Sungho Hong, PhD

Computational Neuroscience Unit, Okinawa Institute of Science and Technology, 1919-1 Tancha, Onna-son, Okinawa 904-0495, Japan; shhong@oist.jp; Phone: +81-98-966-1587; Fax: +81-98-966-1063; Skype: sungho.hong

Education

PhD in Physics/Theoretical High Energy Physics, University of Pennsylvania, 2004. Thesis: *Hadron Form Factors and Interactions: Comparing AdS/CFT and QCD.* Advised by Matthew J. Strassler & Mirjam Cvetič.

MSc in Physics/Elementary Particle Physics, Korea Advanced Institute of Science and Technology, 1999. Thesis: *Aspects of String Theory Compactified on Orbifold.* Advised by Kiwoon Choi.

BSc in Physics, Korea Advanced Institute of Science and Technology, 1995.

Research Experience

Group Leader, Computational Neuroscience Unit, Okinawa Institute of Science and Technology, 2012—. Supervisor: Erik De Schutter.

Currently studying the roles of biophysical 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*.

Developing a large-scale (~ 1 million cells) computational model of the cerebellar cortex with physiological details. Published in *PLOS Comput Biol*.

Studied the cellular mechanisms for encoding circadian rhythms in the suprachiasmatic nucleus (SCN) and choroid plexus (with Toru Takumi, RIKEN BSI). Published in *PNAS* and *Nat Commun.*

Researcher, Computational Neuroscience Unit, Okinawa Institute of Science and Technology, 2007–2012. 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 clustering method for analyzing imaging data of the *Bmal1* gene expression in the SCN neurons. Published in *J Neurosci*.

Senior Fellow, Physiology and Biophysics Department, University of Washington, 2004-2007. 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, Department of Physics and Astronomy, University of Pennsylvania, 1999-2004. Advisor: Matthew J. Strassler & Mirjam Cvetič.

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 4 publications in *JHEP.*

Grants

Principal Investigator, Role of Ion Channel Distributions in Dendritic Information Processing of the Cerebellar Purkinje Cell. JSPS KAKENHI (科研費), Grant no:15K06725 (with Weiliang Chen, OIST). Amount: ¥3,700,000. Designed the research program and wrote the grant.

Recipient of the OCNS Travel Award for *60 Years of the Hodgkin-Huxley* (Cambridge, UK), 2012.

Teaching Experience

Assistant Lecturer, Computational Neuroscience (A310), Okinawa Institute of Science and Technology (Okinawa, Japan), 2014-2020. Introduction building physiologically detailed computer models of neural systems and to a simulation platform. Materials available at https://github.com/shhong/a310_cns_2020.

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

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

Service and Outreach

Academic Editor, *PeerJ*, 2016—.

Reviewer for the *Computational Neuroscience Meeting*, 2012—.

Reviewer for *Neuroinformatics, Cell Reports, PLOS Computational Biology, Physical Review Letters, Cerebellum, Neural Computation*, and *Journal of Physics A*, 2004—.

Military service (mandatory). The 72 Infantry Division, Korean Army, 1995-1996.

Publications

Journal and Peer-reviewed Conference Publications:

Han, D., De Schutter, E., and **Hong, S.** (2020). Lamina-specific neuronal properties promote robust, stable signal propagation in feedforward networks. Advances in Neural Information Processing Systems *33*: Annual Conference on Neural Information Processing Systems (NeurIPS) 2020, in press.

Zang, Y., **Hong. S**, and De Schutter, E. (2020). Firing rate-dependent phase responses of Purkinje cells support transient oscillations. eLife *9*, e60692.

Wichert, I., Jee, S., De Schutter, E., and **Hong, S.** (2020). Pycabnn: Efficient and extensible software to construct an anatomical basis for a physiologically realistic neural network model. Front. Neuroinform. *14*, 31.

Myung, J.*, Schmal, C.*, **Hong, S.***, Tsukizawa, Y., Rose, P., Zhang, Y., Holtzman, M. J., De Schutter, E., Herzel, H., Bordyugov, G., and Takumi, T. (2018). The choroid plexus is an important circadian clock component. Nat. Commun. *9,* 1062. (*contributed equally)

Sudhakar, S. K.*, **Hong, S.***, Raikov, I., Publio, R., Lang, C., Close, T., Guo, D., Negrello, M., and De Schutter, E. (2017). Spatiotemporal network coding of physiological mossy fiber inputs by the cerebellar granular layer. PLOS Comput. Biol. *13*, e1005754. (*contributed equally)

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

Huang, S., **Hong, S.**, and 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. USA *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.

Preprints:

Linderman, S.*, Kros., L*, **Hong, S.***, Meijas, J.F., Romano, V., Negrello, M., Bosman, L.W.J, De Zeeuw, C.I. (2020). Cerebellar Purkinje cells can differentially modulate coherence between sensory and motor cortex depending on region and behavior. bioRxiv. doi:10.1101/2020.03.11.986943.

Other Publications:

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:

Hong, S. (2019) Lamina-specific neuronal properties promote robust, stable signal propagation in feedforward networks. OCNS Workshop: *Neural Multiplexed Coding* (Barcelona, Spain).

Hong, S. (2018). Impact of neuronal properties on network coding. NCTS Winter School: *Frontiers of Complex Systems Science* (Taipei, Taiwan).

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*).

Sudhakar, S. K., **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).

Invited Talks:

Nov 2018, Korea Brian Research Institute (Daegu, Korea).
Oct 2017, Center for Functional Connectomics, KIST (Seoul, Korea).
Oct 2017, Dept. of Bio and Brain Engineering, KAIST (Daejon, Korea).
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).