior level course on the analysis and application of aerodynamic forces on an airfoil. Total enrollment (3 semesters): 35/20/65 students.
4. **Numerical methods for engineers.** Instructor, Fall 2010 and 2011, NCSU MAE 589. First year graduate course on the analysis and application of numerical methods. Average total enrollment: 10-15 students.
5. **Fluid mechanics.** Instructor, Fall 2008, 2009 and 2011, NCSU MAE 308. Junior level undergraduate course on the analysis of internal fluid flow and applications. Average total enrollment: 50-60 students.
6. **Design of thermal systems.** Instructor, Spring 2009, 2010, 2011, NCSU MAE 412. Senior level undergraduate course on the analysis and design of industrial heat exchangers and pumping systems. Total enrollment: 40 students.
7. **Combinatorics.** Instructor, Spring 2008, UCLA Math 113. Upper level undergraduate course on the application and analysis of combinatorial science. Total enrollment: 35 students.
8. **Applied numerical methods.** Instructor, Winter 2008, UCLA Math 151A. Upper division undergraduate course on the application and analysis of numerical methods. Total enrollment: 20 students.

9. **Calculus of several variables.** Instructor, Fall 2007, UCLA Math 32A. Lower division undergraduate course on vector calculus. Total enrollment: 120+ students.
10. **Transport phenomena.** Instructor, Spring 2007, UCLA Mechanical and Aerospace Engineering 105D. Engineering course where students develop an understanding of heat transfer. Total enrollment: 26 students.
11. **Mathematical modeling.** Instructor, Spring 2006 and Winter 2007, UCLA Math 142. Upper level mathematics course where students develop tools for analyzing fixed points, and other aspects of dynamical systems. Total enrollment (2 semesters): 25/30 students.
12. **Ordinary differential equations.** Instructor, Fall 2005, UCLA Math 33B. Lower division mathematics course on basic theory and solutions of ordinary differential equations. Total enrollment: 130 students (approximately half engineering students).
13. **Thermoscience.** Teaching Assistant, Fall 2001, UCSB ME 151C. Duties included organizing recitation session, grading papers and maintaining website for 3rd quarter undergraduate heat transfer course. Total enrollment: 70 students.

Advising and Mentoring Activities:

PhD student:

Andrew White, ISU-AE (8/11-8/16)

MS thesis students:

Veera Sajjanapu ISU-AE (12/14-present)

Tejaswi Soori ISU-EM (12/14-5/16)

Sushma Madanu ISU-EM (12/14-12/16)

Andrew White, ISU-EM (09/11-6/13)

Michael Sullivan NCSU-MAE (9/10-12/13)

Cory Hinton, NCSU-MAE (9/10-12/13)

David Edson, NCSU-MAE (9/09-6/11)

Ameya Joshi, NCSU-MAE (9/08-8/10)

Undergraduate students:

Stanley Barbel, ISU-AE (6/14-present)

Caroline Periera ISU-AE (12/13-present)

Dina Caicedo-Parra, ISU-AE (12/13-present)

Hyaquino Hyacinthe, ISU-AE (12/13-12/14)

Matthew Walrath, ISU-AE (12/13-6/13)

David Swan, NCSU-MAE (6/11-6/12)

Chima Igboko, NCSU-BioE (9/11-12/11)

Matthew McFarland, NCSU-MAE (12/11-6/11)

Andrew White, NCSU-MAE (3/09-9/11)

William Hourigan, UCLA-MAE (7/07-6/08).

Mario Lopez, UCLA-MAE (7/07-6/08).

Robert Glidden, UCLA-MAE (7/07-6/08).

Parousia Rockstroh, Harvey Mudd College-Math (7/07-6/08).

Asher Metchik, UCLA-MAE (7/06-1/07).

Chi Wey, UCLA-MAE (7/05-7/07).

Alexandre Persat, Harvard University visiting scholar (summer '05).

Branden Reid, Harvard University visiting scholar (summer '04).

Peer Reviewer for (past and present):

Physics of Fluids, Computers and Chemical Engineering (Canada), Journal of Combinatorial Theory Series A, Physical Review E, Journal of Fluid Mechanics, Physical Review Letters, Langmuir, Journal of Colloid and Interface Science, Journal of Petroleum Science and Engineering, International Journal of Multiphase Flow

Professional Affiliations:

1. American Institute of Aeronautics and Astronautics (AIAA) 2014-present
2. American Physical Society (APS) 2005-present
3. American Chemical Society (ACS) 2007-2008, 2013-present
4. American Institute of Chemical Engineers (AIChE) 2004-2005
5. American Society for Engineering Education (ASEE) 2008-2012

External Support:

1. ACS-PRF, September 1, 2016-August 31, 2018, \$110,000, “**A computational fluid dynamics study of micro-emulsion formation and transport in a porous media.**”
2. NSF-CBET, October 1, 2012-September 30, 2016, \$250,000, “**Accelerated versus decelerated settling velocity of a drop**”
3. NC Space Grant, March 15, 2009-March 14, 2010, \$15,000 “**Feasibility study of steam generation in a microgravity environment for microgravity steam turbine applications**”