

Mark-Anthony Bray

Curriculum Vitae

CONTACT INFORMATION

Broad Institute
Imaging Platform
7 Cambridge Center
Cambridge, MA 02142
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ACADEMIC BACKGROUND

Doctor of Philosophy, May 2003
[Biomedical Engineering](#), Vanderbilt University, Nashville, TN
Research Advisor: [John Wikswo, Jr, Ph.D](#)
Thesis title: "[Visualization and analysis of electrodynamic behavior during cardiac arrhythmias](#)"

Master of Science, May 1999
Biomedical Engineering, Vanderbilt University, Nashville, TN
Research Advisor: [Shien-Fong \(Marc\) Lin, Ph.D](#)
Thesis title: "Three-dimensional visualization of epifluorescent cardiac action potential activity"

Bachelor of Science, May 1996
[Biomedical Engineering](#), Tulane University, New Orleans, LA
Minors in Computer Science and Math
Summa Cum Laude with Departmental Honors
Research Advisor: [Natalia Trayanova, Ph.D](#)

PROFESSIONAL EXPERIENCE

Broad Institute *Cambridge, MA*
Computational biologist Spring 2008 – Present

- Contribution of advancements to the Imaging Platform's open-source software tools for cell image analysis (www.cellprofiler.org)
- Coordination of efforts to analyze and assist collaborating biologists in the application of these tools to significant questions in the life sciences
- Work on scientific publications with an interdisciplinary and collegial team of scientists

RESEARCH EXPERIENCE

Harvard University *Cambridge, MA*
Postdoctoral research associate, Director: Dr. Kevin Kit Parker Spring 2004 – Spring 2008
Investigated an *in vitro* cellular model of pathological cardiac function by systematically altering cellular architecture in cardiac cells.

- Characterized the spatial and temporal progression of calcium handling in custom-shaped cultured cardiac tissues and single cells.
- Performed analysis of cytoskeletal organization in cells cultured to replicate morphologies observed in heart failure.
- Studied nuclear morphology and positioning in live cardiac cells to examine intracellular stresses imposed during contraction.

Developed image analysis techniques to quantify *in vitro* cellular function for systems biology and bioinformatics applications.

- Implemented algorithm for multidimensional detection of calcium influx events and validated performance by statistical analysis to synthetic data.
- Developed software for detection, characterization and temporal tracking of nuclear morphology and motion.
- Adapted fingerprint enhancement software for use in cytoskeleton detection.
- Performed image registration of fluorescence images obtained from live and immunohistochemical cellular data.

Developed particle-tracking methodology for quantification of cellular force generation.

Vanderbilt University

Nashville, TN

Postdoctoral research associate, Director: Dr. John P. Wikswo

Summer 2003 – Spring 2004

Implemented fluorescence-based heart reconstruction algorithm as part of a dedicated cardiac imaging system.

- Revised and extended previously validated algorithm for use with multiple cameras, yielding increased spatial resolution.

Vanderbilt University

Nashville, TN

Graduate research assistant, Director: Dr. John P. Wikswo

Fall 1996 – Spring 2003

Devised, implemented and validated a mirror-based fluorescence imaging system for use on *ex vivo* hearts as proof-of-concept.

- Adapted and developed computer vision techniques for multi-view geometric reconstruction with three-dimensional texture mapping of fluorescence for use on isolated rabbit hearts.
- Demonstrated system capabilities of multiple viewpoint resolution and registration with sub-pixel accuracy.

Developed algorithm for robust detection and tracking of cardiac behavior characteristic of heart electrical pathology

- Algorithm enabled automatic detection of organizing centers of fibrillatory wave propagation, by decomposing physical principles into efficient image processing operations.
- Demonstrated efficacy in both experimental and numerical cardiac tissue preparations.

Tulane University

New Orleans, LA

Research Assistant, Director: Dr. Natalia A. Trayanova

Fall 1995 - Spring 1996

Performed computational research investigating the effect of monophasic and biphasic shocks on a cardiac cable fiber model.

GRANTS

- [NSF Research Initiation Grant \(RIG BP\)](#), “Improving data quality and discovery tools in high-throughput microscopy”, 2011 – 2013
- [UNCF-Merck Postdoctoral Science Research Fellowship](#), 2006 – 2008
- [NIH National Research Service Award Predoctoral Fellowship](#), 2002 – 2003
- [UNCF-Merck Graduate Science Research Dissertation Fellowship](#), 2000 – 2002
- [NSF Minority Graduate Fellowship](#), 1997 – 2000

HONORS & ACTIVITIES

- University Graduate Fellow (Vanderbilt University), 1996 – 2000
- Dean's list (Tulane University), 1992 – 1996
- Alpha Eta Mu Beta (biomedical engineering honor society), initiated 1995
- Tau Beta Pi, initiated 1996
- Phi Eta Sigma (freshman honor society), initiated 1992
- [Dean's Honor Scholar](#) (full tuition scholarship at Tulane University), 1992 – 1996
- [National Achievement Scholar](#), 1992 – 1996

TEACHING

- **Software tutorial instructor** *Broad Institute, 2009 – present*
Developed and presented curriculum and workshop for users of open-source software developed by the Imaging Platform, CellProfiler and CellProfiler Analyst. Writing of online tutorials to instruct in use of CellProfiler for specialized assays and functionality.
- **Undergraduate/graduate research supervisor** *Harvard University, 2004 – 2008*
Mentoring undergraduate and graduate students and supervising research projects and manuscript preparation. Train and teach new laboratory personnel ranging from postdoctoral fellows to summer undergraduates in sterile procedure, cell culture and cleanroom microfabrication. Organize strategy meetings to coordinate lab experimental schedules and maintain familiarity with ongoing projects in order to advise and assist. Delivered research talks to local middle- and high-school students, participated in panel forums for undergraduate scholars.
- **Teaching fellow for ES 211: Cardiac Biophysics.** *Harvard University, 2004*
Led weekly sections and office hours for students, delivered guest lectures, designed class projects and exam evaluation.
- **Undergraduate student research supervisor** *Vanderbilt University, 2003 – 2004*
Mentored undergraduate students during senior design project in addition to supervising research. Established project timetables and deadlines as well as assisted in manuscript writing.
- **Athletic tutor** *Tulane University, 1994 – 1996*
Tutored student athletes weekly in math, computer science and physics. Offered assistance in homework completion and exam preparation.

PROFESSIONAL ACTIVITIES

Critical reviewer of manuscripts for the *Journal of Cardiovascular Electrophysiology*, *IEEE Transactions in Biomedical Engineering* and *American Physiological Society: Heart and Circulatory Physiology*.

TECHNICAL AND SPECIALIZED SKILLS

- **Laboratory experience:** Microfabrication and microcontact printing, microscopy (light, fluorescence, confocal), immunohistochemistry, live cell immunofluorescence staining, electrophysiological optical recording, cell culture and sterile technique.
- **Computer software:** High proficiency in MATLAB: Developed analytical tools for cellular morphometrics and cytometry, developed algorithms for visualization and analysis of cardiac electrical information, developed and implemented numerical simulation software for cardiac wave propagation, designed graphical user interfaces for a variety of uses. Intermediate proficiency in Python.

PUBLICATIONS

REFEREED JOURNALS:

1. **Bray MA**, Fraser AN, Hasaka TP, Carpenter AE. Workflow and metrics for image quality control in large-scale high-content screens. *J Biomol Screen*. 17(2):135-143, 2012 [[Pubmed](#)]
2. Pong T, Adams WJ, **Bray MA**, Feinberg AW, Sheehy SP, Werdich AA, Parker KK. Hierarchical architecture influences calcium dynamics in engineered cardiac muscle, *Exp Biol Med*, 236(3):366-73, 2011 [[Pubmed](#)]
3. Kamentsky L, Jones TR, Fraser A, **Bray MA**, Logan DJ, Madden KL, Ljosa V, Rueden C, Eliceiri KW, Carpenter AE. Improved structure, function, and compatibility for CellProfiler: modular high-throughput image analysis software. *Bioinformatics*, 27(8):1179-80, 2011 [[Pubmed](#)]
4. Grosberg A, Kuo PL, Guo CL, Geisse NA, **Bray MA**, Adams WJ, Sheehy SP, Parker KK. Self-organization of muscle cell structure and function. *PLoS Comput Biol*, 7(2): e1001088, 2011 [[Pubmed](#)]

5. Elkabets M, Gifford AM, Scheel C, Nilsson B, Reinhardt F, **Bray MA**, Carpenter AE, Jirström K, Magnuson K, Ebert BL, Ponten F, Weinberg RA, McAllister SS. Human tumors instigate granulin-expressing hematopoietic cells that promote malignancy by activating stromal fibroblasts in mice. *J Clin Invest*, 121(2): 784-99, 2011 [[Pubmed](#)]
6. **Bray MA**, Adams WJ, Geisse NA, Feinberg AW, Sheehy SP and Parker KK. Nuclear morphology and deformation in micropatterned cardiac myocytes. *Biomaterials*, 31(19):5143, 2010 [[Pubmed](#)]
7. **Bray MA**, Sheehy SP and Parker KK. Sarcomere alignment is regulated by myocyte shape. *Cell Motil Cytoskeleton*, 65(8):641, 2008 [[Pubmed](#)]
8. Evertson DW, Holcomb MR, Eames MDC, **Bray MA**, Sidorov VY, Xu J, Wingard H, Dobrovolny HM, Woods MC, Gauthier DJ and Wikswa JP. High-resolution high-speed panoramic cardiac imaging system. *IEEE Trans BME* 55(3):1241, 2008. [[Pubmed](#)]
9. **Bray MA**, Geisse NA and Parker KK. Multidimensional detection and analysis of Ca²⁺ sparks in cardiac myocytes. *Biophys J*, 92(12): 4433, 2007 [[Pubmed](#)]
10. Gray RA, Iyer A, **Bray MA** and Wikswa JP. Voltage-calcium state-space dynamics during the initiation of reentry. *Heart Rhythm*, 3(2): 247, 2006 [[Pubmed](#)]
11. **Bray MA** and Wikswa JP. Examination of optical depth effects on fluorescent imaging of cardiac propagation. *Biophys J*, 85(6): 4134-45, 2003 [[Pubmed](#)]
12. **Bray MA**, and Wikswa JP. Interaction dynamics of a pair of vortex filament rings. *Phys Rev Lett*, 90(23): 238303, 2003 [[Pubmed](#)]
13. **Bray MA**, Lin S-F, and Wikswa JP, Jr. Three-dimensional visualization of phase singularities on the isolated rabbit heart. *J Cardiovasc Electrophysiol: EP Images* 13(12): 1311, 2002 [[Pubmed](#)]
14. **Bray MA**, and Wikswa JP, Jr. Use of topological charge to determine filament location and dynamics in a numerical model of scroll wave activity. *IEEE Trans BME*, 49(10): 1086, 2002 [[Pubmed](#)]
15. **Bray MA**, and Wikswa JP, Jr. Considerations in phase plane analysis for non-stationary reentrant cardiac behavior. *Phys Rev E*, 65(5): 051902, 2002 [[Pubmed](#)]
16. Wu T-J, **Bray MA**, Ting C-T, and Lin S-F. Stable bound pair of spiral waves in rabbit ventricles. *J Cardiovasc Electrophysiol: EP Images*, 13(4): 414, 2002 [[Pubmed](#)]
17. **Bray MA**, Lin S-F, Aliev RR, Roth BJ and Wikswa JP, Jr. Experimental and theoretical analysis of phase singularity dynamics in cardiac tissue. *J Cardiovasc Electrophysiol*, 12(6): 716-722, 2001 [[Pubmed](#)]
18. **Bray MA**, Lin S-F, and Wikswa JP, Jr. Three-dimensional surface reconstruction and fluorescent visualization of cardiac activation. *IEEE Trans BME*, 47(10): 1382-1391, 2000 [[Pubmed](#)]
19. Trajanova, N and **Bray MA**. Membrane refractoriness and excitation induced in cardiac fibers by monophasic and biphasic shocks. *J Cardiovasc Electrophysiol*, 8(7):745-757, 1997 [[Pubmed](#)]

BOOK CHAPTERS:

1. Geisse NA, Feinberg AW, Kuo P, Sheehy SP, **Bray M-A**, Parker KK. Micropatterning Approaches for Cardiac Biology. In: *Micro- and Nanoengineering of the Cell Microenvironment: Technologies and Applications*. Khademhosseini A, Toner M, Borenstein JT, Takayama S (eds). Boston: Artech House; 2008. pg 341-357.

INVITED TALKS (presenter in *italics*):

1. **Bray M-A**. "Cardiac Biophysics: From Fluxes to Fibrillation." *Joint Annual Conference of the National Society of Black Physicists and the National Society of Hispanic Physicists*. San Jose, CA, 2006
 2. Wikswa, JP and **Bray M-A**, "Cardiac phase, in the spatial or phase domains, for identifying reentrant behavior and examining the response of cardiac tissue to electrical stimulation" *Gordon Research Conference: Cardiac Arrhythmia Mechanisms*, New London, NH 2003
 3. Wikswa, JP, Woods MC, and **Bray M-A**, "Phase Space: A New Perspective for Studying Cardiac Reentry." Proceedings of the Second Joint EMBS-BMES Meeting, Houston, TX 2002
 4. Wikswa, JP, and **Bray M-A**. "Phase and wave vector dynamics during cardiac reentry." Dynamic Days, Chapel Hill, NC 2001
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CONFERENCE PROCEEDINGS AND ABSTRACTS:

1. **Bray M-A**, Otani NF, and Wikswo JP. The role of cellular coupling in cardiac phase plane dynamics. *BMES Annual Fall Conference*, 2003
2. Geisse NA, **Bray M-A**, Sheehy SP, Olding BP, Wolfe PJ and Parker KK. Cytoskeletal structure and Ca²⁺ spark localization in engineered cardiac myocytes, *European Heart Journal*, 27 Suppl 1, 30, 2006.
3. **Bray M-A** and Wikswo JP. Optical depth effects associated with simulated reentrant cardiac action potentials, *PACE*, 26(4), Part II: 977, 2003
4. Wikswo JP and **Bray M-A**. Interaction dynamics of a scroll ring pair. *Bulletin Am Phys Soc*, 47(1), Part II: 949, 2002
5. Wikswo JP and **Bray M-A**. Analysis of topological charge in electrodynamic systems using Fourier decomposition. *68th Annual Meeting of the APS Southeastern Section*
6. **Bray M-A** and Wikswo JP. Phase resetting and reentry initiation due to a premature stimulus: A phase portrait perspective. *34th World Congress of the International Union of Physiological Sciences (IUPS)*
7. Wikswo JP and **Bray M-A**. Cardiac phase plane dynamics during stimulation and reentry. *Bulletin Am Phys Soc*, 46(1), Part II: 1107, 2001
8. **Bray M-A**, Wikswo JP, Jr, Lin S-F, and Roth BJ. Quantitative analysis of four synchronous rotors in cardiac reentry. *Ann Biomed Eng*, vol 28, suppl 1, S-55, 2000
9. **Bray M-A**, and Wikswo JP, Jr. Determination of the center of rotation in the phase plane for unstable reentrant cardiac arrhythmias, *PACE*, 23(4), Part II: 640, 2000
10. Wikswo JP, **Bray M-A**, Rousakov S, and Aliev R. Wave vector dynamics for the analysis of cardiac activation and reentry, *PACE*, 22(4), Part II: 833, 1999
11. Wikswo JP, Jr., **Bray M-A**, Lin S-F, and Roth BJ. Highly ordered cardiac reentry involving four synchronous rotors. *Bulletin Am Phys Soc*, 44(1), Part II: 1386, 1999
12. Wikswo J, Aliev R, **Bray M-A**, Baudenbacher F, Baudenbacher P, Sidorov V, and Woods M. Virtual electrodes. *Europace Supplements: Cardioslim 13th International Congress*, vol 3, A99, 2002
13. **Bray M-A**, Lin S-F, and Wikswo JP, Jr. Three-dimensional visualization of epifluorescent electrodynamics. *Proc. of the First Joint BMES/EMBS Conference*, vol 1, 281, 1999
14. **Bray M-A**, Lin S-F, and Wikswo JP, Jr. Panoramic epifluorescent visualization of cardiac action potential activity. *Proc. of SPIE, Medical Imaging 1999: Image Display*, 99, 1999
15. **Bray M-A** and Roth BJ. The effect of electroporation on the strength-interval curve during unipolar stimulation of cardiac tissue. *Proc. 19th Annual IEEE/EMBS Conf.*, vol 1, 15-18, 1997
16. Trayanova, N. and **Bray M-A**. Wavefront termination with monophasic and biphasic shocks: A simulation study. *Proc. 18th Annual IEEE/EMBS Conf.*, vol 3, 1289-1290, 1997

PRESENTATIONS (ORAL AND POSTER):

1. Sheik-Khalil E, **Bray M-A**, Carpenter AE, Fenyö EM. High-throughput plaque reduction assays for HIV neutralization. *Keystone Symposia: HIV Evolution, Genomics and Pathogenesis*, March 2011
2. Khan I, Fraser A, **Bray M-A**, Griesdoorn V, Smith P, Carpenter A and Errington R. LineageProfiler: a map for visualizing experimental protocols. *Workshop on Visualizing Biological Data (VIZBI) 2011*
3. **Bray M-A**. Quantifying challenging phenotypes in images. *High Content Analysis*, 2010
4. Feinberg AW, Adams WJ, **Bray M-A**, Sheehy SP, Parker KK. Engineering contractility of myocardial sheets (Received Best Poster Award). *Materials Research Society (MRS) Fall Meeting*, 2007
5. **M-A Bray**, Geisse NA, and Parker KK. Nuclear morphology and deformation in micropatterned cardiac myocytes. *MRS Annual Fall Conference*, 2007
6. **M-A Bray**, Sheehy SP and Parker KK. Cardiac myocyte cytoskeletal architecture as a function of cell shape. *MRS Annual Fall Conference*, 2007
7. Geisse NA, **Bray M-A**, Dabiri B, Sheehy SP and Parker KK. Distribution of calcium sparks in micropatterned cardiac myocytes. *BMES Annual Fall Conference*, 2007
8. Adams WJ, Kuo P-L, **Bray M-A**, Sheehy SP and Parker KK. Modeling nuclear deformation during cardiac contraction. *BMES Annual Fall Conference*, 2007
9. **Bray M-A**, Geisse NA, Sheehy SP and Parker KK. Nuclear morphology and deformation in micropatterned cardiac myocytes. *BMES Annual Fall Conference*, 2007

10. Kuo P-L, Guo C, Geisse NA, **Bray M-A**, Sheehy S and Parker KK. Myofibrillogenesis and cytoskeletal self assembly in cardiac myocytes. *BMES Annual Fall Conference, 2007*
11. Kuo P-L, Goodman DE, O'Grady ML, Andress WF, Ho WS, **Bray M-A**, and Parker KK. Mathematical model of neonatal rat ventricular myocytes action potential. *BMES Annual Fall Conference, 2005*
12. **Bray M-A**, Geisse NA and Parker KK. Localization and visualization of calcium sparks in micropatterned cardiac myocytes. *BMES Annual Fall Conference, 2005*