

February 2024

## Research Interests

Mathematical problems of fluid motion, especially singular limits involving the Navier-Stokes equations, Euler equations, and other equations of fluid mechanics.

## Academic Positions

- 2012- **Associate Professor**, *University of California Riverside*
- 2018-2020 **Vice Chair Mathematics**, *University of California Riverside*
- 2014-2019 **Undergraduate Advisor Mathematics**, *University of California Riverside*
- 2008-2012 **Assistant Professor**, *University of California Riverside*
- 2005-2008 **Tamarkin Assistant Professor**, *Brown University*
- 2002-2005 **Assistant Instructor**, *University of Texas at Austin*
- 2000-2002 **Teaching Assistant**, *University of Texas at Austin*
- 1998-1999 **Teaching Assistant**, *George Mason University*

## Degrees

- May 2005 **Ph.D.** Mathematics, *University of Texas at Austin*; advisor, Misha Vishik
- May 2000 **M.S.** Mathematics, *George Mason University*; advisor, Flavia Colonna
- May 1980 **B.S.** Mathematics & Physics, *University of Maryland, College Park*

## Grants and Awards

- 2012-2016 **NSF Standard Grant**  
*Fluid flow in the presence of boundaries and singularities*, co-PI Gung-Min Gie
- 2010-2014 **NSF Collaborative Research Grant**  
*Analysis of Incompressible High Reynolds Number Flows (one of 4 PIs)*
- 2007-2010 **NSF Standard Grant**  
*Vanishing viscosity in the presence of a boundary*
- May 2005 **Frank Gerth III Dissertation Award**
- 2004-2005 **VIGRE fellowship**, *UT Austin*
- Spring 2004 **Hubert S. Wall Fellowship**, *UT Austin*

## PhD Students

- Aug 2020 **Taylor Baldwin**  
*Solutions to the 2D Euler Equations Satisfying the Serfati Condition With Relaxed Constraints on the Initial Vorticity*  
Defended 27 August 2020

Feb 2024 **Thomas Schellhous**  
*Striated Regularity of Vorticity in a Bounded Domain*  
Defended 2 February 2024

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## Visiting Positions

Spring 2021 **Member MSRI**  
Program on *Mathematical problems in fluid dynamics*

Winter 2017 **Member ICERM**  
Program on *Singularities and Waves In Incompressible Fluids*

Spring 2014 **Member IMPA**  
Thematic program in *Incompressible Fluid Dynamics*

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## Refereed Papers

- 32 **With Christophe Lacave, Milton C. Lopes Filho, and Helena J. Nussenzveig Lopes**, *Large time behavior for the 3D Navier-Stokes with Navier boundary conditions*, In preparation, **2023**
- 31 **With Gung-Min Gie and Anna Mazzucato**, *The 3D Euler equations with inflow, outflow and vorticity boundary*, Submitted, **2022**
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- 30 **With David M. Ambrose and Fazel Hadadifard**, *Contour dynamics and global regularity for periodic vortex patches and layers*, To appear, SIAM Journal on Mathematical Analysis, **2024**
- 29 **Kelliher**, *The strong vanishing viscosity limit with Dirichlet boundary conditions*, Nonlinearity, Volume 36, Number 5, 1-33, **2023**
- 28 **With David Ambrose, Elaine Cozzi, and Daniel Erickson**, *Existence of Solutions to fluid equations in Hölder and Uniformly Local Sobolev Spaces*, Journal of Differential Equations, Volume 364, 15 August 2023, pages 107-151, **2023**
- 27 **With Gung-Min Gie and Anna Mazzucato**, *The linearized 3D Euler equations with inflow, outflow*, Advances in Differential Equations, Volume 28, Numbers 5-6, May/June, 373-412, **2023**
- 26 **With Hantaek Bae**, *Propagation of regularity of level sets for a class of active transport equations*, Journal of Mathematical Analysis and Applications, Volume 497, Issue 1, 1 May **2021**
- 25 **Kelliher**, *Stream functions for divergence-free vector fields*, Quarterly of Applied Mathematics, 79 (2021) 163-174  
Published electronically: 18 June **2020**.
- 24 **With Gung-Min Gie, Milton C. Lopes Filho, Anna Mazzucato, and Helena J. Nussenzveig Lopes**, *The Vanishing viscosity limit for some symmetric flows*, Annales de l'Institut Henri Poincaré (C) Non Linear Analysis, 36(5), 1237-1280, **2019**
- 23 **With Elaine Cozzi**, *Well-posedness of the 2D Euler equations when velocity grows at infinity*, Discrete & Continuous Dynamical Systems, 39(5), 2361-2392, **2018**
- 22 **With Gung-Min Gie and Anna Mazzucato**, *Boundary layers for the Navier-Stokes equations linearized around a stationary Euler flow*, Journal of Mathematical Fluid Mechanics, 20 (4), 1405-1426, **2018**

- 21 **With Elaine Cozzi and Gung-Min Gie**, *The aggregation equation with Newtonian potential: The vanishing viscosity limit*, Journal of Mathematical Analysis and Applications, 453(2), 841-893, 15 September **2017**
- 20 **Kelliher**, *Observations on the vanishing viscosity limit*, Transactions of the American Mathematical Society, 369, 2003-2027, **2017**  
Published electronically: 2 June 2016.
- 19 **With Elaine Cozzi**, *Incompressible Euler Equations and the Effect of Changes at a Distance*, Journal of Mathematical Fluid Mechanics, 18(4), 765-781, **2016**
- 18 **Kelliher**, *A characterization at infinity of bounded vorticity, bounded velocity solutions to the 2D Euler equations*, Indiana University Mathematics Journal, 64(6), 1643-1666, **2015**
- 17 **With David M. Ambrose, Milton C. Lopes Filho, and Helena J. Nussenzveig Lopes**, *Serfati solutions to the 2D Euler equations on exterior domains*, Journal of Differential Equations, 259(9), 4509-4560, **2015**
- 16 **With Mihaela Ignatova, Gautam Iyer, Robert L. Pego, Arghir D. Zarnescu**, *Global existence for two extended Navier-Stokes systems*, Communications in Mathematical Sciences, 13(1), 249-267, **2015**
- 15 **With Gung-Min Gie**, *Boundary layer analysis of the Navier-Stokes equations with generalized Navier boundary conditions*, Journal of Differential Equations, 253, pp. 1862-1892, **2012**
- 14 **Kelliher**, *On the flow map for 2D Euler equations with unbounded vorticity*, Nonlinearity, 24(9), 2599-2637, **2011**
- 13 **With Roger Temam and Xiaoming Wang**, *Boundary layer associated with the Darcy-Brinkman-Boussinesq model for convection in porous media*, Physica D: Nonlinear Phenomena, 240(7), 619-628, **2011**
- 12 **Kelliher**, *Eigenvalues of the Stokes operator versus the Dirichlet Laplacian for a bounded domain in the plane*, Pacific Journal of Mathematics, 244(1): 99-132, **2010**
- 11 **Kelliher**, *Infinite-energy 2D statistical solutions to the equations of incompressible fluids*, Journal of Dynamics and Differential Equations, 21(4): 631-661, **2009**
- 10 **With Milton C. Lopes Filho and Helena J. Nussenzveig Lopes**, *Vanishing viscosity limit for an expanding domain in space*, Annales de l'Institut Henri Poincaré (C) Analyse Non Linéaire, 26(6): 2521-2537, **2009**
- 9 **Kelliher**, *On the vanishing viscosity limit in a disk*, Mathematische Annalen, 343:701-726, **2009**
- 8 **With Dragoş Iftimie**, *Remarks on the vanishing obstacle limit for a 3D viscous incompressible fluid*, Proceedings of the AMS, 137(2):685-694, **2009**
- 7 **Kelliher**, *Vanishing viscosity and the accumulation of vorticity on the boundary*, Communications in Mathematical Sciences, 6(4):869-880, **2008**
- 6 **With Riad Masri**, *Analytic continuation of multiple Hurwitz zeta functions*, Mathematical Proceedings of the Cambridge Philosophical Society, 145(3):605-617, **2008**
- 5 **Expanding domain limit for incompressible fluids in the plane**, Communications in Mathematical Physics, 278(3):753-773, **2008**
- 4 **With Elaine Cozzi**, *Vanishing Viscosity in the plane for vorticity in borderline spaces of Besov type*, Journal of Differential Equations, 235(2):647-657, **2007**

- 3 **Kelliher**, *On Kato's conditions for vanishing viscosity*, Indiana University Mathematics Journal, 56(4):1711-1721, **2007**
- 2 **Kelliher**, *Navier-Stokes equations with Navier boundary conditions for a bounded domain in the plane*, SIAM Journal on Mathematical Analysis, 38(1):210-232, **2006**
- 1 **Kelliher**, *The inviscid limit for two-dimensional incompressible fluids with unbounded vorticity*, Mathematical Research Letters, 11(4):519-528, **2004**

## Invited Talks

- 48 **Large time behavior for 2D and 3D Navier-Stokes with Navier boundary conditions**, Analysis and PDE Seminar, joint with The Chinese University of Hong Kong, The University of Hong Kong, and Ulsan National Institute of Science and Technology (delivered online), 7 April 2023
- 47 **3D Euler equations with inflow, outflow**, University of California San Diego, Analysis Seminar (delivered online), 3 May 2022
- 46 **Well-posedness and regularity of solutions to the 3D Euler equations with inflow, outflow**, AMS Spring Western Sectional Meeting 2021 (delivered online), 1 May 2021
- 45 **The 3D Euler equations with inflow, outflow**, MSRI Euler/Navier-Stokes Seminar (delivered online), 1 April 2021
- 44 **Vanishing Viscosity**, MSRI introductory 5 minute talk (delivered online), 9 February 2021
- 43 **Well-posedness and regularity of solutions to the 3D Euler equations with inflow, outflow**, Indiana University PDE/Applied Math Seminar, Indiana University (delivered online), Bloomington, Indiana, 12 October 2020
- 42 **The 3D Euler equations with inflow, outflow**, AMS Fall Western Sectional Meeting 2020 (delivered online), 24 October 2020
- 41 **2D Euler equations with non-decaying vorticity and velocity**, Mathematics of Fluid Motion III: Theory and Computation, Korea Institute for Advanced Study (KIAS), Seoul, South Korea, 19 December 2019
- 40 **Boundary Layers for Incompressible Fluids: The Annoyance of Characteristic Points**, SIAM Conference on Analysis of Partial Differential Equations (PD19), La Quinta, CA, 14 December 2019
- 39 **Striated Regularity in Fluid Equations and Related PDEs**, SIAM Conference on Analysis of Partial Differential Equations (PD19), La Quinta, CA, 12 December 2019
- 38 **The strong vanishing viscosity limit with Dirichlet boundary conditions: facts, speculations, and conjectures**, CAMS colloquium at USC, 1 April 2019
- 37 **Non-Decaying Solutions to the 2D Euler Equations**, Spring 2019 AMS Western Sectional Meeting, University of Hawaii, 23 March 2019
- 36 **Striated regularity for a class of active transport equations**, Geometry & Analysis Day University of Colorado Boulder, Boulder, CO October 2018
- 35 **Bounded vorticity, unbounded velocity solutions to the 2D Euler equations**, PDE and Analysis Seminar University of Pittsburgh, Pittsburgh, PA April 2018
- 34 **Techniques of 2D fluids applied to the aggregation equation**, 2018 Joint Math Meeting, San Diego, CA January 2018

- 33 ***Mathematical Analysis in Incompressible Fluid Dynamics - Part I of II***, 2017 SIAM Conference on Analysis of Partial Differential Equations, Baltimore, MD, December 2017
- 32 ***Bounded Vorticity, unbounded velocity solutions to the 2D Euler equations***, Nonlinear Partial Differential Equations Seminar, Texas A&M University, College Station, Texas, Sept 2017
- 32 ***Non-decaying solutions to the 2D Euler equations***, DyCoV: Local and global dynamics of concentrated vortices, University of Rennes, Rennes (France), May 2017
- 31 ***Vanishing viscosity***, Dynamics of Small Scales in Fluids, ICERM, Providence, RI, February 2017
- 30 ***Of Kato and Prandtl***, Dynamics of Small Scales in Fluids, ICERM, Providence, RI, February 2017
- 29 ***Does the vanishing viscosity limit hold? (Parts I and II)***, Madison Workshop in Analysis and PDE, University of Wisconsin, Madison, WI, 30 September, 1 October 2016
- 28 ***Recent progress on the vanishing viscosity limit in the presence of a boundary***, The 7th Pacific RIM Conference on Mathematics, Seoul, South Korea, July 2016
- 27 ***Aggregation equations and 2D incompressible fluids***, 2016 Joint Math Meeting, Seattle, WA January 2016
- 26 ***Striated Regularity of Velocity for the Euler Equation***, SIAM Conference on Analysis of Partial Differential Equations, Scottsdale, AZ December 2015
- 25 ***Observations on the Vanishing Viscosity Limit***, SIAM Conference on Analysis of Partial Differential Equations, Scottsdale, AZ December 2015
- 24 ***Conservation of striated regularity for Eulerian velocities***, AMS Western Sectional Meeting, Las Vegas, NV, April 2015
- 23 ***Serfati's approach to vortex patches***, Autumn School and Workshop on Mathematical Fluid Dynamics, Bad Boll Germany, 28 October 2014
- 22 ***Vortex patches, a short history***, Claremont Center for the Mathematical Sciences (CCMS) Colloquium, Claremont, CA, 24 September 2014
- 21 ***Vortex patches redux***, Fourth Workshop on Fluids and PDE, IMPA, Rio de Janeiro, 26 May 2014
- 20 ***On the behavior of bounded vorticity, bounded velocity solutions to the 2D Euler equations***, Mathematical Congress of the Americas, Guanajuato, Mexico, August 2013; SIAM Conference on Analysis of Partial Differential Equations, Orlando, FL December 2013
- 19 ***Bounded solutions to the 2D Euler equations***, Applied math seminar, Claremont Graduate University, March 2013
- 18 ***A characterization of 2D bounded solutions to the Euler equations***, PDE and Analysis Seminar, University of Pittsburgh, March 2013
- 17 ***Fluids and boundaries***, Mathematics Colloquium, California State University, Long Beach, October 2012

- 16 *Some recent results on an extended Navier-Stokes system*, 9th AIMS Conference on Dynamical Systems, Differential Equations, and Applications, Orlando, Florida, July 2012; AMS Western Sectional Meeting, University of Arizona, Tucson, 27 October 2012
- 15 *Bounded vorticity, bounded velocity (Serfati) solutions to 2D Euler equations*, Oregon State University Analysis Seminar, 20 February 2012; Spring 2012 AMS Western Sectional Meeting, University of Hawaii, 3 March 2012; Carnegie Mellon Center for Nonlinear Analysis Seminar, 27 March 2012; 9th AIMS Conference on Dynamical Systems, Differential Equations, and Applications, Orlando, Florida, July 2012
- 14 *Boundary Layer Analysis of the Navier-Stokes Equations with Generalized Navier Boundary Conditions*, SIAM Conference on Analysis of Partial Differential Equations (PD11), San Diego, CA, November 2011
- 13 *Boundary Layer Correctors for Curved Boundaries*, SIAM Conference on Analysis of Partial Differential Equations (PD11), San Diego, CA, November 2011
- 12 *On uniqueness and properties of the flow map for weak solutions to the 2D Euler equations*, 3rd Workshop on Fluids and PDE, UNICAMP, Brazil, 27 June to 1 July 2011
- 11 *Boundary layers in fluid mechanics*, CAMS colloquium at USC, 15 October 2010
- 10 *Boundary layer associated with the Darcy-Brinkman-Boussinesq model for convection in porous media*, Fall AMS Western Section Meeting, UCLA, October 9-10 2010
- 9 *An inverse problem associated with flow maps*, Fall AMS Western Section Meeting, UCLA, October 9-10 2010
- 8 *On the Uniqueness of Weak Solutions to the 2D Euler Equations (properties of the flow)*, SIAM Conference on Analysis of Partial Differential Equations (PD09), Miami, FL, December 2009
- 7 *Infinite-energy statistical solutions to the equations of incompressible fluids in the plane*, Carnegie Mellon and Penn State, December 2009; University of California Irvine, November 2009; 2009 SIAM annual meeting, Denver, Colorado, July 2009
- 6 *Vanishing viscosity and the accumulation of vorticity on the boundary*, April 2009 Spring AMS Western Section Meeting; March 2009 Spring AMS Central Sectional Meeting; Brown University, December 2008; University of Texas at Austin, September 2008
- 5 *Vanishing viscosity in the presence of a boundary*, Carnegie Mellon University, March 2008
- 4 *Eigenvalues of the Stokes operator versus the Dirichlet Laplacian*, University of Texas at Austin, September 2007
- 3 *A connection between the Pompeiu problem and incompressible fluid mechanics*, Rio de Janeiro, Brazil, Workshop on Partial Differential Equations, August 2007
- 2 *Vanishing viscosity in the presence of a boundary*, UNICAMP, Campinas, Brazil, First annual workshop in PDE and Fluids, August 2007

- 1 *Unbounded [Expanding] domain limit for Navier-Stokes and Euler equations*, Analytical and Stochastic Fluid Dynamics Seminar, MSRI and George Mason University, October 2005

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## Professional Service

- December 2019 **Co-organizer of the minisymposium, *Incompressible Fluid Mechanics*, SIAM Conference on Analysis of Partial Differential Equations, La Quinta, CA**
- Oct 2019 **Co-organizer of Special Session, *Fluid Dynamics: from theory to numerics*, at the American Mathematical Society Fall 2017 Western Sectional Meeting, 11 November 2017, Riverside, CA**
- Oct 2017 **Co-organizer of Special Session on Mathematical Fluid Mechanics at the American Mathematical Society Fall 2017 Western Sectional Meeting, 11 November 2017, Riverside, CA**
- June 2016 **Co-organizer of the workshop, *Recent Advances in Hydrodynamics*, 6-10 June 2016, Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Banff, Alberta, Canada**
- January 2016 **Co-organizer of the special session on *Equations of Fluid Motion*, 2016 Joint (AMS/MAA) Mathematics Meeting, Seattle, WA**
- December 2015 **Co-organizer of the minisymposium, *Analytical Methods in Fluid Mechanics*, SIAM Conference on Analysis of Partial Differential Equations, Scottsdale, AZ**
- May 2014 **Member of Scientific Committee, 26-30 May 2014, Fourth Workshop on Fluids and PDE, held at IMPA, Rio de Janeiro, Brazil**
- Dec 2013 **Co-organizer of the *minisymposium, Recent Progress on the Incompressible Euler Equations*, 8-9 December 2013, SIAM Conference on Analysis of Partial Differential Equations, Orlando, FL**
- March 2012 **Co-organizer of the AMS special session on *Fluids and Boundaries*, Fall 2013 AMS Western Sectional Meeting, 2-3 November 2013, held at the University of California Riverside**
- May 2012 **Co-organizer of the *Analysis and applications of evolutionary PDEs workshop*, 5-6 May 2012, held at the University of California Riverside**
- March 2012 **Co-organizer of the AMS special session on *Nonlinear Partial Differential Equations of Fluid and Gas Dynamics*, Spring 2012 AMS Western Sectional Meeting, 3-4 March 2012, held at the University of Hawaii at Manoa, Honolulu**
- Oct 2012 **Co-organizer of the *Fourth Southern California Symposium on the Mathematics of Fluids*, October 2011, held at the University of California Riverside**
- Nov 2009 **Co-organizer of the AMS special session on *Fluid Mechanics*, Fall 2009 AMS Western Sectional Meeting, 7-8 Nov 2009, held at the University of California Riverside**

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## Teaching

### University of California Riverside

- Fall 2023 **Grad Complex Analysis (Math 210a)**
- Winter 2024 **Grad Real Analysis (Math 209b)**
- Spring 2023 **Calculus (Sequences and Series) (Math 9c)**
- Winter 2023 **Calculus (Sequences and Series) (Math 9c)**  
**Grad Complex Analysis (Math 210b)**



Fall 2022 **ODE (Math 146a)**  
 Spring 2022 **Calculus (Sequences and Series) (Math 9c) two sections**  
 Winter 2022 **Grad Complex Analysis (Math 210b)**  
 Fall 2021 **ODE (Math 146a)**  
 Winter 2021 **Integral Calculus (Math 9b) two sections**  
 Fall 2020 **Grad Real Analysis (Math 209a)**  
 Winter 2020 **Multivariable Calculus (Math 10a)**  
                   **Undergrad Complex Analysis (Math 165a)**  
 Fall 2019 **Grad Complex Analysis (Math 210a)**  
 Winter 2019 **Multivariable Calculus (Math 10a)**  
 Fall 2018 **Grad ODE (Math 207A)**  
 Winter 2018 **Grad PDE (Math 207B)**  
 Fall 2017 **ODE (Math 46) two sections**  
 Spring 2017 **Grad PDE (Math 207c)**  
 Fall 2016 **Grad ODE (Math 207a)**  
 Winter 2016 **Integral Calculus (Math 9b)**  
                   **Grad PDE (Math 207b)**  
 Fall 2015 **Integral Calculus (Math 9b)**  
 Winter 2015 **Grad PDE (Math 207b)**  
 Fall 2014 **ODE (Math 46), Grad ODE (Math 207a)**  
 Winter 2014 **ODE (Math 146b), Grad ODE (Math 207a)**  
 Fall 2013 **Grad ODE (Math 207a)**  
 Spring 2013 **Multivariable Calculus (Math 10a)**  
 Winter 2013 **ODE (Math 146b)**  
 Fall 2012 **Applied Linear Algebra (Math 113), Grad ODE (Math 207a)**  
 Spring 2012 **ODE (Math 46), Graduate Real Analysis (Math 209c)**  
 Winter 2012 **Integral Calculus (Math 9b), Multi-variable Calculus (Math 10b)**  
 Spring 2011 **Calculus (Sequences and Series) (Math 9c)**  
 Winter 2011 **Grad ODE (Math 211a), Integral Calculus (Math 9b)**  
 Fall 2010 **Ordinary Differential Equations (Math 146a)**  
 Spring 2010 **Graduate Real Analysis (Math 209c)**  
 Winter 2010 **Numerical Analysis (Math 135b), Differential Calculus (Math 9a)**  
 Fall 2009 **Real Analysis (Math 151a)**  
 Spring 2009 **Graduate PDE (Math 212)**  
 Winter 2009 **Ordinary Differential Equations (Math 146b)**  
 Fall 2008 **Ordinary Differential Equations (Math 146a)**  
                   **Brown University**  
 Spring 2008 **Multivariable calculus (MA0180)**  
 Fall 2007 **Graduate Real Analysis (MA2210, APMA2110)**  
 Spring 2007 **Partial Differential Equations (MA112)**



Fall 2006 **Honors Multivariable Calculus (MA35), Analysis: Functions of Several Variables (MA113)**

Spring 2006 **Multivariable Calculus (MA18), Analysis: Functions of One Variable (MA101)**

Fall 2005 **Multivariable Calculus (MA20)**  
**University of Texas at Austin**

Summer 2004 **Instructor for Math 305G (precalculus)**

Fall 2002 **Instructor for Emerging Scholars Program workshop**