

Ann M. Hermundstad, Ph.D.

CONTACT INFORMATION Postdoctoral Researcher *Office:* David Rittenhouse Lab 2N3C
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 Department of Physics and Astronomy
 University of Pennsylvania
 Philadelphia, PA 19104

RESEARCH INTERESTS Information processing in complex, adaptive biological systems, with emphases on visual, olfactory, and higher cognitive processing. Development of theoretical, computational, and data-driven techniques for exploring the dependence of biological function on anatomical structure, temporal dynamics, and environmental variability.

ACADEMIC EMPLOYMENT **University of Pennsylvania**, Philadelphia, PA USA
2012-present *Postdoctoral Researcher*
 Supervisor: Vijay Balasubramanian
 Affiliations: Department of Physics and Astronomy, University of Pennsylvania
 Department de Physique Theorique, Ecole Normale Superieure

EDUCATION **University of California, Santa Barbara**, California, USA
 Ph.D. Physics, September 2012
 Advisor: Jean Carlson
 Area of emphasis: Condensed Matter Theory
 Thesis title: *Expeditions in Neurocartography: Mappings between Structural and Functional Pathways in Artificial and Cognitive Neural Systems*
 M.A. Physics, June 2010
 Advancement topic: *Learning, memory, and the role of neural network architecture*
 Committee: Jean Carlson (advisor), James Langer, Scott Grafton, Elizabeth Gwinn
Colorado School of Mines, Golden, Colorado USA
 B.S. Engineering Physics, Minor in Mathematics, May 2006
 Advisor: Lincoln Carr

RESEARCH EXPERIENCE **University of Pennsylvania**, Philadelphia, PA USA
2012-present *Postdoctoral Researcher*
 Collaborators: Vijay Balasubramanian, Gašper Tkačik, Jonathan Victor, Mary Conte, Thierry Mora, Aleksandra Walczak, Venkatesh Murthy, Charles Stevens, John Briguglio, Kamesh Krishnamurthy, Danielle Bassett, Kevin Brown
 Projects: Natural scene statistics and visual sensitivity to higher-order spatiotemporal structure, the role of randomness and nonlinearities in shaping olfactory processing, adaptation of population codes in retinal networks, structural constraints on information flow in human brain networks.

University of California, Santa Barbara, CA USA**2009-2012** *Graduate Student Researcher*

Collaborators: Jean Carlson, Kevin Brown, Danielle Bassett, Scott Grafton, Michael Miller

Projects: Network analysis of structural and functional connectivity in the human brain, complexity and tradeoffs in neural network models, influence of architecture on network performance, robustness and plasticity in learning and memory processes, applications to biological and computer sciences.

2009-2010 *Graduate Student Researcher*

Collaborators: Jean Carlson, James Langer, Ralph Archuleta

Project: Friction and energy dissipation in sheared granular materials, applications to earthquake physics.

2008 *Graduate Student Researcher*

Collaborators: Joan-Emma Shea, Giovanni Bellesia

Project: Molecular dynamics simulations of polypeptides, folding of frustrated proteins, effect of surface patterning on folding.

Colorado School of Mines, Golden, CO USA**2005-2006** *Undergraduate Student Researcher*

Collaborators: Lincoln Carr, Dimitri Dounas-Frazer

Project: Quantum tunneling of Bose-Einstein condensates, dynamic evolution of an interacting condensate confined to a double well potential.

PUBLICATIONS
IN PRINT
OR IN REVIEW**Hermundstad, A.M.**, Briguglio, J., Conte, M., Victor, J.D., Tkačik, G. and V. Balasubramanian (2014), Variance is salience: efficient coding in central sensory processing, *eLife*, *in review/revision*.**Hermundstad, A.M.**, Brown, K.S., Bassett, D.S., Aminoff, E.M., Freeman, S., Clewett, D., Tipper, C., Johnson, A., Miller, M.B., Grafton, S.T. and J.M. Carlson (2014), Structurally-constrained relationships between cognitive states in the human brain, *PLoS Comput. Biol.*, 10(5):e1003591, doi:10.1371/journal.pcbi.1003591.**Hermundstad, A.M.**, Bassett, D.S., Brown, K.S., Aminoff, E.M., Freeman, S., Clewett, D., Tipper, C., Johnson, A., Miller, M.B., Grafton, S.T. and J.M. Carlson (2013), Structural foundations of resting-state and task-based functional connectivity in the human brain, *Proc. Natl. Acad. Sci. USA*, 110(15):6169–6174, doi:10.1073/pnas.1219562110.**Hermundstad, A.M.**, Brown, K.S., Bassett, D.S. and J.M. Carlson (2011), Learning, memory, and the role of neural network architecture, *PLoS Comput. Biol.*, 7(6):e1002063, doi:10.1371/journal.pcbi.1002063.**Hermundstad, A.M.**, Daub, E.G., and J.M. Carlson (2010), Energetics of strain localization in a model of seismic slip, *J. Geophys. Res.*, 115:B06320-1–9, doi:10.1029/2009JB006960.Dounas-Frazer, D.R., **Hermundstad, A.M.**, and L.D. Carr (2007), Ultracold bosons in a tilted multilevel doublewell potential, *Phys. Rev. Lett.*, 99(20):200402-1–4, doi:10.1103/PhysRevLett.99.200402.PUBLICATIONS
IN PREPARATION**Hermundstad, A.M.**, Marre, O., Palmer, S., Berry, M.J. 2nd, V. Balasubramanian, and Tkačik, G. (2014), Retina encodes information in synergistic bursts, *in preparation*.**Hermundstad, A.M.**, Mora, T., Walczak, A., and V. Balasubramanian (2014), Methods for isolating the structure of noise in neural responses, *in preparation*.

Hermundstad, A.M., and K. S. Brown (2014), Topology shapes synchronization states in networks of pulse-coupled oscillators, *in preparation*.

Krishnamurthy, K., **Hermundstad, A.M.**, Mora, T., Walczak, A., Murthy, V., Stevens, C.F., and V. Balasubramanian (2014), The functional role of randomness in olfactory processing, *in preparation*.

CONFERENCE
PROCEEDINGS

Hermundstad, A.M., Briguglio, J., Conte, M., Victor, J.D., Tkačik, G. and V. Balasubramanian (2013), Natural scene statistics relate to perceptual salience of second-, third-, and fourth-order spatial correlations, *BMC Neuroscience*, 14(Suppl. 1):P16, doi:10.1186/1471-2202-14-S1-P16.

Briguglio, J.*, **Hermundstad, A.M.***, Conte, M., Victor, J.D., Tkačik, G. and V. Balasubramanian (2013), Perceptual salience of fourth-order visual textures and natural scene statistics, *J. Vision*, 13(9):1234, doi:10.1167/13.9.1234.

Hermundstad, A.M., Brown, K.S, Bassett, D.S. and J.M. Carlson (2011), Structural Drivers of Function in Information Processing Networks, *Proceedings of the Forty-Fifth Asilomar Conference on Signals, Systems, and Computers*.

Hermundstad, A.M., Brown, K.S, Bassett, D.S. and J.M. Carlson (2011), Architectural constraints on learning and memory function, *BMC Neuroscience*, 12(Suppl. 1):P31, doi:10.1186/1471-2202-12-S1-P31.

SCIENTIFIC
EDITING

2013-2014 I was a scientific editorial advisor on the forthcoming undergraduate textbook *Physical Models of Living Systems* by Philip Nelson. I helped vet the book for clarity, proposed improvements to the text and graphics, and reviewed all problem solutions. My name appears on the title page of this book.

GRANT
PREPARATION

2011-2012 I co-wrote two grant renewals for the Army Research Office Institute for Collaborative Technologies (successful on both occasions)

FELLOWSHIPS

2012 Chair's Fellowship, Physics Department, UCSB
(*quarterly stipend*)

2011 Philanthropic Education Organization National Scholar Award
(*\$30,000 in research funds*)

2007-2010 Government Assistance in Areas of National Need Fellowship, UCSB
(*annual stipend plus travel expenses*)

2009 School for Scientific Thought Fellowship, UCSB
(*quarterly stipend for designing and teaching a course*)

2008 Let's Explore Applied Physics and Mathematics Fellowship, UCSB
(*quarterly stipend*)

2006 National Institute of Standards and Technology Graduate Fellowship
(*5 year fellowship; declined*)

2006 Jefferson Scholar Graduate Fellowship, University of Virginia
(*5 year fellowship; declined*)

2002-2006 Presidential Scholarship, CSM

TRAVEL
GRANTS

2013 Computational Systems Neuroscience Travel Grant

2011 Organization of Computational Neurosciences Travel Grant

AWARDS

- 2011 Computational Neuroscience Meeting Student Poster Award
 2010 Chair's Appreciation Award, Physics Department, UCSB
(awarded for outstanding service to the Department of Physics)
 2008 National Science Foundation Fellowship Honorable Mention
 2006 Ryan Sayers Memorial Award, CSM
(awarded to one student each year for academic and research achievement in physics and mathematics)
 2006 Outstanding Graduating Senior, Physics Department, CSM
 2006 Blackwell Award for Excellence in Creative Expression, CSM
(awarded to one student each year who excels in the evocative representation of the human condition through the genres of poetry, fiction, creative non-fiction, music, or the artistic representation of academic inquiry)

INVITED

PRESENTATIONS

- 2014 Biophysics Group Meeting, Institute for Science and Technology Austria
 2014 Seminar on Representations of Information in Neural Systems, Intellis Corporation.
 2014 Biophysics Seminar, Rutgers University.
 2013 Vision Seminar, Rank Prize Symposium on the Computational Basis of Early Vision.
 2013 Physics of Complex Systems Seminar, Colorado School of Mines.
 2012 Neuroscience Seminar, Janelia Farm Research Campus.
 2012 Physics of Living Matter Seminar, University of Pennsylvania.
 2012 Neuronal Networks Seminar, Brandeis University.
 2012 Systems Biology Seminar, UC San Francisco.
 2012 Annual Founders' Day Meeting, PEO Chapters of Santa Barbara.
 2012 Omidyar Seminar, Santa Fe Institute.
 2011 Computational Neurobiology Seminar, Salk Institute.
 2011 Biophysics Symposium, Princeton University.
 2011 Network Science Seminar, Asilomar Conference on Signals, Systems, and Computers.
 2011 Physics Colloquium, Colorado School of Mines.
 2011 Theoretical Physics Seminar, Colorado School of Mines.
 2011 Education Seminar, Colorado School of Mines.

CAMPUS

PRESENTATIONS

- 2014 Network Visualization Seminar, University of Pennsylvania.
 2014 Physics of Living Matter Seminar, University of Pennsylvania.
 2014 Postdoc Research Symposium, Ecole Normale Supérieure.
 2013 Complex Systems Seminar, UC Santa Barbara.
 2013 Women in Physics Seminar, UC Santa Barbara.
 2012 Cognition, Perception, and Cognitive Neuroscience Seminar, UC Santa Barbara.
 2011 NSF IGERT Systems Biology Seminar, UC Santa Barbara.
 2011 SAGE Center for the Study of the Mind Seminar, UC Santa Barbara.
 2011 Earth Science Group Seminar, UC Santa Barbara.
 2011 UCSB Visit Day, network science poster presentation.
 2009 Government Assistance in Areas of National Need (GAANN) Seminar, UC Santa Barbara.

CONFERENCE
PRESENTATIONS

- 2014 Biophysical Society (BPS) Annual Meeting, submitted.
- 2014 Optical Society of America (OSA) Vision Meeting, to be given October 10, oral presentation.
- 2014 Computational Systems Neuroscience (CoSyNe) Annual Meeting, poster presentations (2).
- 2013 Organization for Computational Neurosciences (OCNS) Annual Meeting, poster presentation.
- 2013 Vision Sciences Society (VSS), poster presentation.
- 2013 Computational Systems Neuroscience (CoSyNe) Annual Meeting, poster presentation.
- 2012 UCSB Visit Day, complex systems poster presentation.
- 2012 Institute for Collaborative Biotechnologies Annual Meeting, poster presentation.
- 2011 Organization for Computational Neurosciences (OCNS) Annual Meeting, poster presentation.
- 2011 UCSB Visit Day, network science poster presentation.
- 2010 American Association for the Advancement of Science (AAAS) Annual Conference, poster presentation.
- 2009 Southern California Earthquake Community (SCEC) Annual Conference, poster presentation.

EXTERNAL
COVERAGE

- 2013 Hermundstad et al., PNAS 2013, was featured in the Science review *Structural and Functional Brain Networks: From Connections to Cognition* by Friston and Park, for which I designed new graphical representations of data.
- 2013 Hermundstad et al., PNAS 2013, was featured in the press article *UCSB Neuroscientists Study Connectivity in the Human Brain: White matter functions like cable networks to connect different brain areas*.

PROGRAM
INITIATION

University of California, Santa Barbara, California USA

2010 *Co-Creator*, School for Scientific Thought

In collaboration with another graduate student, I initiated a program in which graduate students design and teach special topics courses for high school students. Together with the Education and Outreach Department at UCSB, we designed the full structure of the program. In addition to course structure, we developed recruitment activities for local schools, training courses for graduate student instructors, and additional activities to familiarize high school students with the social, academic, and research culture of a university. We presented this program at the AAAS meeting, and we performed several evaluations of the successes and weaknesses of the program. The program is now externally funded by NSF and is in its sixth year of operation.

MENTORING
EXPERIENCE

University of Pennsylvania, Philadelphia USA

2014-present *Advisor*, undergraduate student in Physics and Biochemistry

I am advising an undergraduate student on a project that combines forward modeling, data analysis, and computer simulation to understand

biophysical constraints on growth in human brain networks. This work has been submitted to the Biophysical Society Meeting and is expected to be prepared for publication within the coming year.

TEACHING
EXPERIENCE

University of California, Santa Barbara, California USA

- 2010** *Instructor, School for Scientific Thought*
Subject: Quantum Mechanics
I designed and taught a quantum mechanics course for high school students. I chose the scope of the course, wrote all lecture material, prepared demonstrations, and wrote worksheets and review material. Lecture notes and handouts are posted online here:
- 2010** *Guest Instructor, Summer Institute in Mathematics and Science*
Subject: Introductory Mechanics
I taught introductory mechanics for incoming college freshman.
- 2007-2010** *Teaching Assistant*
Subjects: Classical Mechanics, Laboratory Techniques, Quantum Mechanics
I led weekly lab sections covering topics in projectile motion, wave mechanics, simple harmonic motion, acoustics, basic circuitry, special relativity, and introductory quantum mechanics. During lab and discussion, I held office hours, wrote homework and exam solutions, graded homework and lab reports, and proctored exams.
- 2010-present** *Invited Tutor, Koegel Autism Center (1 student)*
Subjects: Introductory mechanics, wave mechanics, electricity and magnetism.
- 2010** *Private Tutor (3 different students)*
Subjects: Wave mechanics, electricity and magnetism, modern physics.

Colorado School of Mines, Golden, Colorado USA

- 2004-2006** *Workshop Facilitator*
Subject: Introductory Mechanics
I composed a weekly worksheet of written problems covering concepts in introductory mechanics and held weekly workshops to help students complete the worksheets.
- 2004** *Teaching Assistant*
Subject: Introductory Mechanics
I assisted with laboratory demonstrations and written problems.
- 2004** *Private Tutor*
Subject: Introductory Mechanics

PROFESSIONAL
SERVICE

- 2012 Peer Reviewer, PLoS ONE
- 2012 Tutorial Instructor, Winter School on Quantitative Systems Biology, Abdus Salam International Centre for Theoretical Physics
- 2011-2012 Invited Panel Member, The Practice of Science Seminar, UCSB
- 2011 Invited Representative, Physics Department Donor Marketing Committee, UCSB
- 2011 Invited Tutor, National Society for Black Engineers, UCSB

2011 Invited Panel Member, Early Undergraduate Research and Knowledge Acquisition (Eureka!) Seminar, UCSB
2010-2011 Invited Representative, Physics Diversity Committee, UCSB
2009-2010 Program Development, School for Scientific Thought, UCSB
2007-2010 Volunteer, Physics Circus, UCSB
2008 Recruitment, USC Women in Physics Conference
2008 Member, Graduate Student Life Committee, UCSB
2005 Invited Representative, Committee to Increase Student Retention, CSM
2005 Mentor, Freshman Success Seminar, CSM

COMMUNITY
SERVICE

2007 Volunteer Instructor, Instituto Americano, Obrajés, Bolivia
2006 Volunteer, Habitat for Humanity, Chacala, Mexico
2003 Volunteer, Samaritan House, Denver, Colorado

REFERENCES

Available upon request