

Surya Ganguli

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| Address | Department of Physiology, UCSF 513 Parnassus Ave, HSE-806 San Francisco, CA 94143-0444 surya@phy.ucsf.edu http://keck.ucsf.edu/~surya |
| Biographic Data | Born in Kolkata, India. Currently US citizen. |
| Education | University of California Berkeley Berkeley, CA Ph.D. Theoretical Physics, October 2004. Thesis: "Geometry from Algebra: The Holographic Emergence of Spacetime in String Theory" M.A. Mathematics, June 2004. M.A. Physics, December 2000. Massachusetts Institute of Technology Cambridge, MA M.Eng. Electrical Engineering and Computer Science, May 1998. B.S. Physics, May 1998. B.S. Mathematics, May 1998. B.S. Electrical Engineering and Computer Science, May 1998. University High School Irvine, CA Graduated first in a class of 470 students at age 16, May 1993. |
| Research Experience | University of California, San Francisco San Francisco, CA <i>Sloan-Swartz Center for Theoretical Neurobiology</i> Sept 04 to present Conducting research in theoretical neuroscience. Lawrence Berkeley National Lab Berkeley, CA <i>Theory Group</i> Sept 02 to Sept 04 Conducted string theory research under the supervision of Dr. Petr Horava. MIT Department of Physics Cambridge, MA <i>Center for Theoretical Physics</i> January 97 to June 98 Studied the Wigner-Weyl representation of quantum mechanics. Discovered new admissibility conditions satisfied by all Wigner distributions. Also formulated and implemented simulations of quantum dynamics directly in phase space. Xerox Palo Alto Research Center Palo Alto, CA <i>Dynamics of Computation Group</i> May 96 to August 96 Studied the application of quantum computation to NP-complete constraint satisfaction problems. Developed an understanding of the quantum interference process between computational paths required to successfully find solutions. MIT Department of Physics Cambridge, MA <i>Center for Space Research</i> January 96 to May 96 Implemented parallel algorithms for use in N-body simulations of dark matter evolution. Involved parallel programming on an IBM Sp2 Machine in a combination of High Performance Fortran and the Message Passing Interface. Xerox Palo Alto Research Center Palo Alto, CA <i>Information Systems and Technologies Laboratory</i> May 95 to August 95 Developed algorithms for unsupervised speaker segmentation of audio streams, using Hidden Markov Models automatically initialized via hierarchical clustering of speech. MIT Laboratory for Computer Science Cambridge, MA <i>Information Mechanics Group</i> May 94 to August 94 Developed and implemented algorithms for image processing and machine vision on a cellular automata machine. |

Publications

- S. Ganguli, Learning and Memory in an Exactly Solvable Stochastic Spiking Network, in preparation.
- S. Ganguli, S. Ikeda and S. Amari, Survey Propagation, Jeffrey's Priors and Lagrangian Duality, in preparation.
- S. Ganguli and R. Hahnloser, A theory of bird song learning, (book chapter) in preparation.
- Y.D. Nochomovtitz, S. Ganguli and H. Li, Designability as a selection force: an analysis of the yeast cell cycle dynamics, in preparation.
- S. Ganguli and H. Sompolinsky, Short-term memory in neuronal networks through dynamical compressed sensing, *Neural Information Processing Systems* (2010).
- S. Ganguli and H. Sompolinsky, Statistical Mechanics of Compressed Sensing, *Phys. Rev. Lett.* (2010) 104:188701.
- S. Ganguli and P. Latham, Feedforward to the past: the relation between neuronal connectivity, amplification, and short-term memory, *Neuron* (2009) 61:499-501. (Preview)
- S. Ganguli, B. Huh, H. Sompolinsky, Memory Traces in Dynamical Systems, *PNAS* (2008) 105:18970-75.
- S. Ganguli, J. Bisley, J. Roitman, M. Shadlen, M. Goldberg and K. Miller, One Dimensional Dynamics of Attention and Decision Making in LIP, *Neuron* (2008) 58:15-25.
- K. Lau, S. Ganguli and C. Tang, Function Constrains Network Architecture and Dynamics: A Case Study on the Yeast Cell Cycle Network, *Phys. Rev. E* 75 (2007) 051907. (arxiv.org/abs/q-bio/0610025).
- S. Ganguli, A. Ndirango and P. Horava, Boundary Scattering in 1+1 Dimensions as an Aharonov-Bohm Effect, (arxiv.org/abs/hep-th/0501233).
- J. Brown, S. Ganguli, O. Ganor, C. Helfgott, E10 Orbifolds, *JHEP* 06 (2005) 057, (arxiv.org/abs/hep-th/0409037).
- S. Ganguli, O. Ganor and J. Gill, Twisted Six Dimensional Gauge Theories, Matrix Models and Integrable Systems, *JHEP* 0409 (2004) 014, (arxiv.org/abs/hep-th/0311042).
- E.K. Boyda, S. Ganguli, P. Horava and U. Varadarajan, Holographic Protection of Chronology in Universes of the Godel Type, *Phys. Rev. D* 67 (2003) 106003, (hep-th/0212087).

Recent posters (unpublished work only)

- S. Ganguli and H. Sompolinsky, Compressed sensing in the brain: the role of sparseness in short term and long term memory, *Frontiers in Systems Neuroscience. Conference Abstract: Cosyne 2010*.
- S. Ganguli, R. Guetig and H. Sompolinsky, Deciding without remembering, *Frontiers in Systems Neuroscience. Conference Abstract: Cosyne 2009*. doi: 10.3389/conf.neuro.06.2009.03.168.

Talks

- International Congress on Industrial and Applied Mathematics, July 2011.
- Telluride Neuromorphic Cognition and Engineering Workshop, July 2011.
- Collective Behavior in Biological Systems, Aspen Center for Theoretical Physics, June 2011.
- Bernstein Center for Computational Neuroscience Seminar, Goettingen, May 2011.
- Department of Mathematics Seminar, Univ. of Arizona, May 2011.
- Salk Institute for Biological Sciences, April 2011.
- Department of Brain and Cognitive Sciences Seminar, MIT, April 2011.
- Swissnex Public Lecture, San Francisco, March 2011.
- Cosyne Workshop: The role of dimensionality and sparsity in neuronal processing, March 2011.
- Computational and Systems Neuroscience Conference, Main Meeting, Feb 2011.
- Department of Applied Physics Seminar, Stanford University, Feb. 2011.
- Center for Brain Science Seminar, Harvard University, Feb. 2011.
- Center for Mind, Brain and Computation Seminar, Stanford University, Feb. 2011.
- Institute for Neuroinformatics Seminar, ETH Zurich, Jan. 2011.

Biological Modeling Seminar, Stanford University, November 2010.
 Statistics Seminar, Columbia University, November 2010.
 Kavli Institute for Theoretical Physics, UCSB, October 2010.
 Neurotheory and Neuroengineering Seminar, Janelia Farm, May 2010.
 Networks Seminar, Dept. of Mathematics, University of Houston, April 2010.
 Neurobiology and Anatomy Department Seminar, UT Houston, April 2010.
 Applied Mathematics Seminar, Harvard University, March 2010.
 Cosyne Workshop, Persistent activity: mechanisms and functional roles, March 2010.
 Interdisciplinary Center for Neural Computation Seminar, Hebrew University, November 2009.
 Banbury Conference: Working Memory, Apr. 2009.
 Cosyne Workshop: Dimensionality reduction for multi-channel neural recordings, March 2009.
 Computational Neurobiology Lab, Salk Institute, February 2009.
 Redwood Center for Theoretical Neuroscience Seminar, UC Berkeley, Jan. 2009.
 Applied Mathematics Colloquium, Columbia University, Nov. 2008.
 European Conference on Complex Systems: Working Memory in Jerusalem, Sept. 2008.
 Banbury Conference: Theoretical/Experimental Approaches to Attention, April 2008.
 Neural Coding, Computation and Dynamics, Hossegor, France, Sept. 2007.
 Sloan-Swartz Conference, UCSD, July 2007.
 Center for Neural Science Seminar, NYU, June 2007.
 Department of Neurobiology, Yale University, June 2007.
 Cognitive Computing Group, IBM Almaden Research Center, April 2007.
 Gatsby Computational Neuroscience Unit, (2 seminars) April 2007.
 Gatsby Computational Neuroscience Unit, (2 seminars) March 2007.
 Department of Physiology, UCSF, March 2007.
 Cosyne Workshop, Hippocampal/entorhinal plasticity, coding and computation, Feb. 2007.
 Condensed Matter Theory Seminar, Brandeis University, February 2007.
 Volen Center for Complex Systems, Brandeis University, January 2007.
 Sloan-Swartz Conference, Columbia University, July 2006.
 Department of Physiology, Columbia University, April 2006.
 Computational and Systems Neuroscience Conference, Main Meeting, March 2006.
 Computational Biology Seminar, UC Berkeley, October 2005.

Awards and Activities

Burroughs Wellcome Career Award at the Scientific Interface, 2009-2014
 (provides \$500,000 in support for a transition to a faculty position).
 Sloan-Swartz Fellowship, 2004-2009
 Berkeley Outstanding Graduate Instructor
 Tau Beta Pi
 Phi Beta Kappa
 MIT Varsity Tennis
 MIT Treasurer of the South Asian Association of Students
 Member of MIT and Berkeley Bhangra Dance Teams
 MIT EECS Tutor
 Cambridge Elementary School Volunteer
 National Merit Scholar
 National Council of Teachers of English Award in Writing

Teaching Experience

UCSF Neuroscience Graduate Program, 2010.
 Taught a section *Information Theory in Neuroscience* in Loren Frank's *Neural and Behavioral Data Analysis* course.
 Columbia Center for Theoretical Neuroscience, 2008.
 Co-taught *Advanced Theoretical Neuroscience* with Larry Abbott, Stefano Fusi, and Ken Miller.
 Berkeley Department of Physics, 1998-2002.
 Graduate student instructor for the following courses:
Introduction to Electricity and Magnetism (for premedical students).
Analytical Mechanics.

Electromagnetism and Optics.
Introduction to Statistical and Thermal Physics.
Special Relativity and General Relativity.
Quantum Mechanics.

MIT Department of Electrical Engineering and Computer Science, 1997-1998.
Teaching assistant for *Probabilistic systems analysis*.

- Invited Academic Visits**
- Kavli Institute for Theoretical Physics, UCSB, Sept.-Oct. 2010 (1 month).
 - Interdisciplinary Center for Neural Computation, Hebrew University, 2007-2009 (4 months).
 - Movement Control Laboratory (Emo Todorov), UCSD, Feb. 2009 (1 month).
 - Center for Brain Science, Harvard University, 2006-2009 (6 months).
 - Center for Theoretical Neuroscience, Columbia University, 2007-2008 (1 year).
 - Gatsby Computational Neuroscience Unit, Apr. 2007 (1 month).
 - Algebraic Geometry in Biology Workshop, IMA, University of Minnesota, Mar. 2007 (1 week).
 - Mathematical Neuroscience Lab, RIKEN Brain Science Institute, Jun.-Aug. 2005 (2 months).
- Invited Summer Schools**
- Boulder School for Condensed Matter: Biophysics (2007).
 - UCSD CTBP: Quantitative Approaches to Gene Regulatory Systems (2006).
 - Weizmann Institute: Physics of Nonequilibrium Complex Systems (2006).
 - BioMaps: Molecular Mechanisms and Models of Bacterial Signal Transduction (2005).
 - RIKEN Brain Science Institute: Neurobiology of Mental Disorders and the Mind (2005).
 - Okinawa School on Bayesian Methods in Computational Neuroscience (2004).
 - Woodshole MBL: Methods in Computational Neuroscience (2004).
 - Santa Fe Institute Complex Systems Summer School (2004).
 - Boulder Theoretical Advanced Study Institute on Recent Trends in String Theory (2003).
 - Cargese Institute on Progress in String, Field, and Particle Theory, Corsica, France (2002).
 - Princeton School on Quantum Field Theory, Supersymmetry and Enumerative Geometry (2001).
 - Harvard Summer School on Mirror Symmetry (2000).