

Mauro Rodriguez Jr.

Postdoctoral Scholar Research Associate
Department of Mechanical & Civil Engineering
Division of Engineering & Applied Science
California Institute of Technology

1200 E California Blvd, MC 104-44, Pasadena, CA 91125

email: mrdz@caltech.edu, **website:** its.caltech.edu/~mrdz

Nationality: American, U.S. born citizen

Education

University of Michigan (U-M), Ann Arbor

Doctorate of Philosophy, Mechanical Engineering, 2018

Thesis Title: Numerical Simulations of Bubble Dynamics Near Viscoelastic Media

Thesis Link: <http://hdl.handle.net/2027.42/147536>

Thesis Adviser: Eric Johnsen, Ph.D.

Leland Stanford Jr. University

Master of Science, Mechanical Engineering, 2012

University of Illinois at Urbana-Champaign (UIUC)

Bachelor of Science with Honors, Mechanical Science and Engineering, 2010

Academic Interests

Research: Fluid mechanics, computational multi-phase and -component flow dynamics, diffused interfaces, non-linear viscoelasticity, spherical and non-spherical cavitation bubble dynamics, high-strain-rate flow physics, high-performance computing

Advancing the academy: I aim to bring higher education access, support and development to underrepresented communities as a faculty member and influential educator. My mission as an educator is to empower the next generations of diverse critical thinkers in a welcoming/inclusive environment to solve engineering problems involving flow physics.

Skills

Programming Languages: C, C++, Fortran, MATLAB, HTML, OpenMP, MPI and HDF5

Engineering Software: ParaView, Tec360, ProEngineer, Revit Architecture

Spoken Languages: English (Native), Spanish (Native)

Research Activity

California Institute of Technology, Pasadena, California

Computational Flow Physics Laboratory, Postdoctoral mentor: Tim Colonius, Ph.D.

Postdoctoral research fellow, 06/2019-Present: Conducted numerical simulations of bubble dynamics with phase change in and near soft (non-linear viscoelastic) media to predict dynamics of cavitation erosion.

University of Michigan, Ann Arbor, Michigan

Scientific Computing and Flow Physics Laboratory, Doctoral adviser: Eric Johnsen, Ph.D.

Graduate Research Assistant, 06/2012-12/2018: Conducted numerical simulations of non-linear wave and bubble dynamics near linear, viscoelastic media to understand the dynamics and cavitation erosion relevant in non-invasive biomedical therapeutic tools and naval hydraulic applications.

Leland Stanford Jr. University, Stanford, California

Shaqfeh Research Group, Research adviser: Eric Stefan G. Shaqfeh, Ph.D.

Graduate Research Student, 04/2011-06/2012

University of Illinois at Urbana-Champaign (UIUC)

Intel Scholars Undergraduate Research Program, Advisor: Feniosky Pena-Mora, Ph.D.

Undergraduate Research Assistant, 06/08-05/09

Archived Publications

Peer-reviewed Papers

1. S. Padhy, **M. Rodriguez**, E. S. G. Shaqfeh, G. Iaccarino, Jeffrey F. Morris, and N. Tonmukayakul, "The effect of shear thinning and walls on the sedimentation of a sphere in an elastic fluid under orthogonal shear," *J. Non-Newtonian Fluid Mech.*, 2013 **201** 120-129. doi:10.1016/j.jnnfm.2013.07.007
2. **M. Rodriguez** and E. Johnsen, "A high-order, finite-difference approach for numerical simulations of shocks interacting with interfaces separating different linear viscoelastic materials," *J. Comput. Phys.* 2019 **379** 70-90. doi:10.1016/j.jcp.2018.10.035
3. **M. Rodriguez**, K. G. Powell and E. Johnsen, "A high-order accurate AUSM⁺-up approach for simulations of compressible multiphase flows with linear viscoelasticity," *Shock Waves* 2019 **29** 717-734. doi:10.1007/s00193-018-0884-3
4. C. T. Wilson, T. L. Hall, E. Johnsen, L. Mancina, **M. Rodriguez**, J. E. Lundt, T. Colonius, D. L. Henann, C. Franck, Z. Xu, J. R. Sukovich, "A Comparative Study of the Dynamics of Laser and Acoustically Generated Bubbles in Viscoelastic Media," *Physical Review E* 2019 **99** 1-10. doi:10.1103/PhysRevE.99.043103
5. L. Mancina, E. Vlaisavljevich, N. Yousefi, **M. Rodriguez**, T. J. Ziemlewicz, F. T. Lee, D. Henann, C. Franck, Z. Xu, and E. Johnsen, "Modeling tissue-selective cavitation damage," *Phys. Med. Biol.* 2019 **64** 225001. doi:10.1088/1361-6560/ab5010
6. J. S. Spratt, **M. Rodriguez**, K. Schindmayer, S. H. Bryngelson, J. Yang, C. Franck, and T. Colonius, "Characterizing viscoelastic materials via ensemble-based data assimilation of bubble collapse observations," *J. Mechanics and Physics of Solids* *Submitted*. <https://arxiv.org/abs/2008.04410>
7. **M. Rodriguez**, S. A. Beig, E. Johnsen, and C. Barbier, "Inertially-driven gas bubble collapse in a channel," *J. Fluid Mech.* *In preparation*.
8. L. Mancina, **M. Rodriguez**, J. Sukovich, Z. Xu, E. Johnsen, "Acoustic measurements of cavitation nucleus size distribution," *Phys. Med. Biol.* *Under review*.
9. G. Shpuntova, **M. Rodriguez**, J. M. Austin, E. Johnsen, "Modeling the Pressure Wave-induced Asymmetric Collapse of a Two-Dimensional Gas Void with Potential Flow Theory," *J. Fluid Mech.* *In preparation*.
10. **M. Rodriguez**, L. Mancina, S. Buyukozturk, J. Sukovich, C. Franck, Z. Xu, E. Johnsen, T. Colonius, "Modeling Nucleation and Growth of a Laser-induced Cavitation Bubble in Water," *In preparation*.
11. **M. Rodriguez** and E. Johnsen, "Numerical investigation of a shock-induced bubble collapse near an elastic, rigid object," *J. Acoust. Soc. Am.* *In preparation*.

Peer-reviewed Conference Proceedings

1. S. A. Beig, **M. Rodriguez** and E. Johnsen, "Non-spherical bubble collapse near rigid and compliant surfaces," 31st Symposium on Naval Hydrodynamics, Monterey, CA, USA, September 11-16, 2016.

2. **M. Rodriguez** and K. Siles, D. L. Renaud, “A decade-long programmatic study of SHPE’s chapter reporting program: best practices, lessons learned, and outcomes for national engineering diversity chapter-based organizations (Experience),” Paper presented at 2020 ASEE Virtual Annual Conference Content Access, Virtual On-line. doi:10.18260/1-2--33997.
3. S. L. Plata, I. Hasbun, **M. Rodriguez**, D. Renaud, “Social-cognitive leadership theory of SHPE’s premier leadership conference for undergraduates and professionals in the STEM workforce (research paper),” 2020 Collaborative Network for Computing & Engineering Diversity, Virtual On-line *Accepted*.
4. **M. Rodriguez**, I. Hasbun, J. L. Estrada, D. Renaud, “On the effect of SHPE’s social-cognitive leadership theory to Hispanic STEM professionals’ leadership self-efficacy (work in progress),” 2020 Collaborative Network for Computing & Engineering Diversity, Virtual On-line *Accepted*.

Published Abstracts, Posters, and Presentations Presented +20 research talks, select talks below

1. M. Rodriguez and E. Johnsen, Simulations of Shock Propagation in Viscoelastic Media, American Physical Society (APS) 66th Annual Meeting Division of Fluid Dynamics, Pittsburgh, Pennsylvania, November 2013.
2. M. Rodriguez and E. Johnsen, Shock Waves in Viscoelastic Media, 17th U.S. National Congress on Theoretical and Applied Mechanics, Michigan State University, Lansing, Michigan, June 2014.
3. M. Rodriguez and E. Johnsen, Simulations of Bubble Collapse in Viscous and Viscoelastic Media near a Second Viscoelastic Medium, APS 67th Annual Meeting Division of Fluid Dynamics, San Francisco, California, November 2014.
4. M. Rodriguez and E. Johnsen, Simulations of Bubble Collapse in Nonlinear Viscoelastic Medium, Coupled Problems 2015, VI International Conference on Coupled Problems in Science and Engineering, San Servolo, Venice, Italy, May 2015.
5. M. Rodriguez and E. Johnsen, Simulations of Non-spherical Bubble Collapse Dynamics in Viscous and Viscoelastic Media Near a Compliant Object, APS 68th Annual Meeting Division of Fluid Dynamics, Boston, Massachusetts, November 2015.
6. M. Rodriguez and E. Johnsen, Non-spherical Bubble Collapse Dynamics in Viscoelastic Media, XXIV International Congress of Theoretical and Applied Mechanics, Montreal, Canada, August 2016.
7. M. Rodriguez and E. Johnsen, Simulations of Shock-induced Bubble Collapse near Hard and Soft Objects, APS 69th Annual Meeting Division of Fluid Dynamics, Portland, Oregon, November 2016.
8. M. Rodriguez, S. A. Beig, E. Johnsen, and C. Barbier, The Role of Confinement in Bubble Collapse in a Channel, APS 70th Annual Meeting Division of Fluid Dynamics, Denver, Colorado, November 2017.
9. M. Rodriguez and E. Johnsen, Simulations of Rayleigh Bubble Collapse Near a Soft Object, 13th World Congress of Computational Mechanics (WCCM) 2018. New York City, New York, July 2018.
10. M. Rodriguez, S. A. Beig, E. Johnsen, and C. Barbier, Rayleigh Collapse of a Bubble in a Channel, APS 71st Annual Meeting Division of Fluid Dynamics, Atlanta, Georgia, November 2018.
11. M. Rodriguez, E. Johnsen, Collapse of a Bubble Near a Viscoelastic Object, 16th Pan-American Congress of Applied Mechanics, Ann Arbor, Michigan, May 2019.
12. M. Rodriguez, S. A. Beig, E. Johnsen, and Z. Xu, High-fidelity Numerical Simulations of Collapsing Cavitation Bubbles Near Solid and Elastically Deformable Objects, Blue Waters Symposium, Sunriver, Oregon, June 2019.
13. M. Rodriguez, T. Colonius, Numerical simulations of a cavitating bubble with phase transition near an object, APS 72nd Annual Meeting Division of Fluid Dynamics, Seattle, Washington, November 2019.
14. M. Rodriguez, T. Colonius, Acoustically growing cavitating bubble with phase transition near a rigid wall, APS 73rd Annual Meeting Division of Fluid Dynamics Virtual conference, November 2020.

Organization Memberships

American Society of Engineering Education (ASEE), since 2015

American Physical Society (APS), since 2013

Edward A. Bouchet Graduate Honor Society, since 2015

Society for Advancing Hispanics/Chicanos and Native Americans in Science (SACNAS), since 2009

Society for Industrial and Applied Mathematics (SIAM), since 2015

Society of Hispanic Professional Engineers (SHPE), since 2006, lifetime member

Teaching Activity

Research Mentor

California Institute of Technology, Pasadena, California

Freshmen Summer Research Initiative (FSRI), 08/2019

Student: Chase Blagden

Project: On the effects of near-field compressibility and elasticity on bubble oscillations

University of Michigan, Ann Arbor, Michigan

Undergraduate Research Opportunity Program (UROP), 09/2018-Present

Student: Eric Hersey

Project: Numerical Simulations of Spherical Bubble Dynamics in Non-Newtonian Fluids

Undergraduate Research Opportunity Program (UROP), 09/2016-05/2017

Student: Leticia Loeza

Project: Quantifying Histotripsy-induced Cavitation Bubble Collapse Damage in Soft Media

Summer Research Opportunity Program (SROP), 06/2016-08/2016

Student: Nicole Bustos

Project: Effect of Tissue-like Material Properties and Waveform on Histotripsy-induced Cavitation Bubble Dynamics and Bioeffects

Teaching & Instruction

University of Michigan, Ann Arbor, Michigan

College of Engineering – Mechanical Engineering Department

Graduate Student Instructor–Introduction to Fluids Mechanics, 01/2017-04/2017

Center for Engineering Diversity and Outreach Summer Engineering Academy

Engineering Design Concepts Instructor, 04/2015-08/2015, 04/2016-08/2016

Leland Stanford Jr. University, Stanford, California

Engineering Diversity Programs

Accelerated Calculus for Engineers (ACE) Facilitator, 04/2012-06/2012

University of Illinois at Urbana-Champaign (UIUC)

Morrill Engineering Program (MEP)

Facilitated Study Group Mentor, 01/2009-03/2010

Service Activity

Internal Service

Journal article reviewer

Journal of Fluid Mechanics, Journal of Computational Physics, Physical Review Fluids, Physical Review E, Physical Review Applied, Ultrasonics - Sonochemistry

University of Michigan College of Engineering

Diversity, equity, and Inclusion (DE&I) Initiative - graduate strategy subcommittee member

External Service

Society of Hispanic Professional Engineers (SHPE)

Leadership & Conference Chair Held 20+ positions, select positions below

National Graduate Committee Co-Chair, 06/2011 - 08/2016

National Affairs Committee Member, 06/2011 - 06/2018

National Chapter Program Lead Developer, 06/2018 - 06/2020

1. Pre-College Symposium Outreach Chair, 2014 National SHPE Conference Committee, 02/14 - 11/14
2. Graduate Programs Co-Chair, 2015 National SHPE Conference, 03/15 - 11/15
3. Academic Programs Co-Chair, 2015 National SHPE Conference, 03/15 - 11/15
4. Deans' Summit organizer, 2015 National SHPE Conference, 03/15 - 11/15
5. National Institute for Leadership Advancement (NILA) Curriculum Chair, 2018-2020

Invited Speaker Selected lectures provided below, given +25 invited talks, full list available upon request

1. Rodriguez, M., "State of the LatinX Community in STEM," SHPE Conference - Deans' Summit, Seattle, Washington, November 2016.
2. Rodriguez, M., "Post-undergraduate Success for the LatinX STEM Community," SHPE National Conference, Seattle, Washington, November 2016.
3. Rodriguez, M., "How to Be a Servant Leader," National Institute for Leadership Advancement, Albuquerque, New Mexico, August 2017.
4. Rodriguez, M., "Securing a Postdoctoral Fellowship after Successfully Completing Your Graduate Degree," SHPE National Convention, Phoenix, Arizona, August 2019.
5. Rodriguez, M., "Towards the the post-graduation success of first-generation college students," (*presented in Spanish to community parents*), SHPE National Convention, Phoenix, Arizona, August 2019.
6. Rodriguez, M., "Selecting the Best Graduate Program – Masters vs Doctoral," SHPE National Virtual Convention, August 2020.

Financial Awards & Honors

Selected awards provided below, received +20 honors, full list available upon request

Computational co-PI grants

1. 2018 National Science Foundation (NSF) Extreme Science and Engineering Discovery Environment (XSEDE) computation grant, \$42,141.47

2. 2018 NSF Blue Waters Great Lakes Consortium for Petascale Computation Allocation, 350,000 node-hours
3. 2018 NSF Blue Waters Broadening Participation Computational Allocation, 300,000 node-hours
4. 2017 NSF XSEDE computation grant, \$204,685.40
5. 2017 NSF Blue Waters Great Lakes Consortium for Petascale Computation Allocation, 880,000 node-hours

National

1. NSF Alliances for Graduate Education and the Professoriate (AGEP) Postdoctoral Fellowship, 2019
2. Ford Foundation Postdoctoral Fellowship, 2019
3. Ford Foundation Dissertation Writing Fellowship, 2017
4. Edward A. Bouchet Graduate Honor Society Member, 2015
5. Society of Hispanic Professional Engineer's National Paper Competition Finalist, 2013
6. Rackham Graduate Engineering Fellowship Award, University of Michigan, 2012
7. National Science Foundation Graduate Research Fellowship Honorable Mention, Stanford, 2011
8. Stanford's Mechanical Engineering Graduate Engineering Fellowship Award, 2010

Local

1. University of Michigan Museum of Natural History's Portal to the Public Science Communication Fellow, 2017
2. University of Michigan Rackham Graduate School Pre-Doctoral Fellowship, 2017
3. University of Michigan's North Campus Community Dr. Martin Luther King Jr. Spirit Award, 2016
4. Rackham Summer Research Award, University of Michigan, 2015
5. College of Engineering's Distinguished Leadership Award, University of Michigan, 2015
6. Graduate Student of the Year Award, Michigan Difference Student Leadership, University of Michigan, 2015
7. PhD Candidate Achievement Award, Center for Engineering Diversity and Outreach, University of Michigan College of Engineering, 2015
8. University of Michigan's Engineering Graduate Symposium Poster Session, 1st Place, Fluidic Dynamics, Thermodynamics, Heat Transfer, and Combustion section, 2013
9. Ford Foundation Pre-Doctoral Fellowship Honorable Mention, 2012
10. University of Michigan's North Campus Community Dr. Martin Luther King Jr. Spirit Award, 2012
11. University of Michigan's Engineering Graduate Symposium Poster Session, 3rd Place, Fluidic Dynamics, Thermodynamics, Heat Transfer, and Combustion section, 2012