

# Yuji Kawai, Ph.D.

ASSOCIATE PROFESSOR

*The University of Osaka, 1-1 Yamadaoka, Suita, Osaka 565-0871, Japan*

✉ [kawai@otri.osaka-u.ac.jp](mailto:kawai@otri.osaka-u.ac.jp) | 🏠 <http://www.er.ams.eng.osaka-u.ac.jp/kawai/hp/>

Dr. Yuji Kawai has been studying mechanisms of neural information processing in the brain and cognitive development of children by constructing them using computer simulators and robots. He designs recurrent neural networks inspired by structure and function of the human brains for understanding of the brains and applications to artificial intelligence and robots.

## Career

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| April 2023 – present    | <b>Associate Professor</b> , Institute for Open and Transdisciplinary Research Initiatives, the University of Osaka                     |
| April 2021 – March 2023 | <b>Specially Appointed Associate Professor</b> , Institute for Open and Transdisciplinary Research Initiatives, the University of Osaka |
| April 2020 – March 2021 | <b>Specially Appointed Associate Professor</b> , Office of Management and Planning, the University of Osaka                             |
| April 2019 – March 2020 | <b>Specially Appointed Lecturer</b> , Institute for Open and Transdisciplinary Research Initiatives, the University of Osaka            |
| April 2017 – March 2019 | <b>Assistant Professor</b> , Graduate School of Engineering, the University of Osaka                                                    |
| April 2016 – March 2017 | <b>Specially Appointed Assistant Professor</b> , Graduate School of Engineering, the University of Osaka                                |
| April 2013 – March 2016 | <b>Research Fellow of the Japan Society for the Promotion Science (DC1)</b> , Graduate School of Engineering, the University of Osaka   |

## Education

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| April 2013 – March 2016 | <b>Ph.D. course</b> , Department of Adaptive Machine Systems, Graduate School of Engineering, the University of Osaka                |
| April 2011 – March 2013 | <b>Master course</b> , Department of Adaptive Machine Systems, Graduate School of Engineering, the University of Osaka               |
| April 2009 – March 2011 | <b>Bachelor course</b> , Division of Mechanical, Materials and Manufacturing Science, School of Engineering, the University of Osaka |
| April 2004 – March 2009 | <b>High school – Bachelor course</b> , Department of Control Engineering, National Institute of Technology, Matsue College           |

## Societies

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- IEEE Computational Intelligence Society.
- The Robotics Society of Japan.
- The Japanese Society of Artificial Intelligence.
- Japanese Neural Network Society.
- Japanese Cognitive Science Society.
- The Japanese Society of Baby Science

## Awards

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- 2025 **Outstanding Research Award**, Japanese Neural Network Society
- 2023 **Young Researcher Award (IEICE Neurocomputing)**, IEEE Computational Intelligence Society Japan Chapter
- 2019 **JSAI Annual Conference Award**, The Japanese Society for Artificial Intelligence
- 2018 **JSAI Annual Conference Award**, The Japanese Society for Artificial Intelligence  
**Research Award**, Japanese Neural Network Society  
**Babybot Challenge Paper Award**, The 8th IEEE Joint International Conference on Development and Learning and on Epigenetic Robotics
- 2017 **Babybot Challenge Participation Award**, The 7th IEEE Joint International Conference on Development and Learning and on Epigenetic Robotics  
**The 1st Place for RoboCup Japan Open 2017 Soccer SPL League**, RoboCup Japan
- 2014 **Best Presentation Award**, The 31st Annual Conference of the Japanese Cognitive Science Society
- 2013 **JSAI Incentive Award**, The Japanese Society for Artificial Intelligence  
**RoboCup Research Award**, RoboCup Japan
- 2012 **Best Paper Award Finalist**, The 16th Annual RoboCup International Symposium  
**AI Award**, The 35th JSAI SIG Challenge  
**Microsoft Student Travel Award**, The 1st Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics
- 2008 **Hatakeyama Award**, The Japan Society of Mechanical Engineers

## Competitive Research Funds

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### PRINCIPAL INVESTIGATOR

- April 2025 – March 2027 **JSPS Grants-in-Aid for Transformative Research Areas (A) (Publicly Offered Research)**, Reservoir computing-based adaptation in body-control-environment coupled dynamical systems under unknown and perturbed conditions, Project number: 25H02612.
- October 2023 – March 2027 **JST PRESTO**, Computational studies of movements, cognition, and emotion by whole-brain prediction of the cerebellum, Project number: 25H02612.
- April 2013 – March 2016 **JSPS Grant-in-Aid for JSPS Fellows**, Mirror neuron system by sensorimotor abstraction based on reward, Project number: 25-756.

### CO-INVESTIGATOR

- April 2025 – March 2030 **JSPS Grants-in-Aid for Transformative Research Areas (A)**, Designing artificial faces and bodies with functional expression structure, Project number: 25H01236, Project leader: Hisashi Ishihara.
- October 2018 – September 2021 **JSPS Topic-Setting Program to Advance Cutting-Edge Humanities and Social Sciences Research (Responding to Real Society)**, Creating fundamental concepts of society and value based on technology and brain science, Project number: JSPS00118070707, Project leader: Kazuya Matsuura.
- October 2017 – March 2024 **JST CREST**, An exploration of the principle of emerging interactions in spatiotemporal diversity, Project number: JPMJCR17A4, Project leader: Ichiro Tsuda.
- June 2017 – March 2020 **MIC**, R&D for Computing Platform Inspired by Human Brain Cognition, Project number: 17936067, Project leader: Masayuki Murata.

## Publications

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### ARTICLES IN JOURNALS

- Yuji Kawai**, Shinya Fujii, and Minoru Asada, “Modeling the rhythmic complexity of professional drumming with an oscillation-driven reservoir computer,” *Cognitive Neurodynamics*, Vol. 20, 140, 2026.
- Yuji Kawai**, Hiroshi Atsuta, and Minoru Asada, “Leaky extreme learning machines for adaptive tracking of robot arms: A cerebellum-inspired system for position and torque corrections,” *IEEE Access*, Vol. 14, pp. 48612–48632, 2026.
- Yuji Kawai**, Takashi Morita, Jihoon Park, and Minoru Asada, “Oscillations enhance time-series prediction in reservoir computing with feedback,” *Neurocomputing*, Vol. 648, 130728, 2025.
- Yuji Kawai**, Jihoon Park, and Minoru Asada, “Reservoir computing using self-sustained oscillations in a locally connected neural network,” *Scientific Reports*, Vol. 13, 15532, 2023.
- Yuji Kawai** and Minoru Asada, “Spatiotemporal motor learning with reward-modulated Hebbian plasticity in modular reservoir computing,” *Neurocomputing*, Vol. 558, 126740, 2023.
- Yuji Kawai**, Tomohito Miyake, Jihoon Park, Jiro Shimaya, Hideyuki Takahashi, and Minoru Asada, “Anthropomorphism-based causal and responsibility attributions to robots,” *Scientific Reports*, Vol. 13, 12234, 2023.
- Yuji Kawai**, Jihoon Park, Ichiro Tsuda, and Minoru Asada, “Learning long-term motor timing/patterns on an orthogonal basis in random neural networks,” *Neural Networks*, Vol. 163, pp. 298–311, 2023.
- Jihoon Park, **Yuji Kawai**, and Minoru Asada, “Spike timing-dependent plasticity under imbalanced excitation and inhibition reduces the complexity of neural activity,” *Frontiers in Computational Neuroscience*, Vol. 17, 1169288, 2023.
- Yuji Kawai**, Kazuki Tachikawa, Jihoon Park, and Minoru Asada, “Compensated integrated gradients for reliable explanation of electroencephalogram signal classification,” *Brain Sciences*, Vol. 12, No. 7, 849, 2022.
- Yuji Kawai**, Yuji Oshima, Yuki Sasamoto, Yukie Nagai, and Minoru Asada, “A computational model for child inferences of word meanings via syntactic categories for different ages and languages,” *IEEE Transactions on Cognitive and Developmental Systems*, Vol. 12, No. 3, pp. 401–416, 2020.
- Jihoon Park, Koki Ichinose, **Yuji Kawai**, Junichi Suzuki, Minoru Asada, and Hiroki Mori, “Macroscopic cluster organizations change the complexity of neural activity,” *Entropy*, Vol. 21, No. 2, 214, 2019.
- Yuji Kawai**, Jihoon Park, and Minoru Asada, “A small-world topology enhances the echo state property and signal propagation in reservoir computing,” *Neural Networks*, Vol. 112, pp. 15–23, 2019.
- Yuji Kawai**, Yukie Nagai, and Minoru Asada, “Prediction error in the PMd as a criterion for biological motion discrimination: A computational account,” *IEEE Transactions on Cognitive and Developmental Systems*, Vol. 10, No. 2, pp. 237–249, 2018.
- Yuji Kawai**, Yuji Oshima, and Minoru Asada, “Errors in children’s speech originating from undifferentiated grammatical categories: A model for overproduction of an English past-tense morpheme and a Japanese case particle,” *Cognitive Studies*, Vol. 24, No. 1, pp. 52–66, 2017.
- Yuji Kawai**, Yuji Oshima, Yuki Sasamoto, Yukie Nagai, and Minoru Asada, “A model for syntactic development of children: Acquisition processes of syntactic categories reflecting structure of Japanese, English, and Chinese languages,” *Cognitive Studies*, Vol. 22, No. 3, pp. 475–479, 2015.
- Noriaki Kouda, **Yuji Kawai**, and Nobuyuki Matsui, “RCE neural network with a RBF output function and its performance,” *Transactions of the Society of Instrument and Control Engineers*, Vol. 45, No. 11, pp. 620–627, 2007.

### PEER-REVIEWED INTERNATIONAL CONFERENCES (FULL PAPERS)

- Yuji Kawai**, Hiroshi Atsuta, and Minoru Asada, “Sculpting deep attractors in reservoir networks via Oja’s plasticity,” in *Proceedings of the 2026 International Joint Conference on Neural Networks*, pp. 1–7, Jun. 2026.
- Jihoon Park, **Yuji Kawai**, and Minoru Asada, “Frequency specific effects of oscillatory inputs on timing and chaotic time-series learning in spiking reservoir computing,” in *Proceedings of the 32nd International Conference on Neural Information Processing*, pp. 514–528, Nov. 2025.
- Yuji Kawai**, Shinya Fujii, and Minoru Asada, “Slow feature oscillation enhances reservoir computing for learning long-period patterns,” in *Proceedings of the 2025 International Joint Conference on Neural Networks*, pp. 1–7, Jul. 2025.

- Minoru Asada and **Yuji Kawai**, “Advancing cognitive developmental robotics: Robot pain as a bridge from embodiment to social interaction—A framework for ethical and societal integration—,” in *Proceedings of The 2025 International Conference on the AI Revolution: Research, Ethics, and Society*, pp. 488–502, Apr. 2025.
- Yuji Kawai**, Takashi Morita, Jihoon Park, and Minoru Asada, “Oscillation-driven reservoir computing for long-term replication of chaotic time series,” *Artificial Neural Networks and Machine Learning – ICANN 2024 Part X*, pp. 129–141, Sep. 2024.
- Yuji Kawai**, Hiroshi Atsuta, and Minoru Asada, “Adaptive robot control using modular reservoir computing to minimize multimodal errors,” In *Proceedings of the 2024 International Joint Conference on Neural Networks*, Jul. 2024.
- Hiroshi Atsuta, **Yuji Kawai**, and Minoru Asada, “Enhancement of the robustness of redundant robot arms against perturbations by inferring dynamical systems using echo state networks,” In *Proceedings of the 2024 International Joint Conference on Neural Networks*, Jul. 2024.
- Yuji Kawai**, Jihoon Park, Ichiro Tsuda, and Minoru Asada, “Self-organization of a dynamical orthogonal basis acquiring large memory capacity in modular reservoir computing,” In *Artificial Neural Networks and Machine Learning – ICANN 2022*, pp. 635–646, Sep. 2022.
- Tomohito Miyake, **Yuji Kawai**, Jihoon Park, Jiro Shimaya, Hideyuki Takahashi, and Minoru Asada, “Mind perception and causal attribution for failure in a game with a robot,” In *Proceedings of the 28th IEEE International Conference on Robot and Human Interactive Communication*, TuCT1.2, Oct. 2019.
- Yuji Kawai**, Tatsuhiko Inatani, Takako Yoshida, and Kazuya Matsuura, “Exploring future rules for AIs with citizens using a fictitious case video: A workshop report,” In *Proceedings of the International Workshop on Envision of Acceptable Human Agent Interaction based on Science Fiction at HAI 2019*, Oct. 2019.
- Kazuki Tachikawa, **Yuji Kawai**, Jihoon Park, and Minoru Asada, “Effectively interpreting electroencephalogram classification using the Shapley sampling value to prune a feature tree,” In *Proceedings of the 27th International Conference on Artificial Neural Networks*, pp. 672–681, Oct. 2018.
- Yuji Kawai**, Tomohiro Takimoto, Jihoon Park, and Minoru Asada, “Efficient reward-based learning through body representation in a spiking neural network,” In *Proceedings of the 8th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 198–203, Sep. 2018. **(Babybot Challenge Paper Award)**
- Yuji Kawai**, Tatsuya Tokuno, Jihoon Park, and Minoru Asada, “Echo in a small-world reservoir: time-series prediction using an economical recurrent neural network,” In *Proceedings of the 7th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 126–131, Sep. 2017.
- Tomohiro Takimoto, **Yuji Kawai**, Jihoon Park, and Minoru Asada, “Self-organization based on auditory feedback promotes acquisition of babbling,” In *Proceedings of the 7th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 120–125, Sep. 2017. **(Babybot Challenge Participation Award)**
- Koki Ichinose, Jihoon Park, **Yuji Kawai**, Junichi Suzuki, Minoru Asada, and Hiroki Mori, “Local over-connectivity reduces the complexity of neural activity: toward a constructive understanding of brain networks in patients with autism spectrum disorder,” In *Proceedings of the 7th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 233–238, Sep. 2017.
- Yuji Kawai**, Minoru Asada, and Yukie Nagai, “A model for biological motion detection based on motor prediction in the dorsal premotor area,” In *Proceedings of the 4th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 241–247, Oct. 2014.
- Yuji Kawai**, Yuji Oshima, Yuki Sasamoto, Yukie Nagai, and Minoru Asada, “Computational model for syntactic development: Identifying how children learn to generalize nouns and verbs for different languages,” In *Proceedings of the 4th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, pp. 78–84, Oct. 2014.
- Yuji Kawai**, Yukie Nagai, and Minoru Asada, “Perceptual development triggered by its self-organization in cognitive learning,” In *Proceedings of the 2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 5159–5164, Oct. 2012.
- Yuji Kawai**, Jihoon Park, Takato Horii, Kazuaki Tanaka, Hiroki Mori, Yukie Nagai, Takashi Takuma, and Minoru Asada, “Throwing skill optimization through synchronization and desynchronization of degree of freedom,” In *Proceedings of the 16th Annual RoboCup International Symposium*, Jun. 2012. **(Best Paper Award Finalist; Research Award of the RoboCup Japan Open)**
- Yukie Nagai, **Yuji Kawai**, and Minoru Asada, “Emergence of mirror neuron system: Immature vision leads to self-other correspondence,” In *Proceedings of the 1st Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*, Aug. 2011. **(Microsoft Student Travel Award)**

## INVITED TALKS

**Yuji Kawai**, “How do neural networks measure time? Exploring reservoir computing approaches,” *ICONIP 2025 Workshop Frontiers and Hardware Applications of Neural Network Models*, Okinawa, Japan, November 24, 2025.

**Yuji Kawai**, “Oscillations as the key to learn time series: A computational approach from simple timing to complex rhythms,” *CiNet Friday Lunch Seminar*, Osaka, Japan, September 27, 2024.

**Yuji Kawai**, “Learning model of motor timing and patterns using a modular random neural network,” *CiNet Friday Lunch Seminar*, Osaka, Japan, May 20, 2022.