E. Benjamin Randall

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Employment

Staff Research Scientist Nov 2022 - present
Applied Research Associates
Artificial Intelligence and Data Analytics (AIDA) Group
Analytical Spatial Intelligence Research & Technologies (ASIRT) Directorate
Intelligence, Surveillance, and Reconnaissance (ISR) Division

Appointments

T32 Postdoctoral Research Fellow Mar 2021 - Oct 2022
Multidisciplinary Cardiovascular Research Training Grant NIH 5-T32-HL-007853-22
University of Michigan (UM), Ann Arbor, MI, USA
PI: David Pinsky, M.D.
Mentors: Daniel Beard, Ph.D., Brian Carlson, Ph.D, Scott Hummel, M.D.

Adjunct Appointment May 2021 - May 2022
North Carolina State University (NCSU), Raleigh, NC, USA

Postdoctoral Fellow Sep 2019 - Feb 2021
Molecular and Integrative Physiology, UM, Ann Arbor, MI, USA
PIs: Daniel Beard, Ph.D. and Brian Carlson, Ph.D

Education

Ph.D., M.S. Applied Mathematics Aug 2014 - Jun 2019
Minor in Physiology, *Concentration in Interdisciplinary Mathematics*
North Carolina State University (NCSU), Raleigh, NC, USA
Advisor: Mette S. Olufsen, Ph.D.
Thesis title: *Mathematical Analysis of Autonomic Control of Blood Pressure and Heart Rate*

B.S. Mathematics Jan 2013 - May 2014
University of North Carolina at Charlotte (UNCC), Charlotte, NC, USA

B.S. Chemistry – Biochemistry Track Aug 2008 - Dec 2011
Minors in Biology, Linguistics, and Hispanic Studies
University of North Carolina at Chapel Hill (UNC-CH), Chapel Hill, NC, USA

Certificates

Applied Data Science Program Mar 2022 - Jun 2022
Massachussets Institute of Technology (MIT), Boston, MA, USA

Research Interests

Mathematical interests

Mathematical biology, mathematical modeling, data analysis, sensitivity analysis, optimization methods, parameter estimation, inverse problems, applications to medicine/physiology, network modeling, statistics, machine learning, deep learning, epidemiological modeling

Physiological interests

Cardiovascular and cardiac health, autonomic nervous function, baroreflex, chemoreflex, respiratory regulation, systemic regulation of heart rate and blood pressure, heart failure with reduced ejection fraction, heart failure with preserved ejection fraction, postural orthostatic tachycardia syndrome, dysautonomia, hypertension

Funding

2. **Momental Research Fellowship (MRF) Unfettered Research Grant, $10,000.** Jul 2021 - Jun 2022
   Momental Foundation.
   Role: Principal Investigator
1. **Micro-conference Award, $5,350**. Micro-conference on Parameter Estimation. Aug 2018
   American Mathematical Society (AMS) Mathematics Research Communities (MRC) NSF/DMS 1641020.
   Minneapolis, MN, USA
   Role: Co-organizer

Publications

Students/mentees/advisees indicated in *italics*. Asterisks (*) indicate co-first authorship.

Published

8. *Kim, S.**, **Randall, E.B.***, Jezek, F., Beard, D.A., Chesler, N. Computational modeling of ventricular-ventricular interactions suggest a role in clinical conditions involving heart failure. *Frontiers Physiol*, 14:1231688, 2023. DOI: 10.3389/fphys.2023.1231688
7. *Jones, E.*, **Randall, E.B.**, Hummel, S.L., Cameron, D., Beard, D.A., Carlson, B.E. Phenotyping heart failure using model-based analysis and physiology-informed machine learning. *J Physiol*, 2021. DOI: 10.1113/JP281845.
6. Jezek, F., **Randall, E.B.**, Carlson, B.E., Beard, D.A. Systems analysis of the mechanisms governing the cardiovascular response to changes in posture and in peripheral demand during exercise. *J Mol Cell Cardiol*, 163: 33-55, 2021. DOI: 10.1016/j.yjmcc.2021.09.013.
5. **Randall, E.B.**, Hock, M., Lopez, R., Marzban, B., Marshall, C., Beard, D.A. Quantitative analysis of mitochondrial ATP synthesis. *Math Biosci*, 108646, 2021. DOI: 10.1016/j.mbs.2021.108646.
4. **Randall, E.B.**, *Randolph, N.Z.*, Alexanderian, A., and Olufsen, M.S. Global sensitivity analysis informed model reduction and selection applied to a Valsalva maneuver model. *J Theor Biol*. 526: 110759, 2021. DOI: 10.1016/j.jtbi.2021.110759.
3. Gu, F., **Randall, E.B.**, Whitesall, S., Converso-Baran, K., Carlson, B.E., Fink, G.D., Michele, D.E., Beard, D.A. Potential role of intermittent functioning of baroreflexes in the etiology of hypertension in spontaneously hypertensive rats. *JCI Insight*. 5:e139789. 2020. DOI: 10.1172/jci.insight.139789.
2. **Randall, E.B.**, *Randolph, N.Z.*, and Olufsen, M.S. Persistent instability in a nonhomogeneous delay differential equation system of the Valsalva maneuver. *Math Biosci*. 319, 108292:1-11, 2020. DOI: 10.1016/j.mbs.2019.108292.
1. **Randall, E.B.**, Billeschou, A., Brinth, L.S., Mehlsen, J., and Olufsen, M.S. A model-based analysis of autonomic nervous function in response to the Valsalva maneuver. *J Appl Physiol*. 127: 1386–1402, 2019. DOI: 10.1152/japplphysiol.00015.2019.

Submitted/In preparation

3. *Jones, E.*, Hahn, V., Hummel, S.L., **Randall, E.B.**, Sharma, K., Konerman, M., Beard, D.A., Carlson, B.E. Precision phenotyping of cardiovascular dysfunction in heart failure. Submitted.
2. *Jones, T.*, *Beamer, P.*, *Gallegos, N.*, *Hammond, C.*, Geddes, J., Olufsen, M.O. **Randall, E.B.**. ECG and blood pressure collection and mathematical analysis methodology analyzing autonomic function during the Valsalva maneuver. In preparation.
1. **Randall, E.B.**, *Jones, T.*, *Beamer, P.*, *Gallegos, N.*, *Hammond, C.*, Geddes, J., Olufsen, M.O. Model-based analysis of autonomic function identifies postural orthostatic tachycardia syndrome without the necessity of posture change. In preparation.

Recognition

Honors

- **Multidisciplinary Cardiovascular Research Training Grant, Postdoctoral Fellow** Mar 2021 - Oct 2022
  NIH 5-T32-HL-007853-22. UM.
- **fastPACE first runner-up presentation** (out of 9) Fast Forward Medical Innovation, UM Oct 2020
  Developed a commercialization proposal over the course of 5 weeks.
- **Research Training Group (RTG) in Mathematical Biology Fellow** May 2016 - Jul 2018, Jan 2019 - Jul 2019
  NSF/DMS 1246991. NCSU.
- **Three Minute Thesis Finalist** Oct 2016
  Presented research in ≤ 3 minutes. First student from Dept. of Mathematics at NCSU to participate
- **Research Experience for Graduates (REG) Graduate Research Fellowship**, NCSU. May 2015 - Aug 2015
  Advisor: Mette S. Olufsen, Ph.D.

Awards

- **Postdoctoral Travel Award**, $500. UM Postdoctoral Association, UM. Aug 2022
  For attending the IEEE Engineering in Medicine and Biology Conference (EMBC) 2022.
- **BioArtography Travel Award**, $300. UM BioArtography Program. Aug 2021
  For attending EMBC 2022.
- **Postdoctoral Professional Development Award**, $250. UM Postdoctoral Association, UM. Mar 2021
  For renewing annual membership to the Society of Industrial and Applied Mathematics.
- **Postdoctoral Travel Award**, $500. Office of Graduate and Postdoctoral Studies, UM. Feb 2020
  For attending SIAM Conference on the Life Sciences (LS) 2020. (postponed due to COVID-19)
- **Graduate Student Association Travel Assistance Award**, $500. NCSU. Jan 2019
  For attending the Joint Mathematics Meeting (JMM) 2019.
- **Micro-conference Travel Award**, $350. AMS. Aug 2018
  For attending the MRC Micro-conference on Parameter Estimation.
- **Society of Industrial and Applied Mathematics (SIAM) Student Travel Award**, $650. Aug 2018
  For attending SIAM LS 2018.
- **JMM Travel Award**, $950. AMS MRC, NSF/DMS 1321794. Jan 2017
  For attending JMM 2017.

Scholarships

- **Lynn Hauser Pearce Merit Scholarship Award**, $1000. UNCC. Aug 2013 - May 2014
- **A.K. Sutton Merit Scholarship Award**, $1000. UNCC. Aug 2013 - May 2014

Research Experience

- **Postdoctoral Research Fellow**, Molecular and Integrative Physiology — Sep 2019 - Oct 2022
  UM, Ann Arbor, MI, USA
  PIs: Daniel Beard, Ph.D. and Brian Carlson, Ph.D.
- **RTG Fellow**, RTG in Mathematical Biology, NSF/DMS 1246991. — May 2016 - Jul 2019
  NCSU, Raleigh, NC, USA
  Advisor: Mette S. Olufsen, Ph.D.
- **Visiting Researcher** — July 2017
  Coordinating Research Centre, Bispebjerg and Frederiksberg Hospital, Frederiksberg, Denmark
  Advisor: Jesper Mehlsen, M.D.
- **Graduate Researcher/Team Leader** — Jun 2016
  AMS MRC on *Mathematics in Physiology and Medicine*, NSF/DMS 1321794.
  Snowbird, UT, USA
- **REG Research Assistant**, Department of Mathematics — Apr 2015 - Aug 2015
  NCSU, Raleigh, N.C., USA
  Advisor: Mette S. Olufsen, Ph.D.

Presentations

Oral

23. Invited talk. Biomathematics Seminar. NCSU, Raleigh, NC — Oct 2023 (expected)
22. Invited talk. Applied Research Associates. Raleigh, NC — Sep 2022
21. Invited talk. Frontiers in Cardiovascular Physiology. UM. Virtual — May 2022
20. Invited talk. Research seminar. University of California, Irvine (UCI). Virtual. — Aug 2021
19. Invited talk. Complex Systems Advanced Academic Workshop. UM, Ann Arbor, MI, USA — Mar 2020
18. Contributed talk. SIAM Great Lakes 2019. UM, Ann Arbor, Michigan — Apr 2019
17. Invited talk. Research seminar. Moffitt Cancer Center, Tampa, FL, USA — Feb 2019
16. Invited talk. Recruitment weekend for Dept. of Mathematics. NCSU, Raleigh, NC, USA — Feb 2019
15. Contributed talk. JMM 2019. Baltimore, MD, USA — Jan 2019
14. Invited talk. Biomathematics Seminar. — Nov 2018
    Virginia Commonwealth University (VCU), Richmond, VA, USA
13. Invited talk. Biomathematics Seminar NCSU, Raleigh, NC, USA — Oct 2018
12. Invited talk. SIAM Student Chapter Student Tutorial. NCSU, Raleigh, NC, USA — Sep 2018
11. **Conference organizer** and tutorial speaker. Micro-conference on Parameter Estimation. — Aug 2018
    Minneapolis, MN, USA
12. **Minisymposium organizer** and speaker. SIAM LS 2018. Minneapolis, MN, USA — Aug 2018
11. Invited talk. RTG Tutorial Workshop 2018. NCSU, Raleigh, NC, USA — Jul 2018
10. Contributed lightning talk (≤ 5 minute talk). Genomic Sciences and Biomathematics Symposium 2018. — Apr 2018
    NCSU, Raleigh, NC, USA
9. **Minisymposium organizer** and speaker. SIAM Southeastern Atlantic Sectional (SEAS) Conference. — Mar 2018
    UNC-CH, Chapel Hill, NC, USA
8. Invited talk. Recruitment Weekend for Dept. of Mathematics. NCSU, Raleigh, NC, USA — Feb 2018
7. Invited talk. Research Seminar. Bispebjerg and Frederiksberg Hospitals, Frederiksberg, Denmark — Jul 2017
6. Contributed talk. Biology and Medicine through Mathematics (BAMM) Conference 2017. — May 2017
    VCU, Richmond, VA, USA
5. Invited talk. JMM 2017. Atlanta, GA, USA — Jan 2017
4. Invited talk. North Carolina Museum of Natural History. Raleigh, NC, USA — Dec 2016
3. Contributed talk. Triangle Area Graduate Mathematics Conference (TAGMaC) 2016. — Dec 2016
    UNC-CH, Chapel Hill, NC, USA
2. **Competition finalist**. Three Minute Thesis. NCSU, Raleigh, NC, USA — Oct 2016
1. **Team leader** and tutorial speaker. AMS MRC Workshop. Snowbird, UT, USA. — Jun 2016

Posters

6. IEEE Engineering in Medicine and Biology Society (EMBC), Glasgow, Scotland — Jul 2022
5. Biophysical Society Annual Meeting, San Francisco, CA, USA — Feb 2022
4. Graduate Research Symposium, NCSU, Raleigh, NC, USA — Mar 2017
3. RTG Tutorial Workshop, NCSU, Raleigh, NC, USA — Jul 2016
2. SIAM LS 2016, Boston, MA, USA — Jul 2016
1. BAMM 2016, VCU, Richmond, VA, USA — May 2016

Workshops

8. **Host** and speaker. Mentorship through a First Generation Ph.D. Lens. — Aug 2022
   Momental Foundation. Virtual
7. Wearables Research Summit 2021 — Nov 2021
   UM, Ann Arbor, MI, USA
6. Workshop on Mathematical Machine Learning and Applications — Dec 2020
   Pennsylvania State University, State College, PA, USA
5. Advances in Precision and Personalized Medicine — Mar 2019
   Statistical and Applied Mathematical Sciences Institute (SAMSI), Durham, NC, USA
4. RTG Tutorial Workshop on Parameter Estimation, NSF/DMS 1246991 — Jul 2018
   NCSU, Raleigh, NC, USA
3. RTG Tutorial Workshop on Parameter Estimation, NSF/DMS 1246991 — Jul 2016
   NCSU, Raleigh, NC, USA
2. AMS MRC Workshop on Mathematics in Physiology and Medicine, NSF/DMS 1321794 — Jun 2016
   Snowbird, UT, USA
1. Uncertainties in Computational Hemodynamics Workshop, SAMSI — Jun 2015
   SAMSI, Durham, NC, USA

Teaching Experience

- **Guest lecturer**, Department of Molecular and Integrative Physiology, UM. — Mar 2021
  PHYSIOL 520: Lectured and led a computational lab on cardiovascular modeling techniques.
- **Teaching Assistant**, Department of Mathematics, NCSU
  Instructor of Record — Aug 2018 - Dec 2018
  - MA 242: Calculus III, Fall 2018 (47 students)

  Recitation Leader — Jan 2015 - May 2016
  - MA 141: Calculus I, Spring 2016 (65 students)
  - MA 141: Calculus I, Fall 2016 (83 students)
  - MA 131: Calculus for Life and Managerial Sciences A, Spring 2015 (136 Students)

  Lecture Assistant — Aug 2014 - Dec 2014
  - MA 241: Calculus II, Fall 2014 (176 students)
- **Private tutor**, Benjamin Randall Tutoring. — Jul 2014 - present
- **Departmental tutor**, Department of Mathematics, UNCC. — Aug 2013 - May 2014
- **Private tutor** Tutor Doctor. — Mar 2013 - May 2014

Affiliations

- IEEE EMBC — May 2022 - present
- Biophysical Society (BPS) — Nov 2021 - Dec 2022
- Society of Mathematical Biology (SMB) — July 2021 - Dec 2022
- American Physiological Society (APS) — Nov 2019 - Dec 2022
- Beard Lab — Sep 2019 - Oct 2022
- SIAM — Aug 2014 - Dec 2022
- AMS — Aug 2014 - Dec 2022
- Cardiovascular Dynamics Group (CDG) at NCSU — Apr 2015 - Jul 2019

Service

Journal Reviewer

- PLoS Computational Biology
- International Journal of Dynamical Systems and Differential Equations

Administrative positions

- President and Co-founding member, Postdoc Centerspace, UM — Feb 2020 - Oct 2022
- Sub-committee member, UM Postdoctoral Association (PDA) — Mar 2020 - Oct 2022
- Senator, UM Medical School Postdoctoral Senate, UM — Jan 2020 - Oct 2022
- Group Leader, Webmaster, and Secretary, CDG, NCSU — Jan 2016 - Sep 2019
- Group Facilitator, Math Circle (advanced clinic for middle schoolers), NCSU — Sep 2015 - May 2016

Mentoring

- Teresa Jones — May 2021 - May 2023
  Directed Research for Undergraduates in Math and Statistics (DRUMS), NCSU
  Currently a graduate student at NCSU under Mette Olufsen, Ph.D. in the Department of Mathematics
- Perry Beamer, DRUMS, NCSU — May 2021 - May 2023
  Currently an adult English as a Second Language math teacher
- Nicole Gallegos, DRUMS, NCSU — May 2021 - May 2022
  Currently at the John's Hopkins Applied Physics lab
- Caroline Hammond, DRUMS, NCSU — May 2021 - May 2022
  Currently a graduate student at Dartmouth College
- Kiley Hassevoort, Summer Undergraduate Research Fellowship (SURF), UM — May 2021 - Aug 2021
  Currently working as a medical assistant
- Salla Kim, UCI — Apri 2021 - present
  Currently a graduate student at UCI under Naomi Chesler, Ph.D. in the Department of Biomedical Engineering
- Nicholas Z. Randolph. RTG Undergraduate Research, NCSU — May 2018 - Jul 2020
  Currently a graduate student at UNC-CH under Brian Kuhlman, Ph.D. in the Department of Biochemistry and Biophysics
  Received the NSF Graduate Research Fellowship (awarded 2022)
- Emma Jager. RTG Undergraduate Research, NCSU — May 2018 - Aug 2018
- Brittany McLawhorn. Undergrads Union Grads (UUG), NCSU — Oct 2015 - May 2017

Micro-conference organizer

- AMS MRC Micro-conference on Parameter Estimation 2018 — Aug 2018
  Co-organizers: C. Puelz, R. Brady and M.S. Olufsen

Minisymposium organizer

- SIAM LS 2018. Co-organizers: R. Brady and M.S. Olufsen — Aug 2018
- SIAM SEAS 2018. Sole organizer. — Mar 2018

Computing Skills

Proficient in MATLAB, Python (numpy, pandas, scikit-learn, seaborn, matplotlib, tensorflow), LaTeX, Microsoft Office
Experience with Fortran, Modelica, Maple, HTML, and CSS