

Matthew J. Ringuette

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EDUCATION

Doctor of Philosophy in Aeronautics (Fluid Mechanics) (2004)

California Institute of Technology, Pasadena, CA

Dissertation Title: *Vortex Formation and Drag on Low Aspect Ratio, Normal Flat Plates*

Advisor: Professor Morteza Gharib

Minor in Science, Ethics, & Society

Master of Science in Aeronautics (2000)

California Institute of Technology, Pasadena, CA

Bachelor of Science in Aeronautical & Mechanical Engineering (1999)

Rensselaer Polytechnic Institute, Troy, NY

Tau Beta Pi, Founders Award

EMPLOYMENT HISTORY

University at Buffalo, the State University of New York

Buffalo, NY

2008–present: *Assistant Professor*

Department of Mechanical and Aerospace Engineering

Princeton University

Princeton, NJ

2005–2008: *Postdoctoral Research Associate*

Department of Mechanical and Aerospace Engineering

California Institute of Technology

Pasadena, CA

2000–2004: *Research/Teaching Assistant*

Graduate Aeronautical Laboratories (GALCIT)

Rensselaer Polytechnic Institute

Troy, NY

Summer 1999: *Designed & fabricated pipe-flow experiment for teaching lab.*

Department of Mechanical, Aerospace, and Nuclear Engineering

Summer 1998–Spring 1999: *Undergraduate Researcher*
Department of Mechanical, Aerospace, and Nuclear Engineering

Summer 1997: *Undergraduate Researcher*
Department of Civil and Environmental Engineering

RESEARCH INTERESTS

Experimental fluid mechanics, bio-inspired propulsion for autonomous vehicle design, unsteady vortex dynamics, fluid-structure interactions and energy harvesting, coherent structures in turbulent boundary layers, and hypersonics.

HONORS AND AWARDS

Professor of the Year (teaching award), Tau Beta Pi, NY Nu Chapter at SUNY Buffalo (2010)

Air Force Office of Scientific Research (AFOSR) Young Investigator Research Program Award (2010) for proposal: “Flapping-Wing Propulsion Characterized Using Optimal Vortex Formation.” Funding: \$359,510 over 3 years.

Honorary Member, Pi Tau Sigma, National Mechanical Engineering Honor Society (2009)

PROFESSIONAL MEMBERSHIPS AND ACTIVITIES

American Institute of Aeronautics and Astronautics (AIAA)

American Physical Society (APS)

Member, NATO RTO Task Group AVT-202: Extension of Fundamental Flow Physics to Practical MAV Aerodynamics

Member, Low Reynolds Number Aerodynamics Discussion Group (Organized through AIAA Fluid Dynamics Technical Committee)

Reviewer for: Journal of Fluid Mechanics, Physics of Fluids, Experiments in Fluids, AIAA Journal, Journal of Fluids Engineering, Bioinspiration and Biomimetics, Experimental Thermal and Fluid Science

DEVELOPMENT ACTIVITIES

Workshop (invited along with Z. R. Carr), “Rotating-Wing Flows” with four other experimental and computational investigators, Air Force Research Lab at Wright-Patterson Air Force Base (May 2013).

Workshop, “2012 CMMI CAREER Proposal Writing Workshop,” organized by Kansas State U. Division of Continuing Education, hosted by U. Nevada (March 2012)

Workshop, “Application of High-Performance Computing to the Study and Design of Micro Air Vehicles,” Air Force Research Lab at Wright-Patterson Air Force Base (Feb. 2010).

Workshop, “Research Grant Writing at UB,” SUNY Center for Professional Development (Nov. 2008).

SERVICE

Professional

Session Chair: Session 201-FD-46/APA-34, Low Reynolds Number Vortex Physics, 50th *AIAA Aerospace Sciences Meeting*, Nashville, TN, Jan. 2012.
Abstract Reviewer for 42nd *AIAA Fluid Dynamics Conference (June 2012)*, Dec. 2011.
Session Chair: Session 127-FD-31, Leading Edge Vortices and Vortex Interactions, 49th *AIAA Aerospace Sciences Meeting*, Orlando, FL, Jan. 2011.
Session Chair: Session 40-FD-13, Pitching, Plunging, and Rotating Wings, 40th *AIAA Fluid Dynamics Conference*, Chicago, IL, June 2010.
Session Chair: Session HV, Swimming III, 62nd *Annual APS Division of Fluid Dynamics Meeting*, Minneapolis, MN, Nov. 2009.
Session Chair: Session BM, Bio-Fluids: Flight II, 61st *Annual APS Division of Fluid Dynamics Meeting*, San Antonio, TX, Nov. 2008.

School of Engineering & Applied Sciences

MAE Venue creator for annual Buffalo-area Engineering Awareness for Minorities (BEAM) TREK outreach event held in May (2010–2013)
Research presentation/lab tour during Special tour for Western NY area science teachers (April 2010)
Research presentation for IDEX, Inc. visit to School of Engineering & Applied Sciences (Jan. 2010)
Faculty Advisor, NASA Space Grant Outreach Fellowship student (2009–2010 academic year)
Junior Faculty Panel Member, Future Faculty Workshop (May 2009)

Departmental

Member, Undergraduate Studies Committee (May 2010–present)
Member, Lab Upgrade Subcommittee (2008–present)
Co-organizer, MAE Graduate Seminar Series, MAE 503 (Fall 2010–Fall 2011)
MAE Open House, Aerodynamics Lab (Fall/Spring, 2010-2013)
Judge, MAE Poster Competition for graduate students (March 2010)
Faculty Advisor, Pi Tau Sigma Mechanical Engineering Honors Society, NY Delta Lambda Chapter at SUNY Buffalo, (2009–2011)
Coordinator, Preparation of Fluids & Heat Transfer lab for ABET review (October 2008)

TEACHING

University at Buffalo, the State University of New York Buffalo, NY
Physical Fluid Dynamics (MAE 510), graduate level course (Fall 2009–2011)
Individual Problems (MAE 501), graduate level (Spring 2011, Fall 2012, Spring 2013)
Independent Study (MAE 499), undergraduate level (Fall 2010, Spring 2012)
Aerodynamics (MAE 424), undergraduate level course with laboratory (Spring 2012)

Fluid Mechanics and Heat Transfer Laboratory (MAE 338), undergraduate level course
(Fall 2008–2010, Supervised Instructor Fall 2012)

Fluid Mechanics (MAE 335), undergraduate level course (Spring 2009–2011, Fall 2011–
2012)

Princeton University

Princeton, NJ

Substitute lecturer for Fluid Dynamics (MAE 335), undergraduate level course
(2006–2008)

RESEARCH SUPERVISION

Graduate Students

| <i>Student</i> | <i>Degree</i> | <i>Grad. Date</i> | <i>Current Status</i> |
|----------------|---------------|-------------------|-----------------------------|
| Matthew Burge | Ph.D. | Exp. Jan. 2016 | |
| Adam DeVoria | Ph.D. | April 29, 2013 | Postdoc, U. Florida 5/20/13 |
| Adam DeVoria | M.S. | Jan. 14, 2011 | |
| Zakery Carr | Ph.D. | Jan. 2013 | Postdoc Ringuette Group |
| Aaron Dufrene | Ph.D. | Jan. 3, 2013 | Employed, CUBRC |
| Chao Chen | M.S. (course) | Feb 1, 2013 | Employed, Boston |

Undergraduate Students

Eric Niedermeier, Summer 2012-Fall 2012, design and fabrication of wind tunnel smoke-line visualization system, funded through MAE Zimmer award.

Timothy Shea, Summer 2012, design and fabrication of 2-DOF experimental flapping-wing model for AFOSR project, funded through MAE Zimmer award, working for small engineering firm in Ithaca, NY starting June 2013.

Joshua Weisberger, Fall 2011-Spring 2012, setup/testing of department teaching wind tunnel, starting design of visualization system, currently pursuing graduate degree at UB.

Richard Kennedy, Fall 2011-Spring 2012: same topic as above, went on to do UG research at Texas A&M, attending graduate school at Caltech, Fall 2013.

James Trzaskos, Summer 2010-Spring 2011, went on to a Summer 2011 internship then a full-time position at Innovation First designing bio-inspired robotic toys.

John Sisti, Summer 2010, currently pursuing graduate degree at SUNY Buffalo.

Jonathan Bapst, Spring 2009-Spring 2010 partly funded through MAE Zimmer award, currently pursuing graduate degree at U. Washington.

Thesis Committee Member

| <i>Student</i> | <i>Degree</i> | <i>Date</i> |
|------------------|---------------|-------------|
| Rahul Mulinti | M.S. | July 2009 |
| Jun Zha | M.S. | Dec. 2009 |
| Michael Bonarski | M.S. | Aug. 2010 |
| Todd Dorazio | M.S. | Dec. 2010 |
| Jared Kuhl | M.S. | July, 2011 |
| Joseph Richter | M.S. | July, 2011 |
| Benjamin Knox | M.S. | July, 2011 |
| Wei Xie | Ph.D. | May, 2012 |

GRANT SUPPORT

1. National Science Foundation, “The Three-Dimensional Flow Structure and Forces of Flapping-Wing Hovering from Experiments,” \$288,573 (3 years), PI: M. J. Ringuette, Percent credit: 100%, Status: Pending
2. Air Force Office of Scientific Research, Multidisciplinary Research Program of the University Research Initiative (MURI), “Fundamental Processes in High-Temperature Hypersonic Flows,” \$1,495,651, PI: P. E. DesJardin, Co-PI: M. J. Ringuette, Percent credit: 50%, Status: awarded (Sept. 2010–Aug. 2015).
3. Air Force Office of Scientific Research, Young Investigator Program, “Flapping-Wing Propulsion Characterized Using Optimal Vortex Formation,” \$359,510, PI: M. J. Ringuette, Percent credit: 100%, Status: awarded (June 2010–June 2013).

PUBLICATIONS (boldface authors indicate current or former students)

Journal Articles

1. **DeVoria, A. C.** and Ringuette, M. J. “The Force and Impulse of a Flapping Plate Performing Advancing and Returning Strokes in a Quiescent Fluid.” *Exp. Fluids*, Vol. 54:1515, 2013.
2. **DeVoria, A. C.** and Ringuette, M. J. “On the Flow Generated on the Leeward Face of a Rotating Flat Plate.” *Exp. Fluids*, Vol. 54:1495, 2013.
3. **Carr, Z. R., Chen, C.,** and Ringuette, M. J. “Finite-Span Rotating Wings: Three-Dimensional Vortex Formation and Variations with Aspect Ratio.” *Exp. Fluids*, Vol. 54:1444, 2013.
4. **DeVoria, A. C.** and Ringuette, M. J. “Vortex Formation and Saturation for Low-Aspect-Ratio Rotating Flat-Plate Fins.” *Exp. Fluids*, Vol. 52, 2012, pp. 441-462.
5. Ringuette, M. J., Bookey, P., Wyckham, C. and Smits, A. J. “Experimental Study of a Mach 3 Compression Ramp Interaction at $Re_\theta = 2400$.” *AIAA J.*, Vol. 47, No. 2, 2009, pp. 373-385.
6. Ringuette, M. J., Wu, M., and Martín, M. P. “Low Reynolds Number Effects in STBLI of a Compression Corner at Mach 3 and $Re_\theta = 2300$.” *AIAA J.*, Vol. 46, No. 7, 2008, pp. 1883-1886.
7. Ringuette, M. J., Wu, M., and Martín, M. P. “Coherent Structures in Direct Numerical Simulation of Turbulent Boundary Layers at Mach 3.” *J. Fluid Mech.*, Vol. 594, 2008, pp. 59-69.

8. Ringuette, M. J., Milano, M., and Gharib, M. "Role of the Tip Vortex In the Force Generation of Low-Aspect-Ratio Normal Flat Plates." *J. Fluid Mech.*, Vol. 581, 2007, pp. 453-468.

Conference Papers

1. **Burge, M., Carr, Z. R., DeVoria, A. C.**, and Ringuette, M. J. "Pitching Effects on the Leading-Edge-Vortex Formation and Lift Force of Low-Aspect-Ratio Rotating Wings." *52nd AIAA Aerospace Sciences Meeting (Part of Science and Technology Forum, SciTech)*, National Harbor, MD, 13-17 Jan. 2014, *Abstract submitted*.
2. **Carr, Z. R., DeVoria, A. C.**, and Ringuette, M. J. "Aspect Ratio Effects on the Leading-Edge Circulation and Forces of Rotating Flat-Plate Wings." *AIAA Paper 2013-0675, 51st AIAA Aerospace Sciences Meeting*, Grapevine, TX, 7-10 Jan. 2013.
3. **Carr, Z. R., Chen, C.**, and Ringuette, M. J. "Vortex Formation and Forces of Low-Aspect-Ratio, Rotating Flat-Plate Wings at Low Reynolds Number." *AIAA Paper 2012-3280, 42nd AIAA Fluid Dynamics Conference*, New Orleans, LA, 25-28 June 2012.
4. **Carr, Z. R., Chen, C.**, and Ringuette, M. J. "The Effect of Aspect Ratio on the Three-Dimensional Vortex Formation of Rotating Flat-Plate Wings." *AIAA Paper 2012-912, 50th AIAA Aerospace Sciences Meeting*, Nashville, TN, 9-12 Jan. 2012.
5. **DeVoria, A., Mahajan, P.**, and Ringuette, M. J. "Vortex Formation and Saturation for Low-Aspect-Ratio Rotating Flat Plates at Low Reynolds Number." *AIAA Paper 2011-396, 49th AIAA Aerospace Sciences Meeting*, Orlando, FL, Jan. 2011.
6. Sahoo, D., Ringuette, M. J., and Smits, A. J. "Experimental Investigation of a Hypersonic Turbulent Boundary Layer." *AIAA Paper 2009-780, 47th AIAA Aerospace Sciences Meeting*, Orlando, FL, Jan. 2009.
7. Beekman, I., Priebe, S., Ringuette, M. J., and Martín, M. P. "Effect of Wall Temperature and Mach Number on the Turbulence Structure of Hypersonic Boundary Layers." *AIAA Paper 2009-1328, 47th AIAA Aerospace Sciences Meeting*, Orlando, FL, Jan. 2009.
8. Ringuette, M. J., and Smits, A. J. "Wall-Pressure Measurements in a Mach 3 Shock-Wave Turbulent Boundary Layer Interaction at a DNS-Accessible Reynolds Number." *AIAA Paper 2007-4113, 37th AIAA Fluid Dynamics Conference*, Miami, FL, June 2007.
9. Ringuette, M. J., Wu, M., and Martín, M. P. "Coherent Structures in DNS of Turbulent Boundary Layers at Mach 3." *AIAA Paper 2007-1138, 45th AIAA Aerospace Sciences Meeting*, Reno, NV, Jan. 2007.
10. Ringuette, M. J., Martín, M. P., Smits, A. J., and Wu, M. "Characterization of the Turbulence Structure in Supersonic Boundary Layers using DNS Data." *AIAA Paper 2006-3539, 36th AIAA Fluid Dynamics Conference*, San Francisco, CA, June 2006.

11. Martín, M. P., Smits, A., and Wu, M., and Ringuette, M. J. "The Turbulence Structure of Shockwave and Boundary Layer Interaction in a Compression Corner." *AIAA Paper 2006-497, 44th AIAA Aerospace Sciences Meeting*, Reno, NV, Jan. 2006.
12. Milano, M., Ringuette, M. J., Noca, F., and Gharib, M. "Force Computation from DPIV Measurements for a Flat Plate Performing Drag-Maximizing Oscillations." *2nd Intl. Symp. on Aqua Bio-Mechanisms (ISABMEC)*, Honolulu, HI, 2003 (Published as a CD).
13. Milano, M., Ringuette, M. J., and Gharib, M. "Drag Maximization for a Flat Plate Oscillating in a Single Direction." *7th Intl. Symp. on Fluid Control, Measurement and Visualization (FLUCOME)*, Sorrento, Italy, 2003.

Other Conference Presentations

1. **Mahajan, P.** and Ringuette, M. J. "Vortex Structure of Low-Aspect-Ratio Rotating Flat-Plate Wings." *63rd APS Division of Fluid Dynamics Meeting*, Long Beach, CA, November 2010.
2. **DeVoria, A.** and Ringuette, M. J. "Vortex Formation in the Starting Flow of Rotating Low-Aspect-Ratio Plates." *63rd APS Division of Fluid Dynamics Meeting*, Long Beach, CA, November 2010.
3. **DeVoria, A., Bapst, J.,** and Ringuette, M. J. "Vortex Formation Time for a Sweeping Fin." *62nd APS Division of Fluid Dynamics Meeting*, Minneapolis, MN, November 2009.
4. Priebe, S., Beekman, I., Ringuette, M. J., and Martín, M. P. "Chasing Eddies and Their Wall Signature in Turbulent Boundary Layers at Mach 3 Through 10." *61st APS Division of Fluid Dynamics Meeting*, San Antonio, TX, November 2008.
5. Ringuette, M. J., and Smits, A. J. "Unsteady Wall-Pressure Loading in a Mach 3 Compression Ramp Flow at $Re_\theta = 2400$." *60th APS Division of Fluid Dynamics Meeting*, Salt Lake City, UT, November 2007.
6. Ringuette, M. J., Wu, M., and Martín, M. P. "Superstructures in Compressible Turbulent Boundary Layers." *59th APS Division of Fluid Dynamics Meeting*, Tampa, FL, November 2006.
7. Ringuette, M. J., Martín, M. P., and Smits, A. "Characterizing Coherent Structures in Supersonic, Turbulent Boundary Layers." *58th APS Division of Fluid Dynamics Meeting*, Chicago, IL, November 2005.
8. Milano, M., Ringuette, M. J., and Gharib, M. "A Study of Optimal Average Lift Production by a Flapping Flat Plate." *57th APS Division of Fluid Dynamics Meeting*, Seattle, WA, November 2004.

9. Ringuette, M. J., Milano, M., and Gharib, M. "Self-Organizing Evolution Strategy for Lift Maximization of a Flat Plate Periodically Flapping in a Single Direction." *55th APS Division of Fluid Dynamics Meeting*, Dallas, TX, November 2002.
10. Ringuette, M. J., Gharib, M., Choi, F., Assad, C., and Noca, F. "Leading Edge Vortex Formation Number for an Accelerating Airfoil." *54th APS Division of Fluid Dynamics Meeting*, San Diego, CA, November 2001.
11. Hirs, A., Korenowski, G. M., Ringuette, M. J., Joshi, A., and Lopez, J. M. "Measurements in a High Reynolds Number Deep-Channel Viscometer." *51st APS Division of Fluid Dynamics Meeting*, Philadelphia, PA, November 1998.

INVITED TALKS

1. "Unsteady Vortex Formation of Low-Aspect-Ratio Bio-Inspired Propulsors." Syracuse University, Syracuse, NY, November 2nd, 2012.
2. "The Fluid Dynamics of Bio-Inspired Propulsion." School of Engineering & Applied Sciences Emeritus Luncheon. University at Buffalo, the State University of New York, Buffalo, NY, April 28th, 2009.
3. "Unsteady, Three-Dimensional Vortex Flows with Applications to Bio-Inspired Propulsion." University at Buffalo, the State University of New York, Buffalo, NY, October 23rd, 2008.
4. "Characterizing Unsteady, Three-Dimensional Vortices in Low- and High-Speed Flows." University at Buffalo, the State University of New York, Buffalo, NY, April 14th, 2008.
5. "Characterizing Unsteady, Three-Dimensional Vortices in Low- and High-Speed Flows." University of Minnesota, Minneapolis, MN, March 3rd, 2008.