Sungho Hong, PhD

Computational Neuroscience Unit

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Education

University of Pennsylvania — Aug 2004

PhD in Physics - Theoretical High Energy Physics.

Thesis: *Hadron Form Factors and Interactions: Comparing AdS/CFT and QCD.*

Korea Advanced Institute of Science and Technology — Aug 1999

MSc in Physics - Elementary Particle Physics.

Thesis: *Aspects of String Theory Compactified on Orbifold*

Korea Advanced Institute of Science and Technology — Feb 1995

BSc in Physics.

Research Experience

Group Leader, Okinawa Institute of Science and Technology — 2012—presently

Computational Neuroscience Unit. Supervisor: Erik De Schutter

- Currently studying the roles of physiological mechanisms on neural information processing via computational methods, with a focus on the cerebellum.
- Demonstrated that the cerebellar Purkinje neurons use a multiplexed coding scheme combining spike time and firing rate to encode saccadic eye movements (collaboration with Hans-Peter Thier, U. Tübingen). Published in *eLife*.
- Showed that the asymmetric GABAergic signaling is crucial for storing/encoding the memory for circadian rhythm in the suprachiasmatic nucleus (SCN) (with Toru Takumi, RIKEN BSI). Published in *PNAS*.

Researcher, Okinawa Institute of Science and Technology — 2007—2012

Computational Neuroscience Unit. Advisor: Erik De Schutter

- Demonstrated that intrinsic cellular properties determine how neurons transfer information by correlated firing (with Steven Prescott, U. Toronto). This work resulted in two publications in *J Neurosci* and *Neuron*.
- Developed a Compressive Sensing-based method for estimate neuronal phase response curves from limited and noisy experimental data. Published in *J Neurophysiology*.
- Developed a spectral clustering method for analyzing imaging data of the Bmal1 gene expression in the SCN neurons. Published in *J Neurosci*.
- Developed a physiologically detailed computational model of dendritic spiking in the cerebellar Purkinje neurons. Published in *Cerebellum*.

Senior Fellow, University of Washington — 2004—2007

Physiology and Biophysics Department. Advisor: Adrienne L. Fairhall

- Investigated biophysical interpretation of statistical models for neural coding by

single neurons and cellular basis for adaptive information processing. This work resulted in 3 publications in *Neural Comput* and *PLOS Comput Biol.*

Graduate Student, University of Pennsylvania   1999—2004
Department of Physics and Astronomy. Advisor: Matthew J. Strassler
- Developed superstring theory-based methods to analyze hadron-like strongly bound states for solving longstanding puzzles in nuclear physics such as the ρ-meson universality problem. This work resulted in 3 publications in *JHEP.*

Grants and Awards

2015 − 2017	Title: Role of Ion Channel Distributions in Dendritic Information Processing of the Cerebellar Purkinje Cell. PI: Sungho Hong. JSPS KAKENHI (科研費) (Grant no:15K06715). Amount: ¥3,700,000. Role: Principal Investigator. Designed the research program and wrote the grant.
2012	OCNS Travel Award

Publications

Journal Publications:

Hong, S., Negrello, M., Junker, M., Smilgin, A., Thier, P., De Schutter, E. (2016). Multiplexed coding by cerebellar Purkinje neurons. ELife *5*, e13810.

Huang, S., **Hong, S.**, De Schutter, E. (2015). Non-linear leak currents affect mammalian neuron physiology. Front. Cell. Neurosci. *9*, 432-41.

Myung, J., **Hong, S.**, DeWoskin, D., De Schutter, E., Forger, D., and Takumi, T. (2015). GABA-mediated repulsive coupling between circadian clock neurons in the SCN encodes seasonal time. Proc. Nat. Acad. Sci. *112*, E3920-9

Ratté, S., **Hong, S.**, De Schutter, E., and Prescott, S.A. (2013). Impact of neuronal properties on network coding: Roles of spike initiation dynamics and robust synchrony transfer. Neuron *78*, 758-72.

Hong, S., Robberechts, Q., and De Schutter, E. (2012). Efficient estimation of Phase Response Curves via Compressive Sensing. J. Neurophysiol., *208*, 2069−81.

Myung, J., **Hong, S.**, Hatanaka, F., Nakajima, Y., De Schutter, E., and Takumi, T. (2012). Period coding of *Bmal1* oscillators in the suprachiasmatic nucleus. J. Neurosci. *32*, 8900−18.

Hong, S., Ratté, S., Prescott, S.A., and De Schutter, E. (2012). Single neuron firing properties impact correlation-based population coding. J. Neurosci. *32*, 1413−28.

Anwar, H., **Hong, S.**, and De Schutter, E. (2010). Controlling Ca^{2+}-Activated K^+ channels with models of Ca^{2+} buffering in Purkinje cells. Cerebellum, 1−13 (online first).

Hong, S., and De Schutter, E. (2008). Purkinje neurons: What is the signal for complex spikes? Curr. Biol. *18*, R969−R971.

Hong, S., Lundstrom, B.N., and Fairhall, A.L. (2008). Intrinsic gain modulation and adaptive neural coding. PLOS Comput. Biol. *4*, e1000119.

Lundstrom, B.N., **Hong, S.**, Higgs, M.H., and Fairhall, A.L. (2008). Two computational regimes of a single-compartment neuron separated by a planar boundary in conductance space. Neural Comput. *20*, 1239−60.

Hong, S., Agüera y Arcas, B., and Fairhall, A.L. (2007). Single neuron computation: from dynamical system to feature detector. Neural Comput. *19*, 3133–72.

Hong, S., Yoon, S., and Strassler, M.J. (2006). On the couplings of vector mesons in AdS/QCD. J. High Energy Phys. *04*, 003.

Hong, S., Yoon, S., and Strassler, M.J. (2006). Adjoint Trapping: A new phenomenon at strong 't Hooft coupling. J. High Energy Phys. *03*, 012.

Erlich, J., Hong, S., and Unsal, M. (2004). Matrix models, monopoles and modified moduli. J. High. Energy Phys. *09*, 024.

Hong, S., Yoon, S., and Strassler, M.J. (2004). Quarkonium from the fifth dimension. J. High Energy Phys. *04*, 046.

Conference Proceedings/Abstracts and Other Publications:

Kumar, S., Hong, S., and De Schutter, E. (2014). Patterns in network activity and information processing in a detailed computer model of the cerebellar granular layer, BMC Neuroscience *15(Suppl 1)*, O2.

Hong, S., Negrello, M., Junker, M. A., Thier, P., and De Schutter, E. (2013). Saccade angle modulates correlation between the local field potential and cerebellar Purkinje neuron activity, BMC Neuroscience *14(Suppl 1)*, 91.

Hong, S. and De Schutter, E. (2011). Efficient estimation of Phase Response Curves via Compressive Sensing. BMC Neuroscience *12(Suppl 1)*, 61.

Negrello, M., Hong, S., and De Schutter, E. (2010b). What was the Purkinje doing while the monkey slept? BMC Neuroscience *11(Suppl 1)*, 9.

Anwar, H., Hong, S., and De Schutter, E. (2010a). Generating dendritic Ca^{2+} spikes with different models of Ca^{2+} buffering in cerebellar Purkinje cells. BMC Neuroscience *11(Suppl 1)*, 154.

Anwar, H., Hong, S., and De Schutter, E. (2009b). Modeling the excitability of the cerebellar Purkinje cell with detailed calcium dynamics. BMC Neuroscience *10(Suppl 1)*, 34.

Hong, S. and De Schutter, E. (2009a). Rich single neuron computation implies a rich structure in noise correlation and population coding. BMC Neuroscience *10(Suppl 1)*, 05.

Hong, S. and De Schutter, E. (2008). Correlation susceptibility and single neuron computation. BMC Neuroscience *9(Suppl 1)*, 141.

Hong, S. (2004). Hadron Form Factors and Interactions: Comparing AdS/CFT and QCD. University of Pennsylvania Thesis (Philadelphia: University of Pennsylvania).

Presentations

Talks in Conferences and Workshops:

Han, D. and Hong, S. (2017). Heterogeneous layers stabilize propagation of a multiplexed spike signal in a feedforward network, Computational Neuroscience Meeting (CNS) 2017 (Antwerp, Belgium).

Hong, S. (2016) Multiplexed coding in the cerebellar cortex. Annual Meeting of Korean Society for Chemical Senses (Ansan, Korea).

Hong, S. and Myung, J. (2016) GABA-mediated phase couplings and seasonal time coding in the suprachiasmatic nucleus. Japanese Society for Mathematical Biology Meeting (Fukuoka, Japan).

Hong, S. (2015) GABA-mediated phase couplings and seasonal time coding in the suprachiasmatic nucleus. East Asia Joint Symposium on Biomedical Research (Okinawa, Japan).

Hong, S. (2015) Multiplexed coding by cerebellar Purkinje cells. OCNS Workshop: Rate vs. temporal coding schemes: mutually exclusive or cooperatively coexisting? (Prague, Czech).

Hong, S. (2015) Multiplexed coding by cerebellar Purkinje cells. Mini Symposium: Recent Findings on the Cerebellar Microcircuitry (Okinawa, Japan).

Hong, S. (2014) Exploring microcircuits in the cerebellum via computational modeling. Korean Society for Computational Neuroscience Meeting (Seoul, Korea) (*Plenary talk*).

Kumar, S., **Hong, S.**, and De Schutter, E. (2014). Patterns in network activity and information processing in a detailed computer model of the cerebellar granular layer, CNS 2014 (Quebec City, Canada).

Hong, S. (2012) Adaptive computation of neurons with Hodgkin-Huxley mechanisms. OCNS Conference: 60 Years of the Hodgkin-Huxley (Cambridge, UK).

Hong, S. (2012) Single neuron firing properties impact correlation-based population coding. RIKEN BSI Workshop: Circuit Function of the Brain (Wako, Japan).

Hong, S. (2011) Single neuron firing properties impact correlation-based population coding. APCTP Young Computational Neuroscientist Workshop (Daejon, Korea).

Hong, S., and De Schutter, E. (2009). Rich single neuron computation implies a rich structure in noise correlation and population coding. CNS 2009 (Berlin, Germany).

Invited Talks:

Oct 2016	Dept. of Brain and Cognitive Science, DGIST (Daegu, Korea)
July 2016	Center for Functional Connectomics, KIST (Seoul, Korea)
Dec 2015	College of Pharmacy, Hanyang University (Ansan, Korea)
July 2015	Dept. of Neuroscience, Erasmus MC (Rotterdam, Netherlands)
July 2015	Dept. of Cognitive Neurology, University of Tübingen (Tübingen, Germany)
Aug 2013	Blue Brain Project, EPFL (Lausanne, Switzerland)
Aug 2013	Dept. of Neuroscience, Erasmus MC (Rotterdam, Netherlands)
Oct 2009	Dept. of Physics, Kyoto University (Kyoto, Japan)
Oct 2009	Graduate School of Biomedical Sciences, Hiroshima University (Hiroshima, Japan)
Mar 2008	Dept. of Neurobiology, Yale School of Medicine (New Haven, CT)
Jun 2007	Center for Brain Science, Harvard University (Cambridge, MA)
Jun 2006	Dept. of Bio and Brain Engineering, KAIST (Daejon, Korea)
Oct 2003	Physics Dept., University of Washington (Seattle, WA)

Teaching Experience

Courses and Lectures:

Lecturer, Okinawa Course of Computational Neuroscience (OCNC) (Okinawa, Japan)   2016
Course: Introduction to Numerical Methods for Ordinary/Partial Differential Equations
Responsibilities: Introducing differential equations and numerical methods to students with the biology background.

Guest Lecturer, Okinawa Institute of Science and Technology (Okinawa, Japan)   2014-2017
Course: Computational Neuroscience (A310)
Responsibilities: Introducing physiologically detailed computer models of neural systems and designing/grading homework problems (Materials available at https://github.com/shhong/a310_cns_2017).

Graduate Teaching Assistant, University of Pennsylvania (Philadelphia, PA)   1999-2000
Course: Introduction to Physics
Responsibilities: Teaching physics lab (experiment) classes, explaining experimental aims and designs, and grading reports.

Service and Outreach

Academic Editor of *PeerJ*.	Since 2016
Reviewer for the *Computational Neuroscience Meeting*.	Since 2012
Reviewer for *PLOS Computational Biology*, *Physical Review Letters*, *Cerebellum*, *Neural Computation*, and *Journal of Physics A*.	Since 2004
Lab instructor in *Penn Summer Science Academy*, a summer science program for high school students.	2000

Other Experience

Private, 72 Infantry Division, Korean Army.	1995–1996