Kakani Katija Young

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EDUCATION

California Institute of Technology, Pasadena, CA April 2010
Doctor of Philosophy, Bioengineering Option
California Institute of Technology, Pasadena, CA June 2005
Master of Science, Aeronautics Option
University of Washington, Seattle, WA June 2004
Bachelor of Science, Aeronautics and Astronautics

RESEARCH EXPERIENCE

Postdoctoral Investigator, Woods Hole Oceanographic Institution (2012-Present)

Biogenic mixing by multiple organisms **Co-PIs: H Jiang, P Wiebe, G Lawson, C Cenedese**

- Experimental and computational investigation of flow fields and disruption of fluid stratification by individual and multiple swimming organisms
- Measurements to be conducted in WHOI PIV lab, during Tioga field excursions, and Australian Antarctic Division (with Steve Nicol and So Kawaguchi) in Tasmania

Three-dimensional profiling turbulence measurements **Co-PIs: R Geyer and R Schmitt**

- Adapting three-dimensional particle image velocimetry techniques for oceanographic profiling measurements of microstructure and turbulence
- Proposal funded by Woods Hole Oceanographic Institution's Cecil and Ida M. Green's Technology Innovation Award.

Robotic jet-propelled medusae **Co-PIs: SP Colin, JH Costello, S Priya**

- Experimental and computational investigation of propulsive performance by underwater vehicle inspired by *Sarsia tubulosa*, a fast-contracting, jet-propelled medusae
- Measurements to be conducted in WHOI PIV lab, simulations to be conducted at Virginia Tech
- Single organism dynamics extrapolated to multiple-jetting, colonial siphonophores

Postdoctoral Scholar, Woods Hole Oceanographic Institution (2010-2012)

Fluid transport mechanisms of swimming animals **Co-PI: H Jiang**

- Conducting measurements of flow fields surrounding jellyfish throughout their lifecycle to determine dominant thrust mechanisms (i.e., viscous or momentum jets)
- Developing a computational fluid model to evaluate effect of stratification on single and multiple swimming animals utilizing various swimming modes

Graduate Researcher, California Institute of Technology (2004-2010)

Self-contained underwater velocimetry apparatus (SCUVA) **Advisor: JO Dabiri**

- Designed and implemented SCUVA; apparatus enables single scuba diver to make digital particle image velocimetry (DPIV) measurements of animal-fluid interactions
- Device used to study dynamics of jellyfish swimming *in-situ* (e.g. lakes, coastal waters, and open sea) and analyze energetic input of jellyfish to aqueous environment

Lagrangian coherent structures (LCS) **Advisor: JO Dabiri**

- Used dynamical systems techniques (finite-time Lyapunov exponents) to identify coherent structures in animal-generated fluid flows

- LCS used to understand mixing dynamics of vortex ring formation and define criteria for vortex ring pinch-off based on LCS location

Vortex ring interactions with heart valve leaflets **Advisor: M Gharib**

- Studied how fluid transport through a heart valve induces flutter of prosthetic leaflets using motion analysis (MATLAB) and dye visualization
- Ventricular flow fields generated using Caltech Left Ventricle Heart Simulator

Undergraduate Researcher, University of Washington (2003-2004)

Effects of acceleration profiles on Rayleigh-Taylor flow **Advisor: RE Breidenthal**

- Designed, built, and conducted fluids experiment as part of the NASA Reduced Gravity Student Flight Opportunities Program in Houston, TX
- Studied effects of varying acceleration profiles on fluids of differing densities

Mars Gravity Biosatellite **Advisor: AP Bruckner**

- Collaboration between UW, MIT, and University of Queensland (approximately 100 students) in design of spacecraft to study effects of microgravity on mice development
- Responsible for design of bus system; structures subsystem and systems engineering

TEACHING EXPERIENCE

Visiting Lecturer/Assistant Professor (2012-present)

Physics I for non-majors, Bridgewater State University

- Undergraduate student-level introductory, algebra-based physics course
- Developed curriculum to coincide with lab section, presented lectures twice weekly (1.25 hours per lecture), designed homework and exam problems and solutions

Guest Lecturer (2009-2010)

Biomechanics, California Institute of Technology **Professor: SE Fraser**

- Undergraduate and graduate student-level course
- Presented lecture on biomechanics and basic theory behind swimming and flying

Biology, Loyola Marymount University **Professor: RS Houston**

- Undergraduate student-level field biology course
- Presented bio-inspired design and propulsion concepts based on jellyfish research

Bio-inspired Design, California Institute of Technology **Professor: JO Dabiri**

- Undergraduate and graduate student-level course
- Presented design of underwater vehicles based on biological models

Marine Biology, Providence College **Professor: JH Costello**

- Undergraduate student-level course
- Presented current topics of marine biology during 1.25 hr lecture

Teaching Assistant, California Institute of Technology (2004-2005)

Fluid Mechanics (Ae, ME, CE, APhys 101) **Professor: M Gharib**

- Graduate student-level course on basic fluid fundamentals
- Conducted homework and lecture review sessions during weekly office hour, designed homework problems, and wrote homework and exam solutions

Experimental Methods (Ae, ME, CE 104) **Professor: JO Dabiri**

- Graduate student-level course on experimental techniques and their application
- Designed fluids experiments for four lab groups to understand the dynamics of vortex ring pinch-off as a function of cylinder outlet angle.

INDUSTRY EXPERIENCE

Systems Engineer, Woods Hole Oceanographic Institution (2012-present)

Alvin Upgrade **Supervisor: D. Peters**

- Manned, deep-submergence vehicle that is designed for ocean exploration owned by the United States Navy and operated by WHOI
- Responsibilities include updating weights database, writing stability calculations code using the database, and computing weekly and mission-specific stability calculations

Systems Engineer, NASA Ames Research Center (2004)

Advanced Animal Habitat **Supervisor: P. Espinosa**

- Science capsule to be placed on the International Space Station to study the effects of microgravity on rat development
- Responsibilities include writing requirements and hardware documentation on the potable water system and attending meetings with NASA and Lockheed Martin senior engineers

Systems Engineer, University of Washington (2002-2004)

University of Washington's AeroSpace Plane **Advisor: C Vaughan**

- Oversaw 60 students in Senior Design project to develop Space Shuttle replacement vehicle that culminated in design of reusable launch vehicle
- Managed power, weight and cost budgets, schedule (two quarter-long project), wrote interface documentation, requirements, and organized final reports and presentations

FIELD EXPERIENCE

PIV measurements of swimming krill and copepods on R/V Tioga, Wilkinson Basin	July 2011
SCUVA measurements on colonial gelatinous zooplankton, Liquid Jungle Lab, Panama	March 2011
PIV measurements on cubomedusae, Queensland, Australia	January 2010
Adriatic Sea cruise on R/V Nase More in Adriatic Sea	May 2009
Biomixing investigation in Tourist Lake, Palau	October 2008
SCUVA measurements on Cyanea and Ctenophora, Woods Hole, MA	August 2008
Adriatic Sea cruise on R/V Nase More in Adriatic Sea	May 2008
Biomixing investigation in Tourist Lake, Palau	January 2008
SCUVA measurements on Cyanea, Woods Hole, MA	August 2007
SCUVA measurements on medusae, Friday Harbor, WA	March 2007

PUBLICATIONS and PATENTS

Colin SP, Costello JH, **Katija K**, Seymour J, Kiefer K (2012). "Mechanisms of propulsion and maneuvering in cubomedusae." Submitted.

Lucas K, Colin SP, Costello JH, **Katija K**, Klos E (2012). "Fluid interactions that enable stealth predation by the upstream foraging hydromedusa *Craspedacusta sowerbyi*." Submitted.

Katija K, Jiang H (2012). "Swimming by medusae *Sarsia tubulosa* in the viscous vortex ring limit." In revision.

Katija K (2012). "Biogenic inputs to ocean mixing." *Journal of Experimental Biology*, vol. 215, pp. 1040-1049.

Katija K, Colin SP, Dabiri JO, Costello JH (2011). "Quantitatively measuring in situ flows using a self-contained underwater velocimetry apparatus (SCUVA)." *Journal of Visualized Experiments*, vol. 56, e2615.

Katija K, Colin SP, Dabiri JO, Costello JH (2011). "Comparison of flows generated by *Aequorea victoria*: A coherent structure analysis." *Marine Ecological Progress Series*, vol. 435, pp. 111-123.

Dabiri JO, **Katija K**, Costello JH, Colin SP (2011) "Self-contained underwater velocimetry apparatus." *US Patent*, No. 7864305.

Dabiri JO, Colin SP, **Katija K**, Costello JH (2010). "A wake-based correlate of swimming performance and foraging behavior in seven co-occurring jellyfish species." *Journal of Experimental Biology,* vol. 213(8), pp. 1217-1225.

Katija K, Dabiri JO (2009). "A viscosity-enhanced mechanism for biogenic ocean mixing." *Nature*, vol. 460, pp. 624-626.

Rosenfeld M, **Katija K**, Dabiri JO (2009) "Circulation generation and vortex ring formation by static conic nozzles." *Journal of Fluids Engineering*, 131:9.

Katija K, Dabiri JO (2008) "Real-time field measurements of aquatic animal-fluid interactions using a self-contained underwater velocimetry apparatus (SCUVA)." *Limnology and Oceanography: Methods,* vol. 6, pp. 162-171.

Shadden SC, **Katija K**, Rosenfeld M, Marsden JE, Dabiri JO (2007) "Transport and stirring induced by vortex formation." *Journal of Fluid Mechanics,* vol. 593, pp. 315-331.

PUBLICATIONS IN PREPARATION

Katija K, Jiang H, Colin SP, Costello JH (2012). "Ontogenetic propulsive transitions by jetting medusae *Sarsia tubulosa*." In preparation.

Katija K, Jiang H, Wiebe P, Lawson G (2012). "Experimental investigation of hydrodynamic signals eliciting copepod escape response." In preparation.

Jiang H, **Katija K**, Wiebe P, Lawson G (2013). "Evaluation of wake structures generated by swimming pteropods." In preparation.

Katija K, Jiang H (2013). "On the formation of propulsive jets by squid paralarvae." In preparation.

CONFERENCE PROCEEDINGS

Katija K, Jiang H, Colin SP, Costello JH (2012). "Ontogenetic propulsive transitions from viscous to inertial flow regimes." *American Society of Limnology and Oceanography Ocean Sciences Meeting*, February 20-24, Salt Lake City, UT.

Katija K, Jiang H, Colin SP, Costello JH (2012). "Ontogenetic propulsive transitions from viscous to inertial flow regimes." *Society for Integrative and Comparative Biology Annual Meeting*, January 3-7, Charleston, SC.

Katija K (2011). "Biogenic inputs to ocean mixing." *Journal of Experimental Biology Symposium – Integrating Biomechanics and Ecology*, March 14-18, 2011, Cambridge, United Kingdom.

Katija K, Colin SP, Costello JH, Dabiri JO (2011). "Effect of in situ background flow on fluid transport by swimming animals." *Aspen Center for Physics Winter Conference on Ocean Biophysics*, January 16-22, Aspen, CO.

Katija K (2010). "Vortex formation and swimming efficiency in seven co-occurring jellyfish species." *WHOI Postdoctoral Symposium*, November 16, 2010.

Katija K, Dabiri JO (2010). "A Darwinian mechanism for biogenic ocean mixing." *American Society of Limnology and Oceanography Ocean Sciences Meeting*, February 22-26, Portland, OR.

Katija K, Dabiri JO (2009). "A Darwinian mechanism for biogenic ocean mixing." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting,* November 22-24, Minneapolis, MN.

Katija K, Dabiri JO (2009). "A Darwinian mechanism for biogenic ocean mixing." *Southern California Symposium on Flow Physics*, April 18, La Jolla, CA.

Katija K, Dabiri JO (2008). "Mixing efficiency of swimming animals in stratified fluids." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting,* November 23-25, San Antonio, TX.

Katija K, Dabiri JO (2008). "Vortex formation and swimming efficiency in seven co-occurring jellyfish species." *International Congress of Theoretical and Applied Mechanics*, August 25-29, Adelaide, Australia.

Katija K, Dabiri JO (2008). "Energetics of jellyfish locomotion determined from field measurements using a self-contained underwater velocimetry apparatus (SCUVA)." *Society of Integrative and Comparative Biology Annual Meeting*, January 2-6, San Antonio, TX.

Katija K, Dabiri JO (2007). "Energetics of jellyfish locomotion determined from field measurements using a self-contained underwater velocimetry apparatus (SCUVA)." *American Geophysical Union Fall Meeting*, December 10-14, San Francisco, CA.

Katija K, Dabiri JO (2007). "Energetics of jellyfish locomotion determined from field measurements using a self-contained underwater velocimetry apparatus (SCUVA)." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting,* November 18-20, Salt Lake City, UT.

Dabiri JO, **Katija K** (2007). "Progress toward 3D wake structure measurements of aquatic animals using SCUVA." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting*, November 18-20, Salt Lake City, UT.

Katija K, Dabiri JO (2007) "Real-time field measurements of *Aurelia aurita* using a self-contained underwater velocimetry apparatus (SCUVA)." *Second International Jellyfish Blooms Symposium*, June 24-27, Gold Coast, Australia.

Katija K, Dabiri JO (2007). "Dynamics of tethered versus free-swimming jellyfish: A motivating argument for the Self-Contained Underwater Velocimetry Apparatus (SCUVA)." *Southern California Symposium on Flow Physics*, April 7, Pasadena, CA.

Katija K, Dabiri JO (2007) "Tethering versus free-swimming: a wake analysis of *Aurelia aurita*." *Society for Integrative and Comparative Biology Annual Meeting*, January 3-7, Phoenix, AZ.

Katija K, Dabiri JO (2006) "Dynamics of tethered versus free-swimming animals: a wake structure comparison." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting*, November 19-21, Tampa, FL.

Shadden SC, **Katija K**, Dabiri JO, Marsden JE (2006). "Transport induced by vortex formation." *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting*, November 19-21, Tampa, FL.

Katija K, Gharib M, Dabiri JO (2006) "Flow-induced flutter of prosthetic heart valves." *World Congress of Biomechanics*, July 29-August 4, Munich, Germany.

Katija K, Gharib M, Dabiri JO (2005) "Characterization of fluid flow through a simplified heart valve model," *Bulletin of the American Physical Society Division of Fluid Dynamics Meeting*, November 20-22, Chicago, IL.

Boulware JC, Axup J, **Young KK**, Breidenthal R (2004). "The effects of varying acceleration functions on Rayleigh-Taylor flow in a microgravity environment: a Vomit Comet experiment." *University of Washington's Seventh Annual Undergraduate Research Symposium*, May 14, Seattle, WA.

Young KK, Bruckner A (2004). "The Mars Gravity Biosatellite Project: system architecture and mission summary." *University of Washington's Seventh Annual Undergraduate Research Symposium*, May 14, Seattle, WA.

INVITED SEMINARS

"Wake-based studies of jellyfish swimming to inform bio-inspired underwater vehicle design" *Research Coordination Network on Neuromechanics and Dynamics of Locomotion Winter Workshop on Locomotion*, January 16, 2013, New Orleans, LA.

"Jellyfish as models for propulsion." *AmeriMech 2012: Mechanics in Biology*, December 10, 2012, Blacksburg, VA.

"Biogenic inputs to ocean mixing: Evidence from observations of swimming medusa." *University of Washington Department of Biology Integrative Biophysics Seminar*, November 26, 2012, Seattle, WA.

"Alien Deep: How do we make viewers care?" *Blue Ocean Film Festival Panel*, September 28, 2012, Monterey, CA.

"Through the lens of SCUVA." *Rhode Island Energy and Environmental Leaders Day, Ocean Explorers turned Ocean Interpreters*, May 1, 2012, Kingston, RI.

"Observations of swimming by medusae *Sarsia tubulosa*: from viscous vortex rings to trailing jets." *Woods Hole Oceanographic Institution Coastal and Ocean Fluid Dynamics Laboratory Seminar*, March 16, 2012, Woods Hole, MA.

"Experimental studies of jellyfish propulsion for bio-inspired design of underwater vehicles." *WHOI Ocean Science Journalism Fellowship Seminar*, September 14, 2011, Quissett, MA.

"Through the lens of SCUVA." *National Geographic Society Explorer's Symposium, Frontiers of Science panel*, June 23, 2011, Washington D.C.

"Biogenic inputs to ocean mixing." *Princeton University Fluid Mechanics Seminar*, April 29, 2011, Princeton, New Jersey.

"Jellyfish as biogenic ocean mixers and models for propulsion." *Massachusetts Institute of Technology Ocean Engineering Seminar*, April 25, 2011, Boston, MA.

"Biogenic inputs to ocean mixing." *University of Washington's Applied Physics Laboratory and Department of Oceanography Symposium*, April 4, 2011, Seattle, WA.

"Experimental studies of jellyfish propulsion to understand form and function of swimming animals." *Woods Hole Oceanographic Institution Coastal and Ocean Fluid Dynamics Laboratory Seminar*, October 8, 2010, Woods Hole, MA.

"Jellyfish as biogenic ocean mixers and models for propulsion." *Oregon State University Physical Oceanography Seminar Series*, September, 28, 2010, Corvallis, OR.

"Jellyfish as biogenic ocean mixers and models for propulsion." *University of Washington Fluid Mechanics Seminar Series*, September, 24, 2010, Seattle, WA.

"A Darwinian mechanism for biogenic ocean mixing." *Occidental College Biology Seminar Series*, January 29, 2010, Los Angeles, CA.

"A Darwinian mechanism for biogenic ocean mixing." *Naval Undersea Warfare Center Seminar Series*, November 9, 2009, Newport, RI.

"A Darwinian mechanism for biogenic ocean mixing." *Woods Hole Oceanographic Institution Applied Ocean Physics and Engineering Seminar*, October 21, 2009, Woods Hole, MA.

"Mixing efficiency of swimming animals in stratified flows." *Virginia Tech Engineering Science and Mechanics Seminar Series*, March 2, 2009, Blacksburg, VA.

HONORS and AWARDS

National Geographic Society Emerging Explorer	2011
Devonshire Postdoctoral Fellow, Woods Hole Oceanographic Institution	2010-2012
Assistant Professor of Mechanical Engineering, University of Colorado – Declined	2010
Postdoctoral Fellow, National Renewable Energy Laboratory – Declined	2010
Assistant Professor of Engineering Science and Mechanics, Virginia Tech – Declined	2009
NSF Graduate Student Research Fellowship	2009-2010
ICTAM/USNC Travel Grant	2008
ASEE National Defense Science and Engineering Graduate Fellowship	2006-2009
Graduate Research Assistantship, California Institute of Technology	2004-2006
NASA Academy, Ames Research Center	2004
NASA Reduced Gravity Student Flight Opportunities Program	2004
Mary Gates Endowment for Students, Research and Leadership Grant	2003-2004
NSF/CSEM Success in Engineering and Math Scholarship	2003
Lance Erik Fogde Endowed Scholarship, Aeronautics and Astronautics	2003-2004
Sigma Gamma Tau: National Aerospace Honor Society	2003
University of Washington Opportunity Grant	2002-2003
U.S. Olympic Figure Skating Team, Second Alternate	2002
Edy Award for Best U.S. Nationals Performance, Pro Skater's Association	2001
Phi Theta Kappa: National Two-Year College Honor Society	2000
U.S. International Figure Skating Team Member	1999-2003
U.S. Nationals Novice Ice Dancing 1st Place	1999

FUNDING AWARDS

National Geographic Society Emerging Explorer Award ($10,000)	2011
WHOI Interdisciplinary Award (with H Jiang, G Lawson, P Wiebe; $98,109)	2011
National Geographic Society Expeditions Council Grant ($14,120)	2011
Green Technology Innovation Award (with H Jiang, N Farr, R Schmitt; $74,614)	2010

ATHLETIC ACTIVITIES

Women's Champion – 1st Annual Cape Cod Oktoberfest Keg Toss	2011
SCUBA Diver - AAUS, PADI Open Water, Advanced, Rescue, and Divemaster	2006-Present
Competitor - Sprint Distance Triathlons	2006-2008
Member/Competitor - California Institute of Technology Figure Skating Team	2004-2006

VOLUNTEER ACTIVITIES

Mentor – WHOI/MIT Joint Program Student Mentoring **2011-Present**

- Served as academic and professional mentor to Heather Beem, a graduate student in Applied Ocean Physics and Engineering

Guest Judge - King/Drew Magnet High School Science Fair **2010**

- Participated as guest judge at a medicine and science high school in Los Angeles, CA
- Using a requirements matrix, judged student research posters and selected student participants in the California state-wide science fair

Mentor - Boys and Girls Club **2010**

- Spent four hours per week helping 3rd to 6th grade public school students with homework, reading, and science projects
- Students attending Boys and Girls Club in Pasadena, CA have multicultural background

Divemaster - Sharky's Eco-Dive Center **2009-2010**

- Volunteered weekends to assist introductory scuba diving classes in a pool and open water
- Responsibilities included monitoring student equipment, anxiety level, determining logistics for dive sites, and assisting in emergency situations

Host - Caltech Classroom Connection **2009**

- Hosted laboratory tours for a 3rd grade class from an elementary school in Pasadena, CA
- Introduced students to laboratory techniques, jellyfish, and usefulness of science and math in their everyday lives

Mentor - Zen Divers **2006-2008**

- Teaches east Los Angeles students how to scuba dive and other related life lessons
- Training emphasizes math and physics and their role in dive theory
- Responsibilities include in-water instructor support during diving classes and organizing laboratory tours at Caltech

Host - California Institute of Technology Reel Science: Wind **2007**

- Caltech community outreach program targeting K-12 students
- 400 Los Angeles-area students (K-12 grade levels) were in attendance
- Responsibilities included selecting questions for each grade level, introducing myself and my work and how it relates to movie, and directing question and answer session

SELECTED SYNERGISTIC ACTIVITIES

Journal of Visualized Experiments: *Featured Scientist: Kakani Katija talks jellyfish and ocean mixing*
http://vimeo.com/31429333

National Geographic Magazine (and online): Susan Daugherty, *2011 Emerging Explorer*
http://www.nationalgeographic.com/field/explorers/kakani-katija/

British Broadcasting Corporation: Victoria Gill, *Jellyfish help to stir the ocean*
http://news.bbc.co.uk/2/hi/science/nature/8173384.stm

Nature News: Roberta Kwok, *Jellyfish help mix the world's oceans*
http://www.nature.com/news/2009/090729/full/news.2009.745.html

National Public Radio: Geoff Brumfiel, *Jellyfish may help keep planet cool*
http://www.npr.org/templates/story/story.php?storyId=111346982

Discovery Channel: Michael Reilly, *Jellyfish may affect climate by stirring oceans*
http://dsc.discovery.com/news/2009/07/29/jellyfish-climate-ocean.html

National Geographic: Brian Handwerk, *Sea animals change climate via flutters and flaps*
http://news.nationalgeographic.com/news/2009/07/090729-jellyfish-ocean-global-warming.html

New York Times: Henry Fountain, *Microscopic creatures stir the oceans*
http://www.nytimes.com/2009/08/04/science/04obmixx.html#

Time Magazine: Adi Narayan, *Churning ocean waters, one jellyfish at a time*
http://www.time.com/time/health/article/0,8599,1914547,00.html

REFERENCES

Dr. John H. Costello
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