

# ALEXANDRA H. TECHET

ASSOCIATE PROFESSOR OF MECHANICAL AND OCEAN ENGINEERING  
DIRECTOR, EXPERIMENTAL HYDRODYNAMICS LABORATORY  
CO-DIRECTOR, NAVAL ENGINEERING EDUCATION CENTER

DEPARTMENT OF MECHANICAL ENGINEERING  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Prof. Alexandra (Alex) Techet is an Associate Professor of Mechanical and Ocean Engineering (with tenure), in the department of Mechanical Engineering at MIT. She received her B.S.E. in Mechanical and Aerospace Engineering in 1995 from Princeton University and then graduated from the MIT/WHOI Joint Program in Oceanographic Engineering with a M.S. in 1998 and a Ph.D. in 2001. During her doctoral studies she received both the prestigious Department of Defense NDSEG fellowship, as well as the Link Foundation Fellowship in Ocean Engineering and Instrumentation.

In 2002, after a brief post-doc at Princeton University in the Mechanical and Aerospace Engineering Department, Prof. Techet returned to MIT as an Assistant Professor in the Dept. of Ocean Engineering. In 2005, Prof. Techet joined the Mechanical Engineering Dept. at MIT when the two departments merged. She also holds a guest appointment at the Woods Hole Oceanographic Institution and works with researchers there to develop oceangoing instrumentation.

Professor Techet's research is in the area of experimental hydrodynamics and aims to address long-standing hydrodynamics problems faced by the U. S. Navy and the ocean science and engineering communities through rigorous experimental investigation and imaging. Professor Techet was a recipient of the 2004 ONR Young Investigators Award. Her imaging work has been recognized several times (2005, 2007, 2009, and 2011) by the American Physical Society Division of Fluid Dynamics Gallery of Fluid Motion and has been featured on the cover of the Journal of Fluid Mechanics and in the Discovery Channel *Time Warp* TV Series.

In 2011, Professor Techet was invited to give a keynote lecture to the National Academy of Engineering, China-America Frontiers of Engineering program in Ocean Engineering. Professor Techet serves as vice-chair of the External Affairs Committee for the American Physical Society Division of Fluid Dynamics, and is an active advisor for the MIT Student chapter of the Marine Technology Society. She has been an active mentor of graduate and undergraduate students, both through academics and research. Prof. Techet has served as a Freshman Advisor for 5 years and is a member of the MIT Committee on Curricula. Additionally, she has been an active member and past chair of the Joint Committee on Applied Ocean Science and Engineering, serving engineering students in the MIT/WHOI joint program. Prof. Techet also serves as co-director of the Naval

Engineering Center, in collaboration with NAVSEA, University of Michigan and Virginia Tech., which aims to educate and train the next generation of naval and marine engineers for the civilian branches of US Navy laboratories.

Professor Techet is the director of the Experimental Hydrodynamics Laboratory (EHL) (<http://web.mit.edu/ehl/>) and runs the Marine Hydrodynamics Laboratory water tunnel facility. Her group's research in experimental hydrodynamics has made important contributions to several key areas, including: light field imaging for fluid mechanics, 3D multi-phase flow imaging, spray hydrodynamics, water entry of spheres and projectiles, flow structure interactions, unsteady bio-inspired propulsion and maneuvering, and sensing at the air/sea interface. Prof. Techet's work provides critical insights for the design and understanding of a wide range of systems that operate in the marine environment, including surface ships, submarines, undersea projectiles, offshore oil platforms, and ocean energy systems. The EHL employs highly motivated graduate and undergraduate students interested in experimental hydrodynamics. Students interested in working at the EHL should be self-motivated and capable of hands-on experimental work. Expect to get a bit dirty and wet, and to learn a lot about hydrodynamics!

# ALEXANDRA H. TECHET

ASSOCIATE PROFESSOR OF MECHANICAL AND OCEAN ENGINEERING  
DIRECTOR, EXPERIMENTAL HYDRODYNAMICS LABORATORY  
CO-DIRECTOR, NAVAL ENGINEERING EDUCATION CENTER

DEPARTMENT OF MECHANICAL ENGINEERING  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

**Webpage:** <http://web.mit.edu/ahtechet/www>

**Lab URL:** <http://web.mit.edu/ehl/>

## **Education:**

2001 Ph. D. MIT/WHOI Joint Program in Oceanographic Engineering  
1998 M. S. MIT/WHOI Joint Program in Oceanographic Engineering  
1995 B. S. E. Mechanical & Aerospace Engineering, Princeton University

## **Selected Appointments and MIT Service:**

2001-2002 Princeton University, Postdoctoral Researcher  
2002 Joined MIT Faculty in the Department of Ocean Engineering  
2002-2004 MIT, Assistant Professor Ocean Engineering  
2002-2004 MIT, Doherty Assistant Professor of Ocean Utilization  
2005 Joined the MIT Department of Mechanical Engineering  
2005-2006 MIT, Assistant Professor of Mechanical and Ocean Engineering  
2005-present Guest Investigator Woods Hole Oceanographic Institution  
2007-2009 MIT/WHOI Joint Committee on Applied Ocean Science & Engineering (JCAOSE)  
2008-2009 Acting Chair MIT/WHOI JCAOSE  
2010-present MIT Institute Committee on Curriculum  
2011-present Visiting Scholar, Stanford University Department of Civil and Environmental Engineering

## **Selected Professional Service and Memberships:**

1995-present Member American Society of Mechanical Engineering  
1998-present Member American Physical Society, Division of Fluid Dynamics  
Member Marine Technology Society  
2002-present Marine Technology Society (MTS) Student Section Faculty Advisor for MIT Chapter  
Member American Society of Engineering Education

2003	Marine Advanced Technology Education (MATE) Remotely Operated Underwater Vehicle Competition Local Organizer (held at MIT)
2005-2006	MTS/IEEE OCEANS 2006, Boston Conference Organizing Committee
2006	Student Program Technical Chair for MTS/IEEE OCEANS 2006, Boston Conference
2008	NSF Biological Sensing Panel, Sicily, Italy
2010-present	American Physical Society Division of Fluid Dynamics External Affairs Committee, Vice Chair 2012
2010-present	Co-Director Naval Engineering Education Center (NEEC)

### **Selected Honors and awards:**

National Defense Science Engineering Graduate Fellowship (1995)  
 Link Foundation Ocean Engineering and Instrumentation Fellowship (1999)  
 Doherty Assistant Professorship in Ocean Utilization, MIT (2002-2004)  
 Office of Naval Research, Young Investigators Award (2004)  
 T. Francis Ogilvie Young Investigators Award, MIT (2004)  
 Four-time winner of the American Physical Society, Division of Fluid Dynamics, Gallery of Fluid Motion Prize (2005, 2007, 2009, 2011)

### SELECTED PUBLICATIONS FOR ALEXANDRA H. TECHET

1. Hover, F. S., A. H. Techet, and M. S. Triantafyllou, "Forces on Oscillating Uniform and Tapered Cylinders in Cross Flow," *Journal of Fluid Mechanics*, vol. 363, pp. 97-114, May 1998.
2. Techet, A. H., F. S. Hover, and M. S. Triantafyllou, "Vortical Patterns Behind a Tapered Cylinder Oscillating Transversely to a Uniform Flow," *Journal of Fluid Mechanics*, v. 363, pp. 79-96, May 1998.
3. Techet, A. H. and M. S. Triantafyllou, "The Evolution of a 'Hybrid' Shedding Mode," *Proceedings of the 1998 ASME Fluids Engineering Division Summer Meeting*, Washington, DC, 21-23 June 1998.
4. Wolfgang, M., S. Tolkoff, A. Techet, D. Barrett, M. Triantafyllou, D. Yue, F. Hover, M. Grosenbaugh, and W. McGillis, "Drag Reduction and Turbulence Control in Swimming Fish-Like Bodies," *Proceedings of the International Symposium on Seawater Drag Reduction*, Newport, RI, pp. 463-469, 22-23 July 1998.
5. Techet, A. H. and M. S. Triantafyllou, "Boundary Layer Relaminarization in Swimming Fish," *Proceedings of the 9th (1999) International Offshore and Polar Engineering Conference*, Brest, France, v. II, pp. 415-418, May 30-June 4, 1999.
6. Techet, A. H., M. J. Wolfgang, J. M. Kumph, D. K. P. Yue, M. S. Triantafyllou, E. J. Anderson, W. R. McGillis, M. A. Grosenbaugh, "Flow Control of Flexible-

- Hull Vehicles,” *Proc. 11th Inter. Symp. Unmanned Untethered Submersible Technology (UUST99)*, Durham, New Hampshire, August 22-25, 1999.
7. Anderson, E. J., A. H. Techet, W. R. McGillis, M. A. Grosenbaugh, and M. S. Triantafyllou, “Visualization and Analysis of Boundary Layer Flow in Live and Robotic Fish,” *First International Symposium on Turbulence and Shear Flow Phenomena*, Santa Barbara, CA, USA, 12-15 September 1999.
  8. Techet, A. H., E. J. Anderson, W. R. McGillis, M. A. Grosenbaugh, and M. S. Triantafyllou, “Flow Visualization of Swimming Robotic Fish in The Near Boundary Region,” *Third International Workshop on Particle Image Velocimetry*, Santa Barbara, CA, USA, 16-18 September 1999.
  9. Beal, D. N., A. H. Techet, F. S. Hover, D. K. P. Yue, and M. S. Triantafyllou, “Vortex Street Modulation by an Oscillating Foil,” *IUTAM Symposium on Bluff Body Wakes and Vortex-Induced Vibration (BBVIV-2)*, Marseille, France, 13-16 June 2000.
  10. Techet, A. H., “Visualization of the Near-Boundary Hydrodynamics about Fish-Like Swimming Bodies,” *Report to the Link Foundation*. September 2000.
  11. Allen, J. J., A. H. Techet, R. M. Kelso, and A. J. Smits, “Energy Harvesting Eel,” *14th Australasian Fluid Mechanics Conference*, Adelaide University, Adelaide, Australia, 10-14 December 2001.
  12. Techet, A. H., J. J. Allen, and A. J. Smits, “Piezoelectric Eels for Energy Harvesting in the Ocean,” *Proceedings of the 12th (2002) International Offshore and Polar Engineering Conference*, Kitakyushu, Japan, v. II, pp. 713-718, May 25-31, 2002.
  13. Triantafyllou, M. S., A. H. Techet, Q. Zhu, D. N. Beal, and F. S. Hover, “Vorticity Control in Fish-like Propulsion and Maneuvering,” *Integrative and Comparative Biology*, 42:1026-1031, 2002.
  14. Techet, Alexandra H., Franz S. Hover, and Michael S. Triantafyllou, “Separation and Turbulence Control in Biomimetic Flows,” *Flow Turbulence and Combustion*, 71:105-118, 2003.
  15. McLetchie, K., M. Flores, F. Hover, A. Techet, and M. Triantafyllou, “Forces and Flow Visualization of Flapping Foils,” *Proc. 13th Inter. Symp. Unmanned Untethered Submersible Technology (UUST03)*, Durham, New Hampshire, August 24-27, 2003. \*\*
  16. Fish, F., G. Lauder, R. Mittal, A. Techet, M. Triantafyllou, J. Walker, P. Webb, “Conceptual Design for the Construction of a Biorobotics AUV Based on Biological Hydrodynamics,” *Proc. 13th Inter. Symp. Unmanned Untethered Submersible Technology (UUST03)*, Durham, New Hampshire, August 24-27, 2003. (Invited Paper).
  17. Triantafyllou, M. S., A. H. Techet, and F. S. Hover, “Review of Experimental Work in Biomimetic Foils,” *Proc. 13th Inter. Symp. Unmanned Untethered Submersible Technology (UUST03)*, Durham, New Hampshire, August 24-27, 2003. (Invited Paper).

18. M. S. Triantafyllou, F. S. Hover, A. H. Techet, and D. K. P. Yue, "Review of Scaling Laws in Aquatic Locomotion and Fish-like Swimming Robots and Flapping Foils", *2nd International Symposium on Aqua Bio-Mechanisms ISABMEC*, Honolulu, HI, September 14-17, 2003 (Invited Paper).
19. Triantafyllou, M. S., A. H. Techet, and F. S. Hover, "Review of Experimental Work in Biomimetic Foils," *IEEE Journal of Oceanic Engineering*, v. 29(3), pp. 585-594, 2004.
20. M. S. Triantafyllou, A.H. Techet, F. S. Hover, "The Effect of Reynolds Number on Vortex-Induced Vibrations: From Subcritical to Supercritical Flow," *8th International Conference on Flow Induced Vibrations*, Paris, France, July 5-9, 2004.
21. M. S. Triantafyllou, A. H. Techet, F. S. Hover, "High Reynolds Number Test Results", *Workshop on Flow-Induced Vibration*, Trondheim, Norway, October 25-26, 2004.
22. Triantafyllou, M. S., F. S. Hover, A. H. Techet, and D. K. P. Yue "Review of Scaling Laws in Aquatic Locomotion and Fish-like Swimming," *Applied Mechanics Review*, 58(4):226-237, July 2005.
23. A. H. Techet, K. Lim, F.S. Hover, M.S. Triantafyllou, " Hydrodynamic Performance Of A Biologically Inspired Three-Dimensional Flapping Foil" *Proc. 14th Inter. Symp. Unmanned Untethered Submersible Technology (UUST05)*, Durham, New Hampshire, August 21-24, 2005.
24. Techet, A. H. and A. K. McDonald, "High Speed PIV of Breaking Waves on Both Sides of the Air-Water Interface," *6th International Symposium on Particle Image Velocimetry*, Pasadena, California, USA, September 2005.
25. Techet, A. H., T. T. Truscott, and M. K. Thompson, "Integration of hands-on laboratory modules to enhance the introduction of ocean science and engineering to undergraduates," *Proceedings of IEEE/MTS Oceans/Boston 2006 conference*, September 2006.
26. Truscott, T.T, and A.H. Techet, "Air Cavity Formation in the Wake of a Spinning Sphere Impacting a Free Surface," *Physics of Fluids*, **18**, 091113, September 2006. [DOI: 10.1063/ 1.2335903]
27. Epps, B. P. and A. H. Techet, "Impulse Forces Generated During Unsteady Maneuvering of Swimming Fish," *Experiments in Fluids*, 43(5), 691-700, November 2007. [doi:10.1007/s00348-007-0401-4]
28. Techet, A.H. "Propulsive Performance of Biologically-Inspired Flapping Foils at High Reynolds Numbers," *Journal Experimental Biology*, 211, 274-279, 2008. [doi:10.1242/jeb.012849]
29. Aristoff, J.M., Truscott, T.T., Techet, A.H. & Bush, J.W.M. "The Water-Entry Cavity Formed by Low Bond Number Impacts," *Physics of Fluids* **20**, 091111 September 2008.
30. Truscott, T.T. and A.H. Techet, "Water entry of a spinning sphere," *Journal of*

- Fluid Mechanics*, **625**, pp. 135-165, May 2009.
31. Epps, B. P., P. Valdivia y Alvarado, K. Youcef-Toumi, and A. H. Techet, "Swimming performance of biomimetic compliant fish-like robots," *Experiments in Fluids*, 47(6), pp. 927-939, 2009. [DOI 10.1007/s00348-009-0684-8]
  32. Truscott, T. T., D. N. Beal and A. H. Techet, "Shallow angle water entry of ballistic projectiles," *Proceedings of the 7th International Symposium on Cavitation, Ann Arbor, Michigan, USA, August 17-22, 2009*.
  33. Truscott, T. T., J. Belden and A. H. Techet, "3D flow-field PIV and biological sensing using synthetic aperture," *Proc. 16th Inter. Symp. Unmanned Untethered Submersible Technology (UUST09), Durham, New Hampshire, August 23-26, 2009*.
  34. Belden, J., T. T. Truscott, and A. H. Techet, "3D Flow Fields Using Synthetic Aperture PIV," *8th International Symposium on Particle Image Velocimetry, Melbourne, Australia, August 25-28, 2009*.
  35. Belden, J., and A. H. Techet, "Resolving Flow at the Air-Water Interface for Vorticity Flux Measurements," *8th International Symposium on Particle Image Velocimetry, Melbourne, Australia, August 25-28, 2009*.
  36. Truscott, T. T. and A. H. Techet, "A spin on cavity formation during water-entry of hydrophobic and hydrophilic spheres," *Physics of Fluids*, 21, 121703 (4 pages), 2009; doi:10.1063/1.32722642009.
  37. Epps, B. P. and A. H. Techet, "An error threshold criterion for singular value decomposition modes extracted from PIV data," *Experiments in Fluids*, 48(2) 355-367 (15 pages), 2009; doi 10.1007/s00348-009-0740-4.
  38. Techet, A.H. and A.M. Shih, "Jumping Kinematics for Prey Capture in Archer Fish," *Proceedings of the 6th World Congress on Biomechanics, Singapore, 1-6 August, 2010*.
  39. Jeffrey Aristoff, Tadd Truscott, Alexandra Techet, and John W. M. Bush, "The water entry of decelerating spheres" *Physics of Fluids* **22(3)**, 032102, 2010. doi:10.1063/1.3309454 (8 pages)
  40. La Foy, R.R., Belden, J., Truscott, T.T., Shih, A.M. & Techet, A.H. "Oil droplet in alcohol," *Physics of Fluids*, **22**, 91107, 2010. doi: 10.1063/1.3483217 (1 page)
  41. Epps, B. P., T. T. Truscott, and A. H. Techet, "Evaluating derivatives of experimental data using smoothing splines," *Proceedings of the 3rd Mathematical Methods in Engineering International Symposium, Coimbra (Portugal), 21 to 24 October 2010*.
  42. Belden, J., T. T. Truscott, M. Axiak, and A. H. Techet, "Three-dimensional Synthetic Aperture Particle Imaging Velocimetry," *Measurement Science & Technology*, 21,125403 (21pp), 2010. doi:10.1088/0957-0233/21/12/125403.
  43. Belden, J. and A. H. Techet, "Simultaneous quantitative flow measurement using PIV on both sides of the air-water interface for breaking waves," *Experiments in Fluids*, 50 (1), pp. 149-161, (2011); doi: 10.1007/s00348-010-0901-5.

44. A. H. Techet & T. T. Truscott, "Water Entry of Spinning Hydrophobic and Hydrophilic Spheres," *J. Fluids and Structures*, v. 27, n. 5–6, pp. 716–726, 2011; <http://dx.doi.org/10.1016/j.jfluidstructs.2011.03.014>
45. J. Belden & A.H. Techet "Model Based Auto-Calibration of Multi-Camera Three Dimensional PIV Systems" Proceedings of the 9th International Symposium on Particle Image Velocimetry, Tsukuba, Japan; 21-23 July 2011.
46. J. Belden, S. Ravela, T.T. Truscott, & A. H. Techet "Three-Dimensional Synthetic Aperture Imaging and Resolution of Multi-Phase Flows" Proceedings of the ASME-JSME-KSME Joint Fluids Engineering Conference, Hamamatsu, Japan; 24-29 July 2011.
47. Three-Dimensional Synthetic Aperture Imaging and Resolution of Multi-Phase Flows," *16th International Symposium On Applications Of Laser Techniques To Fluid Mechanics*, Lisbon, Portugal, June 2012.
48. Truscott, T.T., Epps, B.P. & Techet, A.H. Unsteady forces on spheres during free-surface water entry, *Journal of Fluids Mechanics*, 2012, under review.