Boyce Eugene Griffith

CONTACT INFORMATION

Leon H. Charney Division of Cardiology
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RESEARCH INTERESTS

Mathematical, numerical, and computational methods in medicine and biology; mathematical physiology, especially cardiac fluid-structure interaction, cardiac electrophysiology, and cardiac electro-mechanical interaction; adaptive numerical methods; parallel scientific computing.

EDUCATION

Courant Institute of Mathematical Sciences, New York University, New York, New York
Ph.D. in Mathematics, September 2005
Dissertation: *Simulating the blood-muscle-valve mechanics of the heart by an adaptive and parallel version of the immersed boundary method*
Advisor: Charles S. Peskin

Rice University, Houston, Texas
B.S. in Computer Science, May 2000
B.A. in Mathematics and in Computational and Applied Mathematics, May 2000

ACADEMIC POSITIONS

2011–present	Affiliated Faculty, Department of Mathematics, Courant Institute of Mathematical Sciences, New York University
2011–present	Affiliated Faculty, Center for Health Informatics and Bioinformatics, New York University School of Medicine
2010–present	Faculty, Program in Computational Biology, Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine
2010–present	Visiting Faculty, School of Mathematics and Statistics, University of Glasgow
2008–present	Assistant Professor of Medicine, Leon H. Charney Division of Cardiology, New York University School of Medicine
2006–2008	Medtronic/American Heart Association Postdoctoral Research Fellow, Courant Institute of Mathematical Sciences, New York University
2005–2006	Courant Instructor, Department of Mathematics, Courant Institute of Mathematical Sciences, New York University

OTHER POSITIONS AND EMPLOYMENT

2002, 2003	Summer Student Visitor, Center for Applied and Scientific Computing, Lawrence Livermore National Laboratory, Livermore, California
1999–2000	Engineering Intern, Scientific Computing Software, NEC Systems, Inc., The Woodlands, Texas
1997, 1998	Summer Undergraduate Researcher, Computer Science and Mathematics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

HONORS AND AWARDS

2009–2010	Whitehead Fellowship for Junior Faculty in Biomedical and Biological Sciences
2006–2008	Medtronic/American Heart Association Postdoctoral Research Fellowship
2006	Kurt O. Friedrichs prize for an outstanding dissertation in mathematics, Department of Mathematics, Courant Institute of Mathematical Sciences, New York University
2005	Society for Industrial and Applied Mathematics Student Paper Prize
2005	Society for Industrial and Applied Mathematics Student Travel Award, SIAM Conference on Applications of Dynamical Systems
2004–2005	New York University Graduate School of Arts and Science Dean's Dissertation Fellowship
2000–2004	Department of Energy Computational Science Graduate Fellowship
2000	*Cum Laude*, Rice University
1999–2000	Fellow, Will Rice College, Rice University
1999, 2000	Rice University Engineering Alumni Award, Department of Computational and Applied Mathematics
1999	Tau Beta Pi National Engineering Honor Society

Active Grants as Principal Investigator

Parallel and adaptive simulation infrastructure for biological fluid-structure interaction. Sponsor: National Science Foundation (OCI 1047734). Duration: 9/15/2010–8/31/2013. Award amount: $499,996.

Hybrid adaptive numerical methods and computational software for biological fluid-structure interaction. Sponsor: National Science Foundation (DMS 1016554). Duration: 9/1/2010–8/31/2014. Award amount: $299,992.

Mathematical modeling and computer simulation of the aortic valve in health and disease. Sponsor: American Heart Association (Scientist Development Grant 10SDG4320049). Duration: 7/1/2010–6/30/2014. Award amount: $308,000.

Other Active Grants

Disappearing gastrointestinal microbiota in epidemic obesity. Sponsor: National Institutes of Health (1R01DK090989-01). PI: Martin Blaser. Duration: 9/25/2010–8/31/2015.

Mathematical models of H. pylori gastric colonization. Sponsor: National Institutes of Health (2R01GM063270-09A1). PI: Martin Blaser. Duration: 7/1/2009–6/30/2014.

Recently Completed Grants as Principal Investigator

Coupled computational models of the His-Purkinje network and the ventricular myocardium. Sponsor: New York University Whitehead Fellowship for Junior Faculty in Biomedical and Biological Sciences. Duration: 9/1/2009–8/31/2010. Award amount: $24,600.

Adaptive and parallel simulations of cardiac fluid dynamics and electrophysiology by the immersed boundary method. Sponsor: National Science Foundation TeraGrid (MRAC Allocation IBN060008). Duration: 8/1/2006–3/31/2008; renewed 4/1/2008–3/31/2009.

Multiphysics and multiscale modeling and simulation of cardiac electrophysiology and mechanics. Sponsor: American Heart Association (Postdoctoral Fellowship 0626001T). Duration: 7/1/2006–6/30/2008. Award amount: $80,000.

Teaching Experience

Spring 2006	Lecturer, Numerical Analysis (undergraduate), Dept. of Math., New York University
Fall 2005	Lecturer, Linear Algebra (undergraduate), Dept. of Math., New York University
1997–2000	Lab Assistant, Principles of Computing and Programming (undergraduate), Dept. of Comp. Sci., Rice University
Summer 1998	Teaching Assistant, Theoretical Foundations of Computer Science, The Center for Talented Youth, The Johns Hopkins University

Publications

Journal articles

- B. E. Griffith. On the volume conservation of the immersed boundary method. *Commun Comput Phys*. In press.
- B. E. Griffith and S. Lim. Simulating an elastic ring with bend and twist by an adaptive generalized immersed boundary method. *Commun Comput Phys*. In press.
- P. E. Hand and B. E. Griffith. Empirical study of an adaptive multiscale model for simulating cardiac conduction. *Bull Math Biol*. In press.
- B. E. Griffith. Immersed boundary model of aortic heart valve dynamics with physiological driving and loading conditions. *Int J Numer Meth Biomed Eng*. In press.
- P. E. Hand and B. E. Griffith. Adaptive multiscale model for simulating cardiac conduction. *Proc Natl Acad Sci U S A*. **107**: 14603–14608 (2010).
- P. Lee, B. E. Griffith, and C. S. Peskin. The immersed boundary method for advection-electrodiffusion with implicit timestepping and local mesh refinement. *J Comput Phys*. **229**: 5208–5227 (2010).
- B. E. Griffith. An accurate and efficient method for the incompressible Navier-Stokes equations using the projection method as a preconditioner. *J Comput Phys*. **228:** 7565–7595 (2009).
- P. E. Hand, B. E. Griffith, and C. S. Peskin. Deriving macroscopic myocardial conductivities by homogenization of microscopic models. *Bull Math Biol*. **71**: 1707–1726 (2009).
- B. E. Griffith, X. Luo, D. M. McQueen, and C. S. Peskin. Simulating the fluid dynamics of natural and prosthetic heart valves using the immersed boundary method. *Int J Appl Mech*. **1**: 137–177 (2009).
- B. E. Griffith, R. D. Hornung, D. M. McQueen, and C. S. Peskin. An adaptive, formally second order accurate version of the immersed boundary method. *J Comput Phys*. **223**: 10–49 (2007).
- B. E. Griffith and C. S. Peskin. On the order of accuracy of the immersed boundary method: Higher order convergence rates for sufficiently smooth problems. *J Comput Phys*. **208**: 75–105

(2005).
- S. J. Cox and B. E. Griffith. Recovering quasi-active properties of dendritic neurons from dual potential recordings. *J Comput Neurosci*. **11**: 95–110 (2001).
- L. J. Gray and B. E. Griffith. A faster Galerkin boundary integral algorithm. *Comm Numer Meth Eng*. **14**: 1109–1117 (1998).

Book chapters
- B. E. Griffith, R. D. Hornung, D. M. McQueen, and C. S. Peskin. Parallel and adaptive simulation of cardiac fluid dynamics. In: M. Parashar and X. Li, editors, *Advanced Computational Infrastructures for Parallel and Distributed Adaptive Applications*. John Wiley and Sons (2009).
- D. M. McQueen, T. O'Donnell, B. E. Griffith, and C. S. Peskin. Constructing a patient-specific model heart from CT data. In: N. Paragios, N. Ayache, and J. Duncan, editors, *Handbook of Biomedical Imaging*. Springer-Verlag (in press, expected publication in 2012).

Conference proceedings
- B. E. Griffith, D. M. McQueen, and C. S. Peskin. Simulating cardiovascular fluid dynamics by the immersed boundary method. 47th AIAA Aerospace Sciences Meeting, 5–8 Jan. 2009, Orlando, Florida. Paper Number AIAA-2009-158 (2009).

Technical Reports
- S. J. Cox and B. E. Griffith. A fast, fully implicit backward Euler solver for dendritic neurons. Rice University Department of Computational and Applied Mathematics Technical Report TR00-32 (2000).

Submitted for publication
- F. Balboa, J.B. Bell, R. Delgado-Buscalioni, A. Donev, T. Fai, B.E. Griffith, and C.S. Peskin. Staggered schemes for fluctuating hydrodynamics.
- B. E. Griffith and X. Luo. Immersed boundary method with finite element elasticity.
- X. Y. Luo, B. E. Griffith, X. S. Ma, M. Yin, T. J. Wang, C. L. Liang, P. N. Watton, and G. M. Bernacca. Effect of bending rigidity in a dynamic model of a polyurethane prosthetic mitral valve.

Synergistic Activities

Development of research tools / Computation methodologies and algorithms for problem-solving

IBAMR: An adaptive and distributed-memory parallel implementation of the immersed boundary method. Used by research groups at New York University and also at Chung-Ang University (South Korea), Montana State University, Northwestern University, Simon Fraser University (Canada), Tulane University, University of Cincinnati, University of Glasgow (UK), University of North Carolina-Chapel Hill, University of Utah, and others. Available from `http://ibamr.googlecode.com`.

Service to the scientific and engineering community

Editorial board for: International Journal of Applied Mechanics.

Journal reviewer for: Bioengineering and Biotechnology; Communications in Computational Physics; Computer Methods in Applied Mechanics and Engineering; Computers & Fluids; Discrete and Continuous Dynamical Systems - Series B; Fluid Dynamics Research; Fluid Dynamics Research; IEEE Transactions on Biomedical Engineering; International Journal for Numerical Methods in Biomedical Engineering; International Journal of Numerical Methods in Fluids; Journal of Computational Mathematics; Journal of Computational Physics; SIAM Journal on Scientific Computing.

Grant reviewer for: Department of Energy; National Science Foundation.

Co-organizer (with Robert Guy) of Minisymposium MS122: Recent Advances in Implicit Immersed Boundary and Related Methods, SIAM Annual Meeting, Pittsburgh, Pennsylvania (2010).

Service within the NYU community

Committee Assignments: Bioengineering Initiative Advisory Panel (NYU School of Medicine); Microbiome Search Committee (NYU School of Medicine).

Admissions interviewer for the Program in Computational Biology, Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine (2011).

POSTDOCTORAL ADVISEES

Jordan Fisher (9/1/2011–present; jointly with Aleksandar Donev, Courant Institute-NYU); Vittoria Flamini (3/1/2011–present); Paul Hand (9/1/2009–8/31/2010; presently at MIT).

GRADUATE STUDENT ADVISEES

Member of thesis committee: Jinguo Zhao (Ph.D., Mathematics, NYU, 2011); Varun Shankar (Ph.D., Scientific Computing, Utah, expected in 2014).

UNDERGRADUATE STUDENT ADVISEES

Hussein Saab (10/1/2010–7/1/2011; jointly with Rémi Dingreville, NYU-Poly).

CONFERENCE AND WORKSHOP TALKS

- Cardiac fluid dynamics by an immersed boundary method with finite element elasticity. Seventh International Congress on Industrial and Applied Mathematics, Vancouver, British Columbia, Canada (2011).
- Adaptive multiscale model of cardiac conduction. Fourth Cardiac Physiome Workshop, Oxford, England, United Kingdom (2011).
- Modeling cardiac electromechanics using the immersed boundary method. SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah (2011).
- Immersed boundary methods for simulating fluid-structure interaction. Spring Workshop on Nonlinear Mechanics, Xi'an Jiaotong University, Xi'an, Shaanxi, China (2011).
- Simulating aortic heart valve dynamics by the immersed boundary method. Second International Conference on Mathematical and Computational Biomedical Engineering, Fairfax, Virginia (2011).
- Immersed boundary method with finite element elasticity. First North American Meeting on Industrial and Applied Mathematics, Huatulco, Oaxaca, México (2010).
- Two extensions to the immersed boundary method: Physical boundary conditions and finite element elasticity. Workshop on Fluid Motion Driven by Immersed Structures, Fields Institute, Toronto, Ontario, Canada (2010).
- A comparison of two adaptive versions of the immersed boundary method. ASME 2010 First Global Congress on NanoEngineering for Medicine and Biology, Houston, Texas (2010).
- Adaptive numerical methods for simulating biological fluid dynamics and electrophysiology. Computational Challenges in Integrative Biological Modeling, Mathematical Biosciences Institute, The Ohio State University, Columbus, Ohio (2009).
- Simulating cardiac fluid-structure interaction by the immersed boundary method. The Cardiac Physiome: Multi-scale and Multi-physics Mathematical Modelling Applied to the Heart, Cambridge, United Kingdom (2009).
- Simulating cardiac fluid-structure interaction by the immersed boundary method. Tenth U.S. National Congress on Computational Mechanics, Columbus, Ohio (2009).
- Simulating the fluid dynamics of the aortic heart valve. A Conference in Memory of Thomas Bringley, New York, New York (2009).
- Adaptive immersed boundary methods for simulating cardiac fluid dynamics. SIAM Conference on Computational Science and Engineering, Miami, Florida (2009).
- Simulating cardiovascular fluid dynamics by the immersed boundary method. 47th AIAA Aerospace Sciences Meeting, Orlando, Florida (2009).
- Simulating cardiac fluid-structure interaction by the immersed boundary method. SIAM Conference on the Life Sciences, Montreal, Quebec, Canada (2008).
- Cardiac fluid dynamics. Summer 2008 Mathematics Workshop on Applications of Analysis in Mathematical Biology/NSF Summer Research Experience for Undergraduates (REU), University of Wisconsin-Eau Claire, Eau Claire, Wisconsin (2008).
- Simulating cardiac fluid dynamics by the immersed boundary method. Inaugural International Conference of the Engineering Mechanics Institute, Minneapolis, Minnesota (2008).
- A parallel and adaptive immersed boundary method for simulating cardiac fluid dynamics. Modeling and High Performance Computing Workshop, U.S.-France Young Engineering Scientists Symposium, Washington, DC (2007).
- Towards an electro-mechano-fluidic model of the heart. Applications of Mathematics in Biology, Physiology, and Medicine—A Conference in Honor of Charles S. Peskin's and David M. McQueen's 60th Birthdays, New York, New York (2006).
- Simulating cardiac blood-muscle-valve mechanics by an adaptive version of the immersed boundary method. Joint SIAM-SMB Conference on the Life Sciences, Raleigh, North Carolina (2006).
- Simulating cardiac blood-muscle-valve mechanics by an adaptive version of the immersed boundary method. Seventh World Congress on Computational Mechanics, Los Angeles, California (2006).

- SIAM Student Paper Prize Presentation: On the order of accuracy of the immersed boundary method: Higher order convergence rates for sufficiently smooth problems. SIAM Annual Meeting, New Orleans, Louisiana (2005).
- Simulating cardiac electrophysiology using the bidomain equations: Numerical methods and computational results. SIAM Annual Meeting, New Orleans, Louisiana (2005).
- Parallel implicit methods for the bidomain equations. SIAM Conference on Applications of Dynamical Systems, Salt Lake City, Utah (2005).
- Numerical approaches and computational results for fluid dynamics problems with immersed elastic structures. DOE Computational Science Graduate Fellowship Annual Fellows' Conference, Washington, DC (2003).
- Recovering quasi-active properties of dendritic neurons from dual potential recordings. SIAM Annual Meeting, Rio Grande, Puerto Rico (2000).

OTHER TALKS

- Adaptive numerical methods and multiscale mathematical models in cardiology. Mathematical Biology Seminar, University of California, Davis, California (2010).
- Immersed boundary method with finite element elasticity. Mathematical Biology Seminar, University of Glasgow, Glasgow, United Kingdom (2010).
- Adaptive numerical methods and multiscale mathematical models in cardiology. Department of Mathematical Sciences Colloquium, Indiana University-Purdue University Indianapolis, Indianapolis, Indiana (2010).
- Adaptive numerical methods and multiscale mathematical models in cardiology. Department of Mathematical Sciences Colloquium, University of Cincinnati, Cincinnati, Ohio (2010).
- Recent work on the immersed boundary method: Adaptivity, physical boundary conditions, and finite element elasticity. Mostly Biomathematics Lunchtime Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2009).
- A comparison of two adaptive versions of the immersed boundary method. Applied Mathematics Colloquium, University of North Carolina, Chapel Hill, North Carolina (2009).
- Two short talks: Progress towards an efficient implicit immersed boundary method, and an extended version of the bidomain model of cardiac electrophysiology. Mathematical Biology Seminar, University of Glasgow, Glasgow, United Kingdom (2009).
- Adaptive numerical methods for simulating cardiovascular fluid dynamics and electrophysiology. Mathematical Biology Seminar, University of Glasgow, Glasgow, United Kingdom (2008).
- Adaptive numerical methods for simulating cardiovascular fluid dynamics and electrophysiology. Department of Biomedical Engineering Seminar, Columbia University, New York, New York (2008).
- IBAMR: A framework for building parallel and adaptive immersed boundary simulations. Center for Computational Science Seminar, Tulane University, New Orleans, Louisiana (2008).
- Adaptive numerical methods for cardiac fluid-structure interaction and electrophysiology. Computer Science and Mathematics Division Seminar Series, Oak Ridge National Laboratory, Oak Ridge, Tennessee (2008).
- Adaptive numerical methods for cardiac fluid-structure interaction and electrophysiology. Department of Computational and Applied Mathematics Colloquium, Rice University, Houston, Texas (2008).
- An adaptive immersed boundary method for fluid-structure interaction with applications to cardiac fluid dynamics. Applied and Computational Mathematics Seminar, School of Mathematics, Georgia Institute of Technology, Atlanta, Georgia (2007).
- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Mathematical Biology Seminar, New Jersey Institute of Technology, Newark, New Jersey (2006).
- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Computational Science and Engineering Seminar, College of Computing, Georgia Institute of Technology, Atlanta, Georgia (2006).
- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Computational Science and Engineering Seminar, Department of Applied and Computational Mathematics, California Institute of Technology, Pasadena, California (2006).
- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Applied Mathematics Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2006).
- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Centre for Scientific Computing, Simon Fraser University, Burnaby, British Columbia, Canada (2006).

- Adaptive immersed boundary methods for simulating cardiac blood-muscle-valve mechanics and electrophysiology. Center for Applied Mathematics Colloquium, Cornell University, Ithaca, New York (2006).
- Adaptive methods for simulating cardiac blood-muscle-valve mechanics. Courant Instructor Day, Courant Institute of Mathematical Sciences, New York University, New York, New York (2005).
- Computational methods for modeling cardiac physiology: A parallel and adaptive version of the immersed boundary method and bidomain simulations of electrical conduction in murine ventricular tissue. Mathematical Biology Seminar, Department of Mathematics, University of Utah, Salt Lake City, Utah (2005).
- A parallel, locally adaptive implementation of the immersed boundary method using SAMRAI, *hypre*, and PETSc. Mostly Biomathematics Lunchtime Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2004).
- A SAMRAI-based implementation of the immersed boundary method. Mostly Biomathematics Lunchtime Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2002).
- Computational cardiac electrophysiology with the bidomain equations. Mostly Biomathematics Lunchtime Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2002).
- Recovering quasi-active properties of dendritic neurons from dual potential recordings. Mostly Biomathematics Lunchtime Seminar, Courant Institute of Mathematical Sciences, New York University, New York, New York (2000).

Conference and Workshop Posters

- Simulating cardiac mechanics by an adaptive version of the immersed boundary method. Second Young Researchers Workshop in Mathematical Biology, Mathematical Biosciences Institute, The Ohio State University, Columbus, Ohio (2006).
- Convergence results for a spatially adaptive immersed boundary method. DOE Computational Science Graduate Fellowship Annual Fellows' Conference, Washington, DC (2004).
- Numerical methods for the bidomain equations. DOE Computational Science Graduate Fellowship Annual Fellows' Conference, Washington, DC (2002).
- An FFT-based method for simulating cardiac conduction in a three-dimensional bidomain. Society for Mathematical Biology Annual Meeting, Hilo, Hawaii (2001).