

# Jonathan Rodolfo Silva, PhD FAHA

Associate Professor

Department of Biomedical Engineering  
Washington University in St. Louis  
St. Louis, MO 63110

Phone: 314-935-8837  
Lab: 314-935-9553  
jonsilva@wustl.edu

## Positions

Department of Biomedical Engineering  
Washington University in St. Louis  
Associate Professor 2018 - present  
Assistant Professor 2012 – 2018

Department Director of Diversity 2020 – present  
Department of Computer Science and Engineering, Adjunct 2020 - present

SentiAR, Inc.  
Founder, Director and Chief Technology Officer 2017 - present

## Education

**Washington University in St. Louis**, St. Louis, MO  
PhD in Biomedical Engineering. 2008

**Case Western Reserve University**, Cleveland, OH  
MS in Biomedical Engineering. 2004

**The Johns Hopkins University**, Baltimore, MD  
BS in Biomedical Engineering. 2000

## Pre- and Postdoctoral Research

**Washington University in St. Louis**, St. Louis, MO  
Postdoctoral training. Department of Cell Biology. 2011 to 2012  
Laboratory of Dr. Colin Nichols.  
Measured and modeled physiological effects of K<sub>ATP</sub> heterogeneity in the heart and the pancreas.

**University of Chicago**, Chicago, IL  
Postdoctoral training. Department of Pediatrics. 2008 to 2011  
Laboratory of Dr. Steve Goldstein.  
Probed Na<sup>+</sup> channel slow inactivation using simultaneous cut-open oocyte recording and fluorescence.

**Washington University in St. Louis**, St. Louis, MO  
Doctoral program, Department of Biomedical Engineering. 2004 to 2008  
Laboratory of Dr. Yoram Rudy  
Dissertation: Linking Ion-Channel Molecular Dynamics to the Action Potential: Cardiac I<sub>Ks</sub> Simulations.

**Case Western Reserve University**, Cleveland, OH  
MS program, Department of Biomedical Engineering  
Laboratory of Dr. Yoram Rudy  
Thesis: Subunit interaction determines I<sub>Ks</sub> Participation in Cardiac Repolarization and Repolarization Reserve.

## Fellowships

- 2011. Burroughs Wellcome Fund, Career Award at the Scientific Interface
- 2011. NIH Cardiovascular Biology Training Grant  
Washington University School of Medicine (By Recommendation)
- 2008. NIH Cardiovascular Pathophysiology and Biochemistry Training Grant  
University of Chicago (Competitive Application)
- 2001. NIH NRSA Pre-doctoral Fellowship
- 2000. Case Prime Fellowship  
Case Western Reserve University
- 1999. Provost's Award for Undergraduate Research  
The Johns Hopkins University
- 1998. Research Experience for Undergraduates (REU) Fellowship  
University of California, San Diego/San Diego Supercomputing Center
- 1997. Ford Foundation Award for Minority Research  
The Johns Hopkins University

## Citations and Honors

- 2007. AAAS/Science Sponsored Membership
- 2005. Cardiac Arrhythmias Gordon Conference: Best Poster
- 2003. Housing and Residence Life Distinguished Service Award, Case Western Reserve University
- 2002. Graduate Dean's Award for Instructional Excellence, Case Western Reserve University
- 1999. Biomedical Engineering Honor Society, The Johns Hopkins University
- 1996. National Merit Scholar

Citations to students:

- 2019. Kathryn Mangold, Best Graduate Poster, Cardiovascular Research Day
- 2019. Kuo Chan Weng, Best Postdoctoral Poster, Cardiovascular Research Day
- 2018. Emily Wagner, Best Poster, CIMED Research Day
- 2018. Wandu Zhu, Washington University Biomedical Engineering Research Award
- 2018. Wandu Zhu, Philip Needleman Pharmacology Prize
- 2018. Wandu Zhu, Biophysical Society Student Research Achievement Award
- 2017. Wandu Zhu, Best Presentation, Gordon Research Seminar
- 2016. Caroline Dong, LMI Aerospace Award for Excellence in Research
- 2015. Wandu Zhu, Best Poster, Cardiovascular Research Day
- 2015. Wandu Zhu, Best Translational Poster, Bo Koster Memorial Symposium
- 2015. Bianca Yu, LMI Aerospace Award for Excellence in Research
- 2014. Eric Hsu, Barry M. Goldwater Scholar
- 2014. Ruben Garcia, Best Pre-College Poster AGMUS Research Symposium

## Research Funding

*Current as PI or MPI*

NIH-NHLBI, R01HL150637

\$2,292,835

7/1/20-6/30/24

Post-Transcriptional Regulation of Myocardial Sodium Channels

Collaborative project to understand how molecular level regulation of Nav channels by intracellular fibroblast growth factors determines myocyte electrophysiology.

NIH-NHLBI, R01HL148803 Personalizing Class I anti-Arrhythmic Drug Therapy Goal is to leverage biophysical insight to predict whether patients with ventricular tachycardia or fibrillation will respond to class I anti-arrhythmic molecules.	\$3,169,663	4/1/20-3/31/25
NIH-NHLBI, R01HL142301 Mechanism of BK Channel Gating Goal is to delineate mechanisms of the dual regulation of BK channels by membrane potential and intracellular Ca <sup>2+</sup> .	\$2,149,137	4/1/19-3/31/22
NIH-NHLBI, 1R44HL140896 Using Augmented Reality to Make Cardiac Ablation Procedures Simpler and Safer SBIR FastTrack grant is to SentiAR, Inc., a WashU spinout, whose goal is to commercialize an augmented reality platform that was developed in the Silva lab for use in the cardiac catheterization laboratory.	\$2,221,372	2/1/18-7/31/21
NIH-NHLBI, 1R01HL136553 Modulation of Cardiac NaV Channel Function and Electrophysiology by Interacting Molecules Combines advanced molecular imaging modalities with multi-scale modeling to understand how molecules that interact with cardiac NaV channels affect arrhythmia susceptibility.	\$1,906,250	4/1/17-3/31/22
ICTS Just in Time, 733 Post-translational Mechanisms in the Coordinated Regulation of Cardiac Rhythms Create mouse models of FGF regulation of Nav channels	\$3,990	10/7/20-10/6/21
<i>Current as Co-I or Preceptor</i>		
NIH-NIDDK, T32 DK108742 Imaging, Modeling and Engineering of Diabetic Tissues Designed to prepare trainees with engineering backgrounds for research focused on fundamental mechanisms and translational possibilities for diabetes and metabolic diseases. Role: Preceptor		06/2016-05/2021
NIH-NHLBI, T32 HL134635 Training in Integrative and Systems Biology of Cardiovascular Disease Provide research opportunities; fundamental education and basic training in cardiovascular physiology. Role: Preceptor		7/1/17-6/30/22
<i>Previous</i>		
Children's Discovery Institute, CH- II-2017-575 Improving Outcomes In The Pediatric Cardiac Catheterization Lab Using Augmented Reality Using mixed reality to guide cardiac ablation (year 1) and catheterization (year 2&3) procedures.	\$450,000	2/1/17-1/31/21
NIH-NHLBI, R01NS092570 KCNQ Channels: Gating and Subunits Modulation Goal is to understand how intracellular and transmembrane subunits regulate KCNQ channel gating.	\$333,594	3/1/20 - 2/28/21
NIH, UG3 TR002170-01 A 3D In-Vitro Disease Model of Atrial Conduction Aim is to create a compact system to test new therapies for atrial fibrillation using adenoviral delivery. Role: Co-I		7/1/17-4/30/20

LEAP Inventor Challenge Using Merged Reality to Improve Cochlear Implant Outcomes Leveraging our experience in creating augmented reality solutions for cardiac ablation to improve cochlear implant outcomes.	\$50,000	1/1/19-12/31/19
CIMED Pilot Grant Effects of Mechanical Forces on Cardiac Excitability in Heart Disease Pilot grant in collaboration with Michael Greenberg and Jonathan Moreno developing technology to simultaneously assess excitability and contraction in iPSC-derived cardiomyocytes.	\$25,000	1/1/18-12/31/18
American Heart Association, 16GRNT31200025 Molecular Pathology of Brugada Syndrome Mutations Goal is to use molecular imaging methods to discover the molecular basis for arrhythmia.	\$154,000	7/1/16-6/30/18
SEAS Collaboration Initiation Grant Applying Mixed Reality to Otolaryngology Procedures Using an augmented reality display to assist surgeons who are performing otolaryngology procedures.	\$25,000	4/25/17-3/24/18
Bear Cub Grant Improving Transcatheter Ablation Outcomes with Virtual Reality Goal is to used mixed reality to enhance visualization during catheter ablation procedures.	\$55,000	6/1/16-5/31/17
Burroughs Wellcome Fund, 1010299 Applying molecular spectroscopy to derive multi-scale cardiac bioelectricity models Goal is to obtain experimental data regarding the molecular motions of the cardiac Na <sup>+</sup> channel.	\$500,000	7/1/11-6/30/17
Institute for Clinical and Translational Sciences, JIT410 The Nav Channel Beta Subunit Role in Chamber-Specific Heart Pharmacology Editing iPSC-derived myocytes to test beta subunits alter Class 1b drug pharmacology.	\$5,000	7/11/16-7/10/17
CIMED Pilot Grant Fluorescent Unnatural Amino Acid Tracking of Membrane Protein Conformation Develop protocols to use fluorescent un-natural amino acids for voltage-clamp.	\$25,000	1/1/14-12/31/14
CIMED Pilot Grant ATP binding to the cytosolic domain of KCNQ1 channel proteins Goal is to assess mechanisms of ATP binding to KCNQ1 ion channels.	\$25,000	1/1/14-12/31/14
<i>Grants to Students</i>		
AHA Graduate Fellowship to Wandu Zhu Discovering molecular mechanisms of how $\beta$ -subunits regulate cardiac Na <sup>+</sup> Channels Student(s): Wandu Zhu Role: Sponsor	\$52,000	7/1/15-6/30/17
CBSE Scholarship Student(s): Wandu Zhu Role: Sponsor	\$10,000	7/1/15-6/30/16
AHA Undergraduate Fellowship Student(s): Bicong Li	\$4,000	7/1/16-9/1/16

Role: Sponsor

HHMI SURF (x3) \$12,000 Summer 2013-15  
Student(s): Chen Zhao, Eric Hsu, Linxuan Yang  
Role: Sponsor

AHA Scholarship in Cardiovascular Disease \$2000 Summer 2016  
Student(s): Alex Goldberg  
Role: Sponsor

## Publications

### Peer Reviewed Publications

1. Moreno JD, Bhagavan D, Li A, Gerstner NC, Miller EW, Huebsch N, Cresci S, **Silva JR**, "Pulsus alternans in cardiogenic shock recapitulated in a single cell fluorescence imaging of a patient's cardiomyocyte" *Circulation: Heart Failure*, accepted
2. Jung C, Wolff G, Wernly B, Bruno R, Franz M, Schulze PC, Silva JNA, **Silva JR**, Bhqatt D, Kelm M, "Virtual and augmented reality in cardiovascular care: State of the art and future perspectives", *JACC: Cardiovascular Imaging*, accepted.
3. Mangold KE, Wang W, Johnson EK, Bhagavan D, Moreno JD, Nerbonne JM, **Silva JR**. "Identification of Structures for Ion Channel Kinetic Models". *PLoS Computational Biology*. 2021 Aug 17.
4. Zhu W, Wang W, Angsutararux P, Mellor RL, Isom LL, Nerbonne JM, **Silva JR**. "Modulation of the effects of Class-Ib antiarrhythmics on cardiac Nav1.5-encoded channels by accessory Nav $\beta$  subunits", *JCI Insight*. 2021 Jun 22.
5. Gholami Derami H, Gupta P, Weng KC, Seth A, Gupta R, **Silva JR**, Raman B, Singamaneni S. "Reversible Photothermal Modulation of Electrical Activity of Excitable Cells using Polydopamine Nanoparticles". *Advanced Materials*. 2021 Jul 3:2008809.
6. Angsutararux P, Kang PW, Zhu W, **Silva JR**. "Conformations of voltage-sensing domain III differentially define Nav channel closed-and open-state inactivation." *Journal of General Physiology*. 2021 Aug 4;153(9):e202112891.
7. Prakosa A, Southworth MK, Silva JN, **Silva JR**, Trayanova NA. "Impact of augmented-reality improvement in ablation catheter navigation as assessed by virtual-heart simulations of ventricular tachycardia ablation." *Computers in Biology and Medicine*. 2021 Jun 1; 133:104366.
8. Silva JN, Southworth MK, Andrews CM, Privitera MB, Henry AB, **Silva JR**. "Design Considerations for Interacting and Navigating with 2 Dimensional and 3 Dimensional Medical Images in Virtual, Augmented and Mixed Reality Medical Applications." In *International Conference on Human-Computer Interaction* 2021 Jul 24 (pp. 117-133). Springer, Cham.
9. Lorenzini M, Burel S, Lesage A, Wagner E, Charrière C, Chevillard M, Evrard B, Maloney D, Ruff K, Pappu R, Wagner S, Nerbonne J, **Silva JR**, Townsend RR, Maier LS, Marionneau C, "Proteomic and functional mapping of cardiac Nav1.5 channel phosphorylation", *Journal of General Physiology*, 2021 153 (2): e202012646.
10. Andrews CM, Henry AB, Soriano IM, Southworth MK, **Silva JR**, "Registration Techniques for Clinical applications of 3-Dimensional Augmented Reality Devices", *IEEE Journal of Translational Engineering in Health and Medicine*, 2020 Dec 17.

11. Kang PW, Westerlund AM, Shi J, White KM, Dou AK, Cui AH, **Silva JR**, Delemotte L, Cui J, "Calmodulin acts as a state-dependent switch to control a cardiac potassium channel opening", *Science Advances*, 2020 Dec 11; 6(50):eabd6798.
12. Southworth MK, Silva JNA, Blume W, Van Hare GF, Dalal AS, **Silva JR**, Performance Evaluation of Mixed Reality Display for Guidance during Transcatheter Cardiac Mapping and Ablation, *IEEE Journal of Translational Engineering in Health and Medicine*, 2020 Jul 3.
13. Zhu W, Li T, **Silva JR**, Chen J. Conservation and divergence in NaChBac and Nav1.7 pharmacology reveals novel drug interaction mechanisms. *Scientific Reports*. 2020 Jul 1;10(1):1-1.
14. Silva JN, Southworth MK, Blume WM, Andrews C, Van Hare GF, Dalal AS, Miller N, Sodhi SS, **Silva JR**. First-In-Human Use of a Mixed Reality Display During Cardiac Ablation Procedures. *JACC: Clinical Electrophysiology*. 2020 Jul 8.
15. Silva JN, Privitera MB, Southworth MK, **Silva JR**. Development and Human Factors Considerations for Extended Reality Applications in Medicine: The Enhanced Electrophysiology Visualization and Interaction System (ĒLVIS). *International Conference on Human-Computer Interaction 2020* Jul 19 (pp. 341-356). Springer, Cham.
16. Salvage SC, Zhu W, Habib ZF, Hwang SS, Irons JR, Huang CL\*, **Silva JR\***, Jackson AP\*. Gating control of the cardiac sodium channel Nav1.5 by its  $\beta$ 3-subunit involves distinct roles for a transmembrane glutamic acid and the extracellular domain. *Journal of Biological Chemistry*. 2019 Dec 20;294(51):19752-63. \*Co-corresponding authors.
17. Moreno JD, Zhu W, Mangold K, Chung W, **Silva JR**. A molecularly detailed Nav1.5 model reveals a new class I antiarrhythmic target. *JACC: Basic to Translational Science*. 2019 Oct 28;4(6):736-51.
18. Southworth, MK, **Silva JR\***, Silva JNA\*. Use of Extended Realities in Cardiology. *Trends in Cardiovascular Medicine*. Apr. 2019. \*Co-corresponding authors.
19. Andrews C, Southworth MK, Silva JNA\*, **Silva JR\***. Extended Reality In Medical Practice. *Current Treatment Options in Cardiovascular Medicine*. 2019 Apr 1;21(4):18. \*Co-corresponding authors
20. Zhu W, Mazzanti A, Voelker T, Hou P, Moreno JD, Angsutararux P, Naegle KM, Priori SG, **Silva JR**, Predicting Patient Response to the Antiarrhythmic Mexiletine Based on Genetic Variation: Personalized Medicine for Long QT Syndrome. *Circulation Research* 2019;124:539:552.
21. Silva JNA, Southworth M, Raptis C, **Silva JR**, "Emergence of Virtual and Augmented Reality in Cardiology", *Journal of the American College of Cardiology: Basic to Translational Science*, 3(3),420-430, 2018.
22. McJunkin JL, Jiramongkolchai P, Chung W, Southworth M, Durakovic N, Buchman CA, **Silva JR**. Development of a Mixed Reality Platform for Lateral Skull Base Anatomy. *Otology & Neurotology*. Dec 1;39(10):e1137-42, 2018.
23. **Silva JR** "How to Connect Cardiac Excitation to the Atomic Interactions of ion channels", *Biophysical Journal*, 114(3),632a-633a, 2018.
24. Peters CH, Yu A, Zhu W, **Silva JR**, Ruben PC, "Depolarization of the Conductance-Voltage Relationship in the Nav1.5 Mixed Syndrome Mutant, E1784K, Caused by Modified Fast Inactivation", *PLoS One*, 12(9):e0184605, 2017
25. Zhu W, Voelker TL, Varga Z, Schubert AR, Nerbonne JM, **Silva JR** "Mechanisms of non-Covalent  $\beta$  Subunit Regulation of Nav Channel Gating", *J of General Physiology*, August; 149(8), 2017.
26. Mangold K, Brumback B, Angsutararux P, Zhu W, **Silva JR** "Mechanisms and Models of Cardiac Na<sup>+</sup> Channel Inactivation", *Channels*, 2017.

27. Hsu EJ, Zhu W, Schubert AR, Voelker T, Varga Z, **Silva JR** "Regulation of Na<sup>+</sup> Channel Inactivation by the DIII and DIV Voltage-Sensing Domains", *J of General Physiology*, March; 149(3):389, 2017.
28. Teed ZR, **Silva JR** "A Computationally Efficient Algorithm for Fitting Ion Channel Gating Parameters", *MethodsX*, 3, 577-588, 2016.
29. Zhu W, Varga, Z, **Silva JR**. "Molecular Motions of Ion Channels that Shape the Cardiac Action Potential: Insights from Voltage-Clamp Fluorometry." *Progress in Biophysics and Molecular Biology*, Dec. 2015.
30. Wang HG, Zhu W, Kanter RJ, **Silva JR**, Honeywell C, Gow RM, Pitt GS "A Novel NaV1.5 Voltage Sensor Mutation Associated with Severe Atrial and Ventricular Arrhythmias", *Journal of Molecular and Cellular Cardiology*, March; 92:52-62, 2016. Brettmann J, Urusova D, Tonelli M, **Silva JR**, Henzler-Wildman K. "Role of Protein Dynamics in Ion Selectivity and Allosteric Coupling in the NaK Channel", *Proceedings of the National Academy of Science*, 112(50):15366-15371, 2015.
31. Varga, Z, Zhu W, Schubert AR, Pardieck JL, Hsu EJ, Zaydman MA, Cui J, **Silva JR**. "Direct Measurement of Cardiac Na<sup>+</sup> Channel Conformations Reveals Molecular Pathologies of Inherited Mutations." *Circulation: Arrhythmia and Electrophysiology*, 8:1228-1239, 2015.
32. Rudokas MW, Varga Z, Asaro AB, Schubert AR, **Silva JR**. "The *Xenopus* Oocyte Cut-Open Vaseline Gap Voltage-Clamp Technique with Fluorometry" *J of Visualized Exp*, e51040-e51040, 2014.
33. **Silva JR**, Cooper P, Nichols CG, "Modeling K<sub>ATP</sub>-dependent Excitability in Pancreatic Islets" *Biophysical Journal*. 107(9), 2016-2026, 2014.
34. Zaydman MA, **Silva JR**, Delaloye K, Larsson HP, Cui J. "Kv7. 1 ion channels require a lipid to couple voltage sensing to pore opening" *Proceedings of the National Academy of Science*, August;110(32):13180-13185, 2013.
35. [Zhang HX\*, **Silva JR**\*], Lin YW, Verbsky JW, Lee US, Kanter EM, Yamada KA, Schuessler RB, Nichols CG. "The Heterogeneity and Function of K<sub>ATP</sub> Channels in Canine Hearts" *Heart Rhythm*, \*Both authors contributed equally, October; 10(10):1576-1583, 2013.
36. **Silva JR** and Goldstein SAN. "Voltage Sensor Movements Describe Slow Inactivation of Na<sub>v</sub> Channels I: Wild Type" *Journal of General Physiology*. March; 141:309-321, 2013.
37. **Silva JR** and Goldstein SAN. "Voltage Sensor Movements Describe Slow Inactivation of Na<sub>v</sub> Channels II: L689I Mutants" *Journal of General Physiology*. March; 141:323-334, 2013.
38. Zaydman MA, **Silva JR**, Cui J. "Ion Channel Associated Diseases: Overview of Molecular Mechanisms" *Chemical Reviews*. November; 112(12):6319-6333, 2012.
39. Silva JNA and **Silva JR**. "The Long QT Syndrome: Current Research and Treatment" *Current Treatment Options in Cardiovascular Medicine* – October; 14(5):473-489, 2012.
40. **Silva JR** and Rudy Y. "Multi-scale Electrophysiology Modeling: From Atom to Organ" *Journal of General Physiology*. May; 135:575-581, 2010.
41. **Silva JR**, Pan H, Wu D, Nekouzadeh A, Decker K, Cui J, Baker N, Sept D, Rudy Y. "A Multiscale Model Linking Ion-Channel Molecular Dynamics and Electrostatics to the Cardiac Action Potential" *Proceedings of the National Academy of Science*. June; 106 (27):11102-11106, 2009.
42. Decker K, Heijman J, **Silva JR**, Hund T, Rudy Y. "Properties and Ionic Mechanisms of Action Potential Adaptation, Restitution and Accommodation in Canine Epicardium" *Am J Physiol: Heart* 2009 Jan; 296:1017-1026, 2009.
43. Nekouzadeh A, **Silva JR**, Rudy Y. "Modeling subunit cooperativity in opening of tetrameric ion channels", *Biophysical Journal*. 2008 October;95(7):3510-20.

44. Rudy Y and **Silva JR**. "Computational biology in the study of cardiac ion channels and cell electrophysiology." *Q Rev Biophys*. 2006 Feb;39(1):57-116.
45. Faber G, **Silva JR**, Livshitz L, Rudy Y. "Kinetic properties of the cardiac L-type Ca<sup>2+</sup> channel and its role in myocyte electrophysiology: a theoretical investigation." *Biophysical Journal*. 2007 Mar;92(5):1522-43.
46. **Silva JR** and Rudy Y. "Subunit Interaction Determines I<sub>Ks</sub> Participation in Cardiac Repolarization and Repolarization Reserve", *Circulation*. 2005;112:1384-1391.
47. **Silva JR** and Rudy Y. "Mechanism of pacemaking in I(K1)-downregulated myocytes." *Circulation Research*. 2003 Feb 21;92(3):261-3.

### **Chapters**

1. Moreno JD, Kang PW, **Silva JR**, "Connecting Cardiac Excitation to the Atomic Interactions of Ion Channels", *Cardiac Electrophysiology: From Cell to Bedside 8<sup>th</sup> ed.*, in press.
2. Mangold K, **Silva JR**, "Ion Channel Modeling". *Modeling and Simulating Cardiac Electrical Activity*. In press.
3. Cox K, Privitera MB, Alden T, **Silva JR**, Avari Silva JN. "Augmented Reality in Medical Devices". *Applied Human Factors in Medical Device Design*. Academic Press, pp. 327-337, 2019.
4. **Silva JR**. "Slow inactivation of Na<sup>+</sup> channel", *Voltage Gated Na<sup>+</sup> Channels*, Ed. Peter Ruben, Springer, Berlin Heidelberg, 2014.
5. Zhang HX, **Silva JR** and Nichols C. "Cardiac K<sub>ATP</sub> Channels in Health and Diseases", *Electrical Diseases of the Heart, 2nd edition*. pp 259-279, Ed. Ihor Gussak et al., Springer London, 2013.
6. **Silva JR** and Rudy Y. "Voltage-Gated Channels and the Heart", *Molecular Machines*. Ed. B. Roux. World Scientific 2011.
7. **Silva JR** and Rudy Y. "Ionic Mechanisms of Ventricular Action Potential Excitation" *Cardiac Electrophysiology: From Cell to Bedside, 5th edition*, Eds. D.P. Zipes and J. Jalife. Elsevier Science, 2008.

### **Patents and Licenses**

1. Blume W, Southworth MK, **Silva JR**, Silva JN, Soriano I, inventors; Sentiar Inc, assignee. Electrogram Annotation System. United States patent application US 17/078,889. 2021 Apr 29.
2. US Patent 10,258,426, **Silva JR**, Silva JNA, "System and Method for Virtual Reality Data Integration and Visualization for 3D Imaging and Instrument Position Data", Apr. 16 2019.
3. US Patent 10,964,291 B2, Southworth, MKS, Blume W, Silva JNA, **Silva JR**, "Disposable sticker within augmented reality environment",
  - a. 10,964,291 B2, Continuation granted on March. 30, 2021.
4. Blume W, Southworth MK, Silva JNA, **Silva JR** "Gaze Based Interface for Artificial Reality Environment", US Patent App 16/453,027.
5. **Silva JR**, Zhu W, Priori S, Mazzanti A, Naegle K "Predicting response to sodium channel blockers", US Patent App 16/708,312

### **Invited Lectures**

1. FASEB SRC Ion Channel Regulation, 2022
2. Society for Mathematical Biology, 2021
3. Cardiology Grand Rounds, Washington University School of Medicine, 2020



4. Venture Café, 2020
5. UC Davis Cardiovascular Symposium, 2020
6. Channelopathy 2020, Quebec City, invited
7. Ohio State University, Department of Biomedical Engineering 2019
8. Skandalaris Center for Interdisciplinary Innovation and Entrepreneurship, 2019
9. Department of Biochemistry and Molecular Biophysics, Washington Univ School of Medicine, 2019
10. University of Michigan, Ann Arbor, Michigan, 2018
11. CECAM Multiscale Modeling Workshop, Lugano, Switzerland, 2018
12. St. Louis University Biomedical Engineering Society, St. Louis, USA, 2018
13. Center for Cardiovascular Research, Washington University School of Medicine, St. Louis USA, 2018
14. Cardiac Arrhythmia Mechanisms Gordon Research Conference, Ventura, California, USA, 2017
15. Experimental Biology Meeting, Chicago, IL, USA, 2017
16. Biomedical Engineering Seminar, Washington University in St. Louis, St. Louis, MO, USA, 2016
17. Cardiac Bioelectricity and Arrhythmia Center 10<sup>th</sup> Anniversary Symposium, Washington University in St. Louis, St. Louis, MO, USA, 2015
18. Center for Cardiovascular Research, Cardiovascular Research Day, Junior Faculty Presentation, Washington University in St. Louis, St. Louis, MO, USA, 2014
19. Biochemistry and Molecular Biophysics Chalk Talk, Washington University in St. Louis, St. Louis, MO, USA, 2014
20. MSTP MAP Talk, Washington University in St. Louis, St. Louis, MO, USA, 2014
21. Cardiac Bioelectricity and Arrhythmia Center Seminar, Washington University in St. Louis, St. Louis, MO, USA, 2014
22. Université de Montréal (GEPROM), Montréal, Québec, Canada, 2013
23. Biophysical Evenings, Washington University in St. Louis, St. Louis, MO, USA, 2013
24. University of British Columbia, Vancouver, British Columbia, Canada, 2012
25. Simon Fraser University, Vancouver, British Columbia, Canada, 2012

## Teaching

BME 440 Introductory Python with Biomedical Applications

Role: Co-Instructor

Year Taught: 2021

Avg. Enrolled Students: 40 undergrad

BME 301 Quantitative Physiology

Role: Course Master

Year(s) Taught: 2018,2019,2020

Avg. Enrolled Students: 65 undergrad

BME 401 Senior Design (Core Curriculum)

Role: Team taught (3)

Years taught: 2013, 2014, 2015, 2016

Avg. Enrolled Students: 77 undergrad

BME 450/550 Numerical Methods for Computational Modeling in Biomedicine (Tier 1 Class)  
Role: Developed, Instructor Avg. Enrolled Students: 19 (25% grad, 75% undergrad)  
Years taught: 2014, 2015, 2016, 2017, 2018

BME 5901 Integrative Cardiac Electrophysiology  
Role: Team-taught (3) Avg. Enrolled Students: 4  
Years taught: 2014, 2016, 2018

## Trainees

### **Graduate**

#### *Current:*

Druv Bhagavan (2020-)

Thesis Topic: Algorithms to connect micro-heart muscle phenotype to patient arrhythmia

Anticipated Graduation: 2023

Po Wei Kang (2019 -)

Thesis Topic: Calmodulin regulation of cardiac ion channels.

Anticipated graduation: 2021

Paweorn Angsutararux (2017 - )

Thesis topic: Novel methods to monitor ion channel gating in myocytes

Anticipated graduation: 2022

Emily Wagner (2017 - )

Thesis Topic : Disordered protein regulation of Nav1.5

Anticipated graduation: 2022

Kathryn Mangold (2016 - )

Thesis topic: Computational modeling of cardiac Na<sup>+</sup> channel gating

Anticipated graduation: 2021

#### *Past:*

Wandi Zhu (2013 - 2018)

Thesis topic: Modulation of Cardiac Na<sup>+</sup> Channel Gating by Interacting Molecules

Currently a postdoctoral fellow at Harvard Medical School

### **Post-graduate**

#### *Current:*

Divya Kernik, PhD (2019 - )

Panpan Hou, PhD (2019 - )

Jonathan Moreno MD, PhD (2017 - )

Kuo-Chan Weng, PhD (2017 - )

#### *Past:*

Christopher Andrews, PhD (2018-2020), Sr. Systems Engineer, SentiAR Inc.

Zoltan Varga, PhD (2013-2014), Asst. Professor, Debrecen Medical School, Hungary

Darya Urusova, PhD (2014-2015), Staff Scientist, Washington University School of Medicine

Arie Krumholz, PhD (2014-2015), Data Scientist (training)

## ***Undergraduate (>6 months)***

### *Past:*

Michael Rudokas (2012-2013), PhD Candidate, University of Nevada Reno  
Bicong Li (2015-2017), Medical Student  
Eric Hsu (2013-2015), MD/ PhD Candidate UT Southwestern  
Zach Teed (2014-2017) – PhD Candidate, Princeton University  
Chen Zhao (2013-2014) – PhD Candidate, The Johns Hopkins University

## **Professional Associations**

### **Fellow**

2018 – Present. American Heart Association

### **Member**

2016 – Present. Biomedical Engineering Society  
2015 – Present. Society of Hispanic Professional Engineers  
2015 – Present. Society of General Physiologists.  
2011 – Present. Heart Rhythm Society  
2010 – Present. American Heart Association  
2009 – Present. Biophysical Society  
2007 – Present. AAAS/Science

## **University and Professional Leadership**

### ***Department***

Director of Diversity (2020-)  
Undergraduate Studies Committee (2013-2014, 2017-)  
Graduate Studies Committee (2014-2016, Cardiovascular Engineering Program Leader)  
Faculty Search Committee (2014, 2016, 2019)  
Masters Studies Committee (2016- )

### ***School***

Advancing Data Science for Racial Equity Faculty Recruiting Committee  
Faculty Advisor, Society of Hispanic Professional Engineers, Undergraduate Chapter  
Representative to Society for the Advancement of Chicanos/Hispanics and Native Americans in Science  
Member, Engineering Space Committee  
Panel, Society of Hispanic Professional Engineers, Q&A  
Panel, Graduate School Forum  
Panel, Engineering Visit Day

### ***University***

Member, Race and Ethnicity Hiring Initiative, 2020-present  
Member, University Public Safety Committee, 2020-2021  
Member, Conflicts of Interest Committee, 2018-present  
Oversight sub-committee  
Member, Danforth COVID-19 Re-opening Committee, 2020  
Member, HHMI Gilliam Fellowship Nomination Review Committee, 2019-2020  
Member, Ethnicity Cluster Hire Review Committee, 2020  
Reviewer, SURF Undergraduate Research Fellowship  
Participant, Libraries Data Curation Pilot  
Participant, StemFIT Program

## **External**

### *Grant Review*

National Institutes of Health, MPPB Study Section, Standing Member  
National Institutes of Health, ESTA Study Section, Standing Member  
American Heart Association, Career Development Award (2020)  
American Heart Association, Strategically Focused Research Network, Sudden Cardiac Death (2019)  
National Institutes of Health, ESTA Study Section, Ad Hoc (2018)  
American Heart Association, Transformational Project Award (2018-2019)  
American Heart Association, Strategically Focused Research Network, Atrial Fibrillation (2018)  
American Heart Association, Electrophysiology 1, permanent member (2015 - 2017)  
American Heart Association, Biomedical Engineering Basic Science 3, ad hoc reviewer (2x)  
FWO, Belgian Research Foundation, Ad hoc reviewer (4x)  
Isaac Newton Trust, Ad hoc Reviewer  
Israel Science Foundation, Ad hoc Reviewer  
Arch Grants Pitch Competition

### *Oversight*

American Heart Association, SFRN: Atrial Fibrillation Oversight Committee (2018 - )  
Heart Rhythm Society Journal Subcommittee

### *Outreach*

Aim High St. Louis Career Day  
Mentor, Sister Thea Bowman School, Under-represented 8<sup>th</sup> Grade Students  
Invited Speaker, Forsyth School 2<sup>nd</sup> Grade, Topic: Biomedical Engineering (2016 - )  
Coach, Lego League, Forsyth School  
Judge, Honors Science Fair, St. Louis

## **Journal Affiliations**

### **Editorial Board:**

Frontiers in Neuroscience

### **Reviewer:**

PLoS ONE	Biophysical Journal
American Physical Society	Physical Biology
Chaos	Journal of Medical and Biological Engineering
MethodsX	Journal of Biomechanical Engineering
Journal of General Physiology	Journal of Molecular and Cellular Cardiology
American Journal of Physiology	Journal of Neuroscience
Scientific Reports	Cardiovascular Research
Circulation Research	Europace
Circulation: Arrhythmia and Electrophysiology	Progress in Biophysics and Molecular Biology
Heart Rhythm Journal	eLife
Journal of the American Heart Association	

## **Center Affiliations**

Center for Cardiovascular Research (CCR)  
Center for Science and Engineering of Living Systems (CSELS)  
Cardiac Bioelectricity and Arrhythmia Center (CBAC)  
Center for the Investigation of Membrane Excitability Diseases (CIMED)