Hideaki Shimazaki, Ph.D

Associate Professor
Graduate School of Informatics
Kyoto University, 606-8501 Japan

Phone: +81-75-753-4906
E-Mail: h.shimazaki@i.kyoto-u.ac.jp
URL: http://www.neuralengine.org

Research agenda Humans and animals recognize the world and act on it for their survival. Our lab aims to provide a unifying and testable theory on how nervous systems realize this remarkable capacity and propose new machine intelligence grounded on it. While we broadly explore mathematical approaches to different levels of questions, including (i) circuit mechanisms, (ii) nonlinear computation, and (iii) information coding, to seek principles of inference, action selection, and learning, we put forward using canonical models commonly found in statistics, physics, and AI in modeling and analyzing neural data, and further constructing intelligent agents based on them to promote a unified view on these topics.

Education

Doctor of Philosophy, Kyoto University   2004 Apr – 2007 Mar

Department of Physics, Graduate School of Science, Kyoto University, Kyoto, Japan.
Supervisor: Prof. Shigeru Shinomoto
Thesis title: Recipes for selecting the bin size of a histogram.

Master of Arts (Neuroscience), Johns Hopkins University   2000 Aug – 2003 Nov

Department of Neuroscience, School of Medicine, Baltimore, MD, USA.
Supervisor: Prof. Ernst Niebur
Thesis title: Communication over distributed neural systems.

Bachelor of Engineering, Keio University   1996 Apr – 2000 Mar

Department of Applied Physics and Physico-Informatics, Yokohama, Japan.
Supervisor: Prof. Yutaka Tomita, Prof. Takeshi Aihara, and Prof. Minoru Tsukada
Dissertation title: Identification of characteristic curve of synaptic modification
                by spike timing: approach with optical recording method.

Research Experiences

Kyoto University, Associate Professor   2022 Sep – present

Hokkaido University, Specially-appointed Associate Professor   2020 Apr – 2022 Sep

Kyoto University, Project-specific Associate Professor   2017 Apr – 2020 Mar

Honda Research Institute Japan Co., Ltd., Senior Scientist   2016 Aug – 2020 Mar

RIKEN Brain Science Institute, Research Scientist   2011 Apr – 2016 Jul
  Postdoctoral researcher at Taro Toyoizumi lab

Massachusetts Institute of Technology, Visiting Researcher   2009 Dec – 2011 Mar
  Postdoctoral researcher at Emery N. Brown lab

RIKEN Brain Science Institute, Visiting Researcher   2007 Aug – 2011 Mar
  Postdoctoral researcher at Sonja Gruen lab

JSPS* Research Fellow at RIKEN Brain Science Institute   **2008 Apr – 2011 Mar**

JSPS* Research Fellow at Kyoto University   **2006 Apr – 2008 Mar**

* Japan Society for the Promotion of Science

Teaching Experiences

Lectures

* Lecture slides are available at http://www.neuralengine.org/res/lecture.

Hokkaido University, Sapporo, Japan   **2020 Apr – 2022 Sep**

A lecture course (90 min x 16 times) on theoretical neuroscience and machine intelligence titled "Introduction to the theory of brains and machines". Additionally, I give introductory lectures on neuroscience and machine learning within the omnibus course offered by CHAIN, titled "Introduction to Interdisciplinary Studies on Humanity".

Kyoto University, Kyoto, Japan   **2017 Apr – 2020 Mar**

Spot lectures on computational neuroscience in "Computational and cognitive neuroscience" course for graduate students, organized by Prof. Kumada and in "Proseminar on neuroinformatics" organized by Prof. Kamitani.

RIKEN Brain Science Institute, Saitama, Japan   **2014 Dec – 2020 Feb**

An introductory course on statistics titled "**Statistics for Neuroscience**" as a part of lecture courses of the RIKEN Brain Science Training Program for selected graduate students. The course covers classical statistical tests and multivariate analysis.

International Christian University, Tokyo, Japan   **2014 Dec – 2017 Mar**

An undergraduate course (140 min x 9 times) on "**Statistical Physics"** at the Department of Material Science of the International Christian University. The course provides concepts in statistical physics including laws of thermodynamics, state functions, and the canonical ensemble formalism.

Society for Young Researchers on Neuroscience, Kanagawa, Japan   **2017 Mar**

An invited lecturer of two-days workshop organized by Society for Young Researchers on Neuroscience (in Japan). The course titled "**Introduction to time-series modeling of neural activity data**" offered basic analysis skills on spiking neural data by point process models. The course included tutorials on generation, estimation, and validation of event data, using Julia language.

The Institute of Statistics and Mathematics, Tokyo, Japan   **2016 Feb**

A fee-charging extension course for businesspersons and scholars on "**Introduction to statistical analysis of point process networks**" at the Institute of Statistics and Mathematics with Prof. Shinsuke Koyama. More than 72 people participated in this course.

Graduate School of Science and Technology at Meiji University, Tokyo, Japan   **2013 May**

Introductory courses of Neuroscience. Course titles: "**Introduction to sensory systems, perception and neural coding studies**" and "**Introduction to neural decoding**".

The Institute for Research in Fundamental Sciences (IPM), Tehran, Iran   **2013 Mar**

Invited two-week lecture course titled "**Introduction to statistical models of neural spike train data**" at School of Cognitive Sciences, IPM in Iran. This course covered recent modeling approaches for neuroscientific data with an introduction to a point process theory, generalized linear modeling, and adaptive filtering theory.

Supervision of postdoctoral researchers

Dr Ulises Rodriguez Dominguez (CMAT, Mexico)   **2020 Sep – present**

Bayesian modeling of the closed loop systems of the hippocampal formation and entorhinal cortex.

Dr Anuj Mishra (Pune University, India)   **2020 Mar – present**

Sequential Bayesian prediction by the projected nonlinear state-space model for large-scale data analysis.

Dr Safura Rashid Shomali (IPM, Iran) **2017 Dec − present**

Identification of local circuitry of in-vivo neurons from higher-order statistics of population activity.

Dr Amin Sayed Moosavi (Kyoto University) **2018 Mar − 2020 Mar**

Dr Amin is interested in emergence of critical phenomena from neural networks, and tries to elucidate its information theoretic implications and the underlying mechanisms.

Dr Miguel Aguilera (University of the Basque Country, Spain) **2018 Jul − 2018 Aug**

Dr Aguilera is a visiting scholar to my lab at Kyoto University, and worked on mean-field approximation methods for kinetic Ising systems.

Supervision of graduate students

Ken Ishihara (Hokkaido University) **2020 Oct − present**

Large-scale analysis of neural data by the state-space kinetic Ising model.

Masanao Igarashi (Hokkaido University) **2020 Oct − 2022 Mar**

Entropy production for discrete-time Markov processes.

Safura Rashid Shomali (IPM, Tehran) **2013 Dec − 2017 Sep**

Co-supervision of Ph.D. thesis with Prof. Majid Nili-Ahmadabadi. Ms. Shomali was a graduate student at IPM in Tehran, Iran. I met her when I gave a lecture course at her institute in March 3-12, 2013. Later she asked for my supervision, and I was appointed as a co-supervisor for her PhD thesis with Prof. Majid Nili-Ahmadabadi on Dec 4, 2013. She visited RIKEN during Jul 23- Sep 23 in 2014. I supervised her project on theoretical analysis of the impact of a presynaptic input on a leaky integrate-and-fire neuron receiving noisy balanced inputs.

Christian Donner (BCCN Berlin) **2014 Jun − 2015 Apr**

Superviser of a summer-intern project at RIKEN Brain Science Institute and co-superviser of his master thesis at Bernstein Center for Computational Neuroscience (BCCN) Berlin with Prof. Klaus Obermayer. During 5/26-8/29 in 2014, Mr. Donner stayed at RIKEN BSI to study the dynamic model of neural interactions, as one of three lab-rotation projects required for his Master's degree at BCCN Berlin. During his stay, he introduced an analytical approximation method to make the model applicable to large-scale analysis.

Supervision of undergraduate students (Internship students)

Bingyue Zhu (University of British Columbia, Canada) **2018 Jun 20 – 2019 Apr 26**

Sequential Bayes estimation and anomaly detection method for physiological time-series signals

Magalie Tatischeff (University of British Columbia, Canada) **2018 Jun 20 – 2019 Apr 26**

Data analysis and development of statistical models for spiking activity of neural populations

Shukla Shashwat (IIT Bombay, India) **2018 May 14 – 2018 Jul 13**

Investigation of advanced time-series models for neural and behavioral activities

Krishna Subramani (IIT Bombay, India) **2018 May 14 – 2018 Jul 13**

Learning a hierarchical model for spatial phases in natural scenes.

Brinti Datta (IIT Bombay, India) **2017 Jul 5 – 2017 Jul 14**

Filtering methods for time-series analysis

Jimmy Gaudreault (Polytechnique Montreal) **2017 May 15 – 2018 Apr 27**

Data analysis of neural population activities by the dynamic Ising model

Arunabh Saxena (IIT Bombay, India) **2017 May 8 – 2017 July 14**

Studying and extending the state-space analysis methods for neural populations

Publications

Journal   *IF, Citation # as of Apr 2021

1. Aguilera M, Igarashi M, **Shimazaki H**. Nonequilibrium thermodynamics of the asymmetric Sherrington-Kirkpatrick model. **Nature Communications** (2023) 10.1038/s41467-023-39107-y

2. Shomali SR, Ahmadabadi MN, Rasuli SN, **Shimazaki H**. Uncovering hidden network architecture from spiking activities using an exact statistical input-output relation of neurons. **Communications biology** (2023) 6, 169 s42003-023-04511-z

3. Tatsumi K, Inamura Y, Kofu M, Kiyanagi R, & **Shimazaki H**. Optimization and inference of bin widths for histogramming inelastic neutron scattering spectra. **Journal of Applied Crystallography** (2022) 55(3) 533-543.

4. Isomura T, **Shimazaki H**, Friston K. Canonical neural networks perform active inference. **Communications biology** (2022) 5(1), 1-15

5. Torigoe M, Islam T, Kakinuma H, Fung CCA, Isomura T, **Shimazaki H**, Aoki T, Fukai T, Okamoto H. Zebrafish capable of generating future state prediction error show improved active avoidance behavior in virtual reality. **Nature Communications** (2021) 12, 5712

6. Aguilera M, Moosavi SA, **Shimazaki H**. A unifying framework for mean field theories of asymmetric kinetic Ising systems. **Nature Communications** (2021) 12, 1197

7. Nakajo H, Chou C, Kinoshita M, Appelbaum L, **Shimazaki H**, Tsuboi T, Okamoto H. Hunger potentiates the habenular winner pathway for social conflict by orexin-promoted biased alternative splicing of the AMPA receptor gene. **Cell Reports** (2020) 31, 107790

8. Shomali SR, Ahmadabadi MN, **Shimazaki H**, Rasuli SN. How does transient signaling input affect the spike timing of postsynaptic neuron near the threshold regime: an analytical study. **Journal of Computational Neuroscience** (2018) 44(2), 147-171

9. Kass RE, Amari S, Arai K, Diekman CO, Diesmann M, Doiron B, Fairhall A, Fiddyment GM, Fukai T, Grün S, Harrison MT, Helias M, Nakahara H, Teramae J, Thomas PJ, Reimers M, Rodu J, Rotstein HG, Shea-Brown E, **Shimazaki H**, Shinomoto S, Yu BM, Kramer MA. Computational Neuroscience: Mathematical and statistical perspectives. **Annual Review of Statistics and Its Application** (2018) 5:8.1–8.32

10. MaBouDi H, **Shimazaki H**, Giurfa M, Chittka L. Olfactory learning without the mushroom bodies: Spiking neural network models of the honeybee lateral antennal lobe tract reveal its capacities in odour memory tasks of varied complexities. **PLoS Computational Biology** (2017) 13(6): e1005551.

11. Donner C, Obermeyer K, **Shimazaki H**. Approximate inference for time-varying interactions and macroscopic dynamics of neural populations. **PLoS Computational Biology** (2017) 13(1): e1005309

12. Mochizuki Y, Onaga T, **Shimazaki H**, Shimokawa T, Tsubo Y, Kimura R, Saiki A, Sakai Y, Isomura Y, Fujisawa S, Shibata K, Hirai D, Furuta T, Kaneko T, Takahashi S, Nakazono T, Ishino S, Sakurai Y, Kitsukawa T, Lee JW, Lee H, Jung MW, Babul C, Maldonado PE, Takahashi K, Arce-McShane FI, Ross CF, Sessle BJ, Hatsopoulos NG, Brochier T, Riehle A, Chorley P, Gruen S, Nishijo H, Ichihara-Takeda S, Funahashi S, Shima K, Mushiake H, Yamane Y, Tamura H, Fujita I, Inaba N, Kawano K, Kurkin S, Fukushima K, Kurata K, Taira M, Tsutsui K, Ogawa T, Komatsu H, Koida K, Toyama K, Richmond BJ, and Shinomoto S. Similarity in neuronal firing regimes across mammalian species. **Journal of Neuroscience** (2016) 36:5736-5747.

13. Chou MY, Amo R, Kinoshita M, Cherng BW, **Shimazaki H**, Agetsuma M, Shiraki T, Aoki T, Takahoko M, Yamazaki M, Higashijima S, and Okamoto H. Social conflict resolution regulated by two dorsal habenular subregions in zebrafish. **Science** (2016) 352(6281) 87-90

14. MaBouDi H, **Shimazaki H**, Amari S, Soltanian-Zadeh H, Representation of higher-order statistical structures in natural scenes via spatial phase distributions. **Vision Research** (2016) 120, 61-73

15. **Shimazaki H**, Sadeghi K, Ishikawa T, Ikegaya Y, Toyoizumi T. Simultaneous silence organizes structured higher-order interactions in neural populations. **Scientific Reports** (2015) 5, 9821.

16. **Shimazaki H**, Amari S, Brown EN, and Gruen S, State-space analysis of time-varying higher-order spike correlation for multiple neural spike train data. **PLOS Computational Biology** (2012) 8(3): e1002385.

17. **Shimazaki H** and Shinomoto S. Kernel bandwidth optimization in spike rate estimation. **Journal of Computational Neuroscience** (2010) 29 (1-2) 171-182 **[384 citations in Google Scholar]**

18. **Shimazaki H** and Shinomoto S. A method for selecting the bin size of a time histogram. **Neural Computation** (2007) 19(6), 1503-1527. **[606 citations in Google Scholar]**

19. **Shimazaki H** and Niebur E. Phase transitions in multiplicative competitive processes. **Physical Review E** (2005) 72(1), 011912.

20. Tsukada M, Aihara T, Kobayashi Y, and **Shimazaki H.** Spatial analysis of spike-timing-dependent LTP and LTD in the CA1 area of hippocampal slices using optical imaging. **Hippocampus** (2005) 15(1), 104-109.

Refereed conference proceedings

21. Donner C, Tagasovska N, He G, Mulleners K, **Shimazaki H**, Obozinski G. Learning interpretable latent dynamics for a 2D airfoil system. International Conference on Learning Representations (ICLR2021) Workshop: Robust and reliable machine learning in the real world. 2021. accepted

22. Gaudreault J, Saxena A, **Shimazaki H**. Online estimation of multiple dynamic graphs in pattern sequences. 2019 International Joint Conference on Neural Networks (IJCNN2019). 10.1109/IJCNN.2019.8852467 **BEST STUDENT AWARD**

23. Gaudreault J and **Shimazaki H**. State-space analysis of an Ising model reveals contributions of pairwise interactions to sparseness, fluctuation, and stimulus coding of monkey V1 neurons. The 27th International Conference on Artificial Neural Networks (ICANN2018), Lecture Notes in Computer Science 11141, 641–651, 2018

24. Donner C and **Shimazaki H.** Approximate inference method for dynamic interactions in larger neural populations. The 23rd International Conference on Neural Information Processing (ICONIP2016), Lecture Notes in Computer Science 9949, 104–110, 2016 **EXCELLENT PAPER AWARD**

25. **Shimazaki H** Single-trial estimation of stimulus and spike-history effects on time-varying ensemble spiking activity of multiple neurons: a simulation study. ELC International Meeting on "Inference, Computation, and Spin Glasses" (ICSG2013). Journal of Physics: Conference Series, 473 012009, 2013.

26. **Shimazaki H**, Amari S, Brown EN, and Gruen S. State-space analysis on time-varying correlations in parallel spike sequences. The 34th International Conference on Acoustics, Speech, and Signal Processing (ICASSP2009). Proc. IEEE ICASSP, 3501-3504, 2009.

27. **Shimazaki H** and Shinomoto S. A recipe for optimizing a time-histogram. Neural Information Processing Systems (NeurIPS2006). Advances in NeurIPS, Vol. 19, 1289-1296, 2007. **SPOTLIGHT POSTER**

28. **Shimazaki H** and Niebur E. Correlated multiplicative modulation in coupled oscillator systems: a model of selective attention. Progress of Theoretical Physics Supplement, No.161 336-339, 2006.

Review papers

29. (In Japanese) **Shimazaki H.** Bayesian and thermodynamic view on dynamics of learning and recognition in organisms. The brain & neural networks (2019) 26(3) 72-98

30. (In Japanese) **Shimazaki H.** The principles of adaptation in recognition and behavior. The brain & neural networks (2018) 25(3) 86-103

31. (In Japanese) **Shimazaki H.** Analysis of multiple neural spike train data using the log-linear model: From stationary to time-varying spike correlation. The brain & neural networks, 8(4) 194-203, 2011

Preprints

32. **Shimazaki H**. The principles of adaptation in organisms and machines II: Thermodynamics of the Bayesian brain. (2020) arXiv:2006.13158

33. Shukla S, **Shimazaki H**, Ganguly U. Structured mean-field variational inference and learning in winner-take-all spiking neural networks. (2019) arXiv:1911.05943

34. MaBouDi H, **Shimazaki H**, Soltanian-Zadeh H, Amari S. Learning Complex Representations from Spatial Phase Statistics of Natural Scenes. *bioRxiv*. (2019) https://doi.org/10.1101/112813 **under revision**

35. **Shimazaki H**. The principles of adaptation in organisms and machines I: machine learning, information theory, and thermodynamics. (2019) arXiv:1902.11233

Book Chapter

36. **Shimazaki H.** Neural Engine Hypothesis. p267-291 In: Chen Z., Sarma S. (eds) Dynamic Neuroscience: Statistics, Modeling, and Control. (2018) Springer, Cham (This is an extended manuscript of "Neurons as an Information-theoretic Engine" *arXiv*:1512.07855, 2015)

37. **Shimazaki H.** Japanese translation of **Principles of Neural Science 5th ed.** Kandel E.R. et al. editors, Appendix F: Theoretical Approaches to Neuroscience: Examples from Single Neurons to Networks by Abbott L.F., Fusi S., and Miller K.D., p1567-1583, Medical Science International Inc., 2014. Original: p1601-1618, McGraw-Hill, 2012.

Awards

1. **Excellent Paper Award at The 23rd International Conference on Neural Information Processing (ICONIP2016)**   **2016 Oct**

2. **Letter of Appreciation from the RIKEN president**   **2009 Oct**

3. **Japanese Neural Network Society Research Award 2009**   **2009 Sep 26**

4. **Japanese Neural Network Society Young Researcher Award 2007**   **2007 Nov 15**

Awards to supervised students
5. **IJCNN 2019 Best Student Award: Jimmy Gaudreault**

6. **ICONIP 2016 Excellent Paper Award: Christian Donner**

Research Grants and Fellowships

1. Grant-in-Aid for Transformative Research Areas A: Cell type census of adaptive neuronal circuits: biological mechanisms of structural and functional organization   2021 Sep – 2026 Mar

2. New Energy and Industrial Technology Development Organization (NEDO): Human-centered Artificial Intelligence Embedded in the Real World   2020 Apr – 2025 Mar

3. MEXT/JSPS KAKENHI Kiban C: Development of statistical analysis methods for visualizing nonlinear activity of large-scale neural populations. Grant Number JP 20K11709   2020 Apr – 2024 Mar

4. Japanese Neural Network Society 30th anniversary grant   2020 Apr – 2021 Mar

5. The grant of Joint Research by the National Institutes of Natural Sciences: Free energy principle of the brain: Implementation and Verification. NINS Program No. 01112005   2019 Apr – 2021 Mar

6. The grant of Joint Research by the National Institutes of Natural Sciences: Tutorial workshop for the free energy principle.   2019 Apr – 2020 Mar

7. The Cooperative Study Program of National Institute for Physiological Sciences 2019 Apr – 2020 Mar

8. Japanese Neural Network Society workshop grant   2018 Apr – 2019 Mar

9. Excellent Young Researchers Overseas Visit Program by JSPS   2009 Dec – 2011 Mar

10. Research Fellowship for Young Scientists by JSPS PD   2008 Apr – 2011 Mar

11. Research Fellowship for Young Scientists by JSPS DC   2006 Apr – 2008 Mar
12. Japan Student Services Organization (Fellowship)   2004 – 2006

13. Solo Snyder Foundation, Johns Hopkins University (Fellowship)   2002 – 2004

14. Murata Overseas Scholarship (Fellowship and Research Grant)   2000 – 2002

Academic service

1. Organisers, International Workshop on Active Inference   2022 Feb – present

2. Action editor, Neural Networks   2020 Jan – present

3. Board member, Japanese Neural Network Society   2018 Mar – 2020 Mar

Selected invited talks

1. Vision Society of Japan: Special session of 'Front of computational approaches to vision and brain science'. Jan 21, 2021. Online. Title: Introduction to theoretical approaches to the brain. (in Japanese)

2. Combining Information theoretic Perspectives on Agency. Jan 28-29, 2020. The University of Tokyo, Japan. Title: The brain as an information-theoretic engine: A new paradigm for quantifying perceptual capacity of neural dynamics.

3. Data Science, Statistics, & Visualisation (DSSV2019) Aug. 13. Doshisha University, Kyoto, Japan. Title: Visualizing dynamics of cooperative activities of neurons for neural coding studies.

4. Brain Science Workshop of Tamagawa Unviersity, Japan. Sep 28, 2017. Host Prof. Yutaka Sakai and Prof Hideo Komatsu. Title: Mathematical and statistical approaches to neural population activity

5. Queen Mary University of London, UK. Jul 4, 2016. Host Prof. Lars Chittka. Title: Population coding of neurons: Dynamics, higher-order interactions, and mechanisms.

6. Bernstein Center of Computational Neuroscience Berlin, Berlin, Germany. Apr 2015. Host Prof. Klaus Obermayer. Title: Simultaneous silence explains structured higher-order interactions of neural populations.

7. ELC International Meeting on "Inference, Computation, and Spin Glasses" (ICSG2013), Sapporo, Japan. Jul 2013. Title: State-space analysis of time-varying higher-order interactions: its applications to neuroscience.

8. The 3rd Mathematical Neuroscience Workshop in School of Mathematics, Institute for Research in Fundamental Sciences (IPM). Tehran, Iran. Mar 2013. Title: The simultaneous silence of neurons explains higher-order interactions in ensemble spiking activity.

9. Neurostatistics Working Group Seminar, Dept. of Biostatistics, Harvard University, Dec 2010. Title: Analysis of dynamic neural spike data: from firing rates to spike correlations.

10. IEEE ICASSP2009, Special Session on `Signal Processing for Neural Spike Trains', Taipei, Taiwan. Apr 2009. Title: State-space analysis on time-varying correlations in parallel spike sequences.

11. NIPS 2008, Workshop on `Statistical Analysis and Modeling of Response Dependencies in Neural Populations', Whistler, Canada. Dec 2008. Title: State-space analysis on time-varying higher-order spike correlations.

12. RIKEN Brain Science Institute Forums, Wako, Japan. Host: Dr. Sonja Gruen. Apr 2007. Title: A recipe for optimizing a time histogram of spike data.

13. The Boadian Seminar at Mind/Brain Institute, Johns Hopkins University. Baltimore, USA. Host: Dr. Ernst Niebur. Mar 2007. Title: A recipe for constructing a peri-stimulus time histogram.

List of all presentations

■ 2022
1. Hideaki Shimazaki. Consciousness and the thermodynamics of the Bayesian brain. International Symposium on Artificial Intelligence and Brain Science 2022. OIST, Japan. Jul 5, 2022 **INVITED TALK**

2. Ken Ishihara, Hideaki Shimazaki. The state-space kinetic Ising model for nonequilibrium neuronal dynamics. NEURO2022. Okinawa, Japan. Jul 2, 2022 **POSTER**

3. Hideaki Shimazaki, Ken Ishihara, Ulises Rodriguez Dominguez, Sai Sumedh Hindupur, Miguel Aguilera, S. Amin Moosavi, Magalie Tatischeff, Jimmy Gaudreault, Christian Donner. State-space analysis for neural population dynamics. Neuro2022. Okinawa, Japan. Jun 30, 2022 **INVITED TALK**

4. Rodriguez Dominguez U and Shimazaki H. Bayesian computation of generic neural binary code by local competition. The 44th Annual Meeting of the Japan Neuroscience Society (Neuro 2021), July 31, 2021. Online. **POSTER**

■ 2021
5. Aguilera M, Moosavi SA, Shimazaki H. An information geometry approach for unifying mean field theories of asymmetric kinetic Ising systems. Entropy 2020: The Scientific Tool of the 21st Century May 7, 2021. Online. **TALK**

6. Shimazaki H. Revealing neuronal population activity by non-stationary and non-equilibrium Ising models. Data-driven biology workshop, Kyoto University, Japan. Mar 23, 2021. Online. **INVITED TALK** (Japanese)

7. Shomali S.R., Rasuli S.N., Shimazaki H. Revealing hidden microcircuits using higher-order interactions of neuronal activity. The 3rd Sharif Neuroscience Symposium Mar 4, 2021. Online. **ORAL PRESENTATION**

8. Shimazaki H. Introduction to theoretical approaches to the brain. Vision Society of Japan. Online. Jan 21, 2021. **INVITED LECTURE** (Japanese)

■ 2020
9. Shomali S.R., Rasuli S.N., Shimazaki H. Higher-order interactions induced by strong shared inputs. 29th Annual Computational Neuroscience Meeting: CNS*2020. Dec 21 **POSTER**

10. Moosavi S.A., Tatischeff M., Zhu B., Shimazaki H. Effects of structured neural correlations in population coding: beneficial or detrimental? Computational and Systems Neuroscience (Cosyne) 2020. Dember, USA. Feb 27 - Mar 1. **POSTER**

11. Shomali S.R., Ahmadabadi M.N., Rasuli S.N., Shimazaki H. Inferring network motifs from neural activity using analytic input-output relation of LIF neurons.Computational and Systems Neuroscience (Cosyne) 2020. Dember, USA. Feb 27 - Mar 1. **POSTER**

12. Shimazaki H. Thermodynamics of the Bayesian brain: A new paradigm for quantifying perceptual capacity of neural dynamics. Computational Principles in Active Perception and Reinforcement Learning in the Brain. Kyoto University, Japan. Feb 13-14, 2020. **INVITED TALK**

13. Shimazaki H. The brain as an information-theoretic engine: A new paradigm for quantifying perceptual capacity of neural dynamics. Combining Information theoretic Perspectives on Agency. The University of Tokyo, Japan. Jan 28-29, 2020. **INVITED TALK**

■ 2019
14. Shimazaki H. Dynamic neural interactions revealed by the state-space Ising model. The 7th International Congress on Cognitive Neurodynamics. Alghero, Italy. Sep 29, 2019. **TALK**

15. Shomali S.R., Ahmadabadi M.N., Rasuli S.N., Shimazaki H. Judging between Excitation and Inhibition: Identifying Local Network Architecture by an Analytic Pre-Post Relation. Bernstein Conference 2019. Berlin, Germany. Sep 18, 2019. **POSTER**

16. Shimazaki H. Visualizing dynamics of cooperative activities of neurons for neural coding studies. Data Science, Statistics, & Visualisation (DSSV2019) Doshisha University, Kyoto, Japan. Aug. 13, 2019 **TALK**

17. Gaudreault J., Saxena A., Shimazaki H. **Online estimation of multiple dynamic graphs in pattern sequences**. The 2019 International Joint Conference on Neural Networks (IJCNN2019), Budapest, Hungary. Jul 14 2019 **TALK** **BEST STUDENT AWARD**

18. Shimazaki H. Network architecture underlying sparse neural activity characterized by structured higher-order interactions. Okinawa Institute of Technology (OIST), Okinawa, Japan. Mar 26 2019 **TALK**

19. Moosavi S.A., Shimazaki H. Role of gain-control and neural correlations in efficient stimulus coding. Consciousness Research Network (CoRN2019), Okazaki, Japan. Feb 23 2019 **POSTER**

20. Tatischeff M., Gaudreault J., Donner C., Shimazaki H.. Thermodynamic analysis of neural populations by the state-space Ising model. Consciousness Research Network (CoRN2019), Okazaki, Japan. Feb 23 2019 **POSTER**

■ 2018
21. Shimazaki H., Tatischeff M., Gaudreault J., Donner C. Thermodynamic analyses of neural populations. Analysis and Synthesis for Human/Artificial Cognition and Behaviour, A satellite workshop of JNNS2018. Okinawa Institute of Science and Technology Graduate University. Oct 22, 2018 **POSTER**

22. Gaudreault J. and Shimazaki H. State-space analysis of an Ising model reveals contributions of pairwise interactions to sparseness, fluctuation, and stimulus coding of monkey V1 neurons. The 27th International Conference on Artificial Neural Networks (ICANN2018), Rhodes, Greek. Oct 5, 2018 **POSTER**

23. Shimazaki H. Neural network architecture that produces sparse population activity. Workshop on multitrack event-trains in neural, social, seismological, and financial data. Karuizawa, Japan. July 7, 2018. **TALK** (In Japanese)

24. Gaudreault J, Saxena A, Shimazaki H. State-space analys of an Ising model reveals contributions of pairwise interactions to sparseness, fluctuation, and stimulus coding of monkey V1 neurons. Mechanism of Brain and Mind, Rusutsu, Hokkaido, Japan. Jan 9, 2018 **POSTER**

■ 2017
25. Shimazaki H. Network architectures underlying variable, sparse population activity of neurons. Fluctuations of event occurrences in a variety of networks. Kyoto, Japan. Nov 15, 2017 **TALK**

26. Shimazaki H. Mathematical and statistical approaches to neural population activity. Brain Science Workshop of Tamagawa University. Isawa-onsen, Yamanashi, Japan. Sep 28, 2017. **INVITED TALK** (In Japanese)

27. Makio Torigoe, Islam Tanvir, Hisaya Kakinuma, Hideaki Shimazaki, Chi Chung Alan Fung, Tazu Aoki, Tomoki Fukai, Hitoshi Okamoto In-vivo imaging of telencephalic neural activities in adult zebrafish performing decision making task in the closed-loop virtual reality environment. Annual Meeting of the Japan Neuroscience Society (Neuro2017). Makuhari Messe, Japan. Jul 23 2017. **INVITED TALK**

■ 2016
28. Donner C. and Shimazaki H., Estimating dynamic functional networks of larger neural populations. Society for Neuroscience 2016. Nov 16, 2016

29. Shomali S.R., Ahmadabadi M.N., Rasuli N. S., Shimazaki H., Exact analysis of spike-timing and higher-order interactions of neurons at the threshold regime suggests network architecture underlying sparse population activity. Society for Neuroscience 2016. Nov 14, 2016

30. Donner C. and Shimazaki H., Large-scale inference of time-varying neural interactions. The 23rd International Conference on Neural Information Processing (ICONIP 2016). Kyoto, Japan. Oct 16, 2016 (Talk by Donner) **EXCELLENT PAPER AWARD**

31. MaBouDi H., Shimazaki H., Lars Chittka L. Modelling elemental learning of honeybees by spiking neural networks. EURBEE 2016. Cluj-Napoca, Romania. Sep 7, 2016 (Talk by MaBouDi)

32. Shimazaki H. Simultaneous silence explains structured higher-order interactions of neural populations. Modeling Neural Activity: Statistics, Dynamical Systems, and Networks, Waikoloa, Hawaii, USA. Jun 22-24 2016, **TALK**

33. Shimazaki H. Toward thermodynamic principles of consciousness. University of Sussex, UK. Jul 7, 2016. **INVITED TALK**

34. Shimazaki H. Higher-order interactions of neural populations. University College London, UK. Jul 5, 2016. **TALK**

35. Shimazaki H. Population coding of neurons: Dynamics, higher-order interactions, and mechanisms. Queen Mary University of London, UK. Jul 4, 2016. **INVITED TALK**

36. Shomali S.R., Ahmadabad M.N., Shimazaki H., Rasuli SN. Exact spike-timing distribution reveals higher-order interactions. CNS*2016. Jeju, South Korea. Jul 2, 2016 (Poster by Shomali) **POSTER (Reviewed)**

37. Shimazaki H. Analysis of network activity of neurons by the dynamic Ising model. International Christian University, Tokyo, Japan. Feb 2, 2016 **INVITED TALK**

38. Shimazaki H. Simultaneous silence explains structured higher-order interactions of neural population. MONA2 - Modelling Neural Activity. Hawaii, USA. Jun 22, 2016 **TALK**

39. Shimazaki H., Peters A.J., Komiyama T., Toyoizumi T. Redundant coding by layer 2/3 neurons of motor cortex during initial motor learning. Mechanism of Brain and Mind, Rusutsu, Hokkaido, Japan. Jan 6-8, 2016 **POSTER**

■ 2015
40. Donner C. and Shimazaki H., Approximation methods for inferring time-varying interactions of a large neural population. Workshop in Statistical Methods for Understanding Neural Systems at Neural Information Processing Systems (NIPS) 2015. Montreal Canada, Dec 11, 2015 **POSTER (Reviewed)**

41. Shimazaki H. Simultaneous silence explains structured higher-order interactions of neural populations. Juelich Research Center. Juelich, Germany. May 5, 2015 **INVITED TALK**

42. Shimazaki H. Simultaneous silence explains structured higher-order interactions of neural populations. Bernstein Center of Computational Neuroscience Berlin. Berlin, Germany. Apr 28, 2015 **TALK**

■ 2014
43. Sharp T., Shimazaki H., Isomura Y., Fukai T. State-space analysis of behaviour- and layer-dependent synchrony in motor cortex during volitional arm movement. Society for Neuroscience (SfN) 2014, Washinton DC, USA. Nov 16, 2014. **POSTER**

44. Sharp T., Shimazaki H., Isomura Y., Fukai T. Behaviour- and layer-dependent synchrony in motor cortex during volitional arm movement. Neuro2014, Yokohama, Japan. Sep 11, 2014. **POSTER**

45. Shomali S.R., Ahmadabadi M.N., Shimazaki H., Rasuli N. S. Theoretical study on spike-timing probability in a pair of pre-post synaptic neurons. Neuro2014, Yokohama, Japan. Sep 11,2014. **POSTER**

46. MaBouDi H., Shimazaki H., Abouzari M., Soltanian-Zadeh H., Amari S. Bimodal distributions of local phase variables in natural images. The 2014 Vision Sciences Society (VSS) Annual Meeting, St. Pete Beach, Florida, USA. May 18, 2014 **POSTER (Reviewed)**

47. Sharp T., Shimazaki H., Isomura Y., Fukai T. Behaviour- and layer-dependent synchrony in motor cortex during volitional arm movement. Workshop on data mining in neuroscience. National Institute of Informatics, Tokyo, Japan. May 28-29, 2014 **TALK**

48. MaBouDi H., Shimazaki H., Abouzari M., Amari S, Soltanian-Zadeh H. Statistical inference for directed phase coupling in neural oscillators. Computational and Systems Neuroscience (Cosyne) 2014. Salt Lake City, USA. Feb 27 **POSTER (Reviewed)**

49. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T. Structured higher-order interactions explain the simultaneous silence of neural populations. Mechanism of Brain and Mind, Rusutsu, Hokkaido, Japan. Jan 8-10, 2014 **POSTER**

■ 2013
50. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T., The simultaneous silence of neurons explains structured higher-order interactions in ensemble spiking activity. Society for Neuroscience (SfN). San Diego, USA. Nov 9-13 **POSTER**

51. Shimazaki H., State-space Analysis of Time-varying Higher-order Interactions: its Applications to Neuroscience. ELC International Meeting on "Inference, Computation, and Spin Glasses" (ICSG2013). Sapporo, Japan. Jul 28 **INVITED TALK**

52. Shimazaki H., Higher-order interactions in population activity of hippocampal CA3 neurons. Workshop on statistical analysis of neurophysiological and clinical data, Kyoto, Japan. Jul 8-9 **TALK**

53. Shimazaki H., Estimating Time-varying Higher-order Neuronal Interactions in Awake Behaving Animals. Modeling Neural Activity: Statistics, Dynamical Systems, and Networks, Lihue, Hawaii, USA. 2013 Jun 26-28 **TALK**

54. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T., The simultaneous silence of neurons explains higher-order interactions in ensemble spiking activity. Neuro2013, Kyoto, Japan. Jun 20 **POSTER**

55. Shimazaki H. Estimating dynamic neural interactions in awake behaving animals. The 3rd Mathematical Neuroscience Workshop in School of Mathematics, Institute for Research in Fundamental Sciences (IPM). Tehran, Iran. Mar 13 **INVITED TALK**

56. Shimazaki H. The Simultaneous Silence of Neurons Explains Higher-Order Interactions in Ensemble Spiking Activity. The 3rd Mathematical Neuroscience Workshop in School of Mathematics, Institute for Research in Fundamental Sciences (IPM). Tehran, Iran. Mar 14 **INVITED TALK**

57. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T. The simultaneous silence of neurons explains structured higher-order interactions in spontaneous spiking activity. Dialog between Neuroscience and Statistics, Institute of Mathematics and Statistics, Tokyo, Japan. Feb 18-19 **TALK**

■ 2012
58. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T. Joint inactivation statistics of population spiking activities. RIKEN BSI Retreat 2012, Karuizawa, Japan. Nov 12-13 **POSTER**

59. Shimazaki H. The simultaneous silence of neurons explains structured higher-order interactions in ensemble spiking activity. RIKEN BSI Lunch Seminar 2012, Wako, Japan. Nov 8 **TALK**

60. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T. Joint inactivation statistics of population spiking activities. Workshop on statistical aspects of neural coding. Nov 1-2. Kyoto University & Ritsumeikan University. **TALK**

61. Shimazaki H. Tracking Dynamic Neural Interactions in Awake Behaving Animals. Workshop on neural information flow, Kyoto University, Kyoto, Japan. Jun 20 **INVITED TALK**

62. Shimazaki H., Sadeghi K., Ikegaya Y., Toyoizumi T. The simultaneous silence of neurons explains higher-order interactions in ensemble spiking activity. Computational and Systems Neuroscience (Cosyne) 2012. Salt Lake City, USA. Feb 23-26 **POSTER (Reviewed)**

■ 2011
63. Shimazaki H., Amari S., Brown E. N., and Gruen S. Dynamics of Higher-order Spike Correlation in an Awake Behaving Monkey: Analysis by a State-space Model. RIKEN BSI Retreat, Karuizawa, Japan. Oct 31 **POSTER**

64. Shimazaki H., Ikegaya Y., and Toyoizumi T. A New Sparse Log-linear Model for Simultaneously Active and Inactive Neurons. RIKEN BSI Retreat, Karuizawa, Japan. Oct 31 **POSTER**

65. Shimazaki H. and Brown E.N. Copula-based Mixture Time-series Model of Continuous and Point Processes for Synthetic Analysis of Neural Signals. RIKEN BSI Retreat, Karuizawa, Japan. Oct 31 **POSTER**

66. Shimazaki H. and Brown E. N. Constructing a joint time-series model of continuous and Bernoulli/Poisson processes using a copula. Computational and Systems Neuroscience (Cosyne) 2011, Salt Lake City, USA. Feb 24-27 **POSTER (Reviewed)**

■ 2010
67. Shimazaki H. Analysis of Dynamic Neural Spike Data: From Firing Rates to Spike Correlations. Neurostatistics Working Group Seminar, Dept. of Biostatistics, Harvard University, Boston, USA. Dec 1 **INVITED TALK**

68. Shimazaki H. Detection of dynamic cell assemblies by the Bayes Factor. Workshop on spatio-temporal neuronal computation, Kyoto University, Kyoto, Japan. Sep 6-7 **INVITED TALK**

69. Shinomoto S*, Shimazaki H, and Shimokawa T. Characterizing neuronal firing with the rate and the irregularity. Neuro2010, Kobe, Japan. Sep 2 S3-10-1-3 **TALK**

70. Shimazaki H., Gruen S., and Amari S. Analysis of subsets of higher-order correlated neurons based on marginal correlation coordinates. Computational and Systems Neuroscience (Cosyne) 2010, Salt Lake City, USA. Feb 25-28 **POSTER (Reviewed)**

■ 2009
71. Shimazaki H., Amari S., Brown E. N., and Gruen S. State-space Model of Dynamic Spike Correlation. Japanese Neural Network Society 2009. Sendai, Japan. Sept. 24-26. TALK+POSTER **Japanese Neural Network Society 2009 Distinguished Research Award**

72. Shimazaki H. Analysis of Dynamic Spike Data: From Spike Rate to Multiple Neuron Spike Correlation. The 6th Brain Lunch Seminar. RIKEN Brain Science Institute, Saitama, Japan. Sep 8. **TALK**

73. Shimazaki H., Amari S., Brown E. N., and Gruen S. Bayes Factor Analysis for Detection of Time-dependent Higher-order Spike Correlations. CNS2009. Berlin, Germany. Jul 18-23 P99 **POSTER**

74. Shimazaki H. and Shinomoto S. Histogram binwidth and kernel bandwidth selection for the Spike-rate estimation. CNS2009. Berlin, Germany. Jul 18-23 P116 **POSTER**

75. Shimazaki H., Amari S., Brown E. N., and Gruen S. Estimating time-varying spike correlations from parallel spike sequences, German-Japanese Workshop "Computational and Systems Neuroscience", Berlin, Germany. May 25-28 **POSTER**

76. Shimazaki H., Amari S., Brown E. N., and Gruen S. State-space Analysis on Time-varying Correlations in Parallel Spike Sequences. IEEE ICASSP2009 Special Session on `Signal Processing for Neural Spike Trains', Taipei, Taiwan. Apr 24 SS-L10.4 **INVITED LECTURE**

77. Shimazaki H., Amari S., Brown E. N., and Gruen S. Detection of non-stationary higher-order spike correlation. Cosyne 2009, Salt Lake City, USA. Feb 26 -Mar 3 II-62 **POSTER (Reviewed)**

■ 2008

78. Shimazaki H., Amari S., Brown E. N., and Gruen S. State-space Analysis on Time-varying Higher-order Spike Correlations. NIPS2008 Workshop on `Statistical Analysis and Modeling of Response Dependencies in Neural Populations', Whistler, Canada. Dec 13 **INVITED TALK**

79. Shimazaki H. and Gruen S. Selecting a state-space model of higher-order correlations in parallel spike trains from competing hierarchical log-linear models. RIKEN BSI Retreat 2008, Karuizawa, Japan. Nov 4-5 **POSTER**

80. Shimazaki H. and Shinomoto S. Spike-rate Estimation with Locally Adaptive Kernel Method. Japanese Neural Network Society 2008, Tsukuba, Japan (In Japanese). Sep 24-26 PS3-4 **SPOTLIGHT POSTER**

81. Shimazaki H. and Gruen S. Estimating time-dependent higher-order interactions in parallel spike trains. Neuro2008, Tokyo, Japan. Jul 9-11 **POSTER**

82. Shimazaki H., Brown E. N. and Gruen S. State-space Analysis on Time-dependent Correlation in Parallel Spike Trains. Statistical Analysis of Neuronal Data (SAND4), Pittsburgh, PA, USA. May 29-31 **POSTER**

■ 2007
83. Shimazaki H. and Gruen S. Estimation of Time-dependent Higher-Order Interactions in Parallel Spike Trains. Riken BSI Retreat, Karuizawa, Japan. Nov 26-28 **POSTER**

84. Shimazaki H. and Shinomoto S. Kernel Width Optimization in the Spike-rate Estimation. Neural Coding 2007, Montevideo, Uruguay. Nov 7 POSTER **BEST POSTER AWARD**

85. Shimazaki H. and Shinomoto S. Optimization of a Histogram of Spike Data. Neuro2007, Yokohama, Japan. Sep 11 P2-k22 **POSTER**

86. Shimazaki H. A Recipe for Optimizing a Time Histogram of Spike Data. Riken BSI Forums at RIKEN Brain Science Institute, Wako, Japan. Host: Sonja Gruen. Apr 17 **INVITED TALK**

87. Shimazaki H. A recipe for constructing a Peri-stimulus Time Histogram. The Boadian Seminar at Mind/Brain Institute. Johns Hopkins University, Baltimore, USA. Host: Ernst Niebur. Mar 1 **INVITED TALK**

88. Shimazaki H. and Shinomoto S. A recipe for optimizing a time-histogram with variable bin sizes. Computational and Systems Neuroscience 2007, Salt Lake City, USA. Feb 22-27 **POSTER (Reviewed)**

■ 2006
89. Shimazaki H. and Shinomoto, S. A recipe for optimizing a time-histogram. Neural Information Processing Systems, Whistler, B. C. Dec 4-9 **POSTER (Reviewed) SPOTLIGHT POSTER**

90. Shimazaki H. A method to optimize a time histogram by correcting onset latencies of spike sequences Japanese Neural Network Society 2006, Nagoya, Japan. Sep 1-2 (In Japanese) O4-1 **TALK＋POSTER Japanese Neural Network Society 2007 Young Researcher Award**

91. Shimazaki H. Self-organized criticality by natural selection. Frontiers in Dynamics: Physical and Biological Systems Tokyo, Japan. May 22-24, 2006, **POSTER**

92. Shimazaki H. and Shinomoto S. Recipes for constructing an optimal time histogram. Statistical Analysis of Neuronal Data (SAND3) Pittsburgh, PA, USA. May 12-13, 2006, **POSTER**

■ 2005
93. Shimazaki H. and Shinomoto S. A recipe for making a time histogram with an optimal bin width from spike sequences. Japanese Neural Network Society 2005, Kagoshima, Japan (In Japanese) **SPOTLIGHT POSTER**