

Yoshitaka Saiki

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WORKING EXPERIENCE

- Hitotsubashi University**, Graduate School of Business Administration
 - Professor Apr 2020 – Present
 - Associate Professor Apr 2013 – Mar 2020
- University of Maryland**, Institute for Physical Science and Technology
 - Visiting Scholar Mar 2017 – Mar 2019
- Japan Science and Technology Agency (JST)**, PRESTO
 - PRESTO Researcher Oct 2016 – Mar 2020
- Hokkaido University**, Graduate School of Science, Department of Mathematics
 - Assistant Professor Sep 2010 – Mar 2013
 - Postdoctoral Researcher Apr 2010 – Aug 2010
- Kyoto University**, Research Institute for Mathematical Sciences (RIMS)
 - JSPS Postdoctoral Researcher Apr 2007 – Mar 2010
- Keio University**, Faculty of Science and Technology, Department of Mathematics
 - Research Associate (COE Postdoctoral Researcher) Apr 2006 – Mar 2007

EDUCATION

- The University of Tokyo**
 - Ph.D. in Mathematical Sciences Apr 2002 – Mar 2006
 - Thesis: Numerical study about a chaotic dynamical system based on unstable periodic orbits
 - Advisers: Prof. Tetsuji Tokihiro, Prof. Junkichi Satsuma, Prof. Michio Yamada
 - Focus: Dynamical system, Computation, Periodic orbits.
 - M.S. in Mathematical Sciences Apr 2000 – Mar 2002
 - Thesis: Construction and Applications of Spatio-temporal Continuous Wavelet Transforms accompanied with Scale invariances of Differential Equations
 - Adviser: Prof. Michio Yamada
 - Focus: Wavelet analysis, Computation.
 - Bachelor of Liberal Arts Apr 1996 – Mar 2000

AWARDS & SCHOLARSHIPS

- JSPS postdoctoral Fellow Apr 2007 – Mar 2010
- FAPESP Fellow Jul 2006 – Aug 2006

GRANTS

- Principal Investigator**
 - JSPS Grant-in-Aid for Scientific Research (B) “New developments in fluid dynamics research based on dynamical systems theory” 2024 – 2028
¥18,590,000 (Direct Cost: ¥14,300,000, Indirect Cost: ¥4,290,000)
 - JSPS Establishing data descriptive science and its cross-disciplinary applications “Data-driven modeling of ordinary differential equations using regression” 2023 – 2025
¥4,680,000 (Direct Cost: ¥3,600,000, Indirect Cost: ¥1,080,000)
 - JSPS Bilateral Open Partnership Joint Research Projects “Dynamical system and reservoir computing” 2022 – 2024
¥3,800,000
 - JSPS Grant-in-Aid for Challenging Exploratory Research “Expediting and Elaborating Business Forecast Using Machine Learning” 2021 – 2024
¥6,240,000 (Direct Cost: ¥4,800,000 Indirect Cost: ¥1,440,000)
 - JSPS Fostering Joint International Research (B) “Intermittency due to hetero-chaotic property and its inference” 2019 – 2024
¥18,070,000 (Direct Cost: ¥13,900,000 Indirect Cost: ¥4,170,000)
 - JSPS Grant-in-Aid for Scientific Research (C) “Fast Computation of Birkhoff Average along a Quasi-periodic Orbit and its Applications” 2017 – 2022
¥4,420,000 (Direct Cost: ¥3,400,000 Indirect Cost: ¥1,020,000)

- JST PRESTO “Construction of a synchronization theory based on hetero-dimensional cycle: Toward an understanding of complex phenomena” 2016 – 2019
¥24,609,000 (Direct Cost: ¥18,930,000 Indirect Cost: ¥5,679,000)
- JSPS Grant-in-Aid for Challenging Exploratory Research “Mathematical characterization of chaotic itinerancy” 2014 – 2016
¥3,770,000 (Direct Cost: ¥2,900,000 Indirect Cost: ¥870,000)
- JSPS Grant-in-Aid for Young Scientists (B) “Analysis of non-hyperbolic systems through unstable periodic orbits” 2011 – 2013
¥4,290,000 (Direct Cost: ¥3,300,000 Indirect Cost: ¥990,000)
- JSPS Grant-in-Aid for JSPS Fellows “Large-scale numerical calculation of chaotic systems through unstable periodic orbits and its applications” 2007 – 2010
¥3,300,000 (Direct Cost: ¥3,300,000)

Co-Investigator

- JSPS Grant-in-Aid for Scientific Research (A) “Creation of machine learning theory for solving turbulent flow closure problems through collaboration of physics and mathematics” 2024 – 2029
- JSPS Grant-in-Aid for Scientific Research (C) “Construction and exploration of a nonlinear economic dynamic model in which time evolution rules change dynamically” 2024 – 2027
- JSPS Grant-in-Aid for Scientific Research (C) “Data analysis and computation of regional business cycles” 2019 – 2022
- JSPS Grant-in-Aid for Challenging Exploratory Research “Construction of mathematical models for long-term forecast of atmospheric variation by climate time-series” 2013 – 2015
- JSPS Grant-in-Aid for Challenging Exploratory Research “Understanding Synchronization of Business Cycles Using Wavelet Analysis and Nonlinear Coupled Oscillator Models” 2012 – 2014

PROFESSIONAL AFFILIATIONS & ACTIVITIES

The Mathematical Society of Japan

- Member 2009 – Present
- Councillor 2010
- Delegate 2011
- Editor (Sugaku Tushin) 2010 – 2011
- Editor (Sugaku) 2022 – Present

The Japan Society for Industrial and Applied Mathematics

- Member 2006 – Present
- Editor 2014 – 2015

The Japanese Society for Mathematical Economics

- Member 2006 – Present
- Councillor 2017 – 2021

Japan Society of Monetary Economics

- Member 2013 – Present

PUBLICATIONS

JOURNALS

Peer-reviewed journal papers

- [35] H. Kato, M. U. Kobayashi, Y. Saiki and J. A. Yorke, “A laminar chaotic saddle within a turbulent attractor,” *Physical Review E (Letter)*, 110, L052202, 2024 (published Nov 7).
- [34] M. U. Kobayashi, K. Nakai and Y. Saiki, “Lyapunov analysis of data-driven models of high dimensional dynamics using reservoir computing: Lorenz-96 system and fluid flow,” *Journal of Physics: Complexity*, 5 025024, 2024 (published June 17).
- [33] M. Muto and Y. Saiki, “Synchronization of US dollar and Euro, US dollar and Japanese yen based on purchasing power parity: Synchronization analysis using Hilbert transform,” *North American Journal of Economics and Finance*, 74, 102191, 2024 (published May 30).
- [32] M. Inubushi, Y. Saiki, M. U. Kobayashi, S. Goto, Characterizing Data Assimilation in Navier-Stokes Turbulence with Transverse Lyapunov Exponents, *Physical Review Letters* 131(25), 254001: 1-6, 2023 (published Dec 18).

- [31] N. Tsutsumi, K. Nakai and Y. Saiki, Constructing low-dimensional ordinary differential equations from chaotic time series of high/infinite-dimensional systems using radial function-based regression, *Physical Review E*, 108(5), 054220, 2023 (published Oct 31).
- [30] Y. Saiki, H. Takahasi and J. A. Yorke, “Hausdorff dimension of Cantor intersections and robust heterodimensional cycles for heterochaos horseshoe maps,” *SIAM Journal on Applied Dynamical Systems* 22(3), 1852-1876, 2023 (published July 28).
- [29] M. Muto, T. Onozaki and Y. Saiki, “Regional Synchronization during Economic Contraction: The Case of the U.S. and Japan,” *Applied Economics* 55(30), 3472-3486, 2023 (published online Sep 5, 2022, published May 1, 2023).
- [28] Y. Saiki, H. Takahasi and J. A. Yorke, “The twisted baker map,” *Nonlinearity* 36, 1776-1788, 2023 (published Feb 7).
- [27] N. Tsutsumi, K. Nakai and Y. Saiki, “Constructing differential equations using only a scalar time-series about continuous time chaotic dynamics” *Chaos* 32(9), 091101, 2022 (published online Sep 12).
- [26] M. U. Kobayashi, K. Nakai, Y. Saiki and N. Tsutsumi, “Dynamical system analysis of a data-driven model constructed by reservoir computing,” *Physical Review E*, 104(4), 044215:1-7, 2021 (published online Oct 28).
- [25] Y. Saiki, H. Takahasi and J. A. Yorke, “Piecewise-linear maps with heterogeneous chaos,” *Nonlinearity* 34(8), 5744-5761, 2021 (published July 13).
- [24] K. Nakai and Y. Saiki, “Machine-learning construction of a model for a macroscopic fluid variable using the delay-coordinate of a scalar observable,” *Discrete and Continuous Dynamical Systems Series S* 14(3), 1079-1092, 2021 (published March).
- [23] S. Das, Y. Saiki, E. Sander and J. A. Yorke, “Solving the Babylonian Problem of quasiperiodic rotation rates,” *Discrete and Continuous Dynamical Systems Series S* 12(8), 2279-2305, 2019 (published online Jan 6).
- [22] Y. Saiki and J. A. Yorke, “Quasiperiodic orbits in Siegel disks/balls and the Babylonian problem,” *Regular and Chaotic Dynamics* 23(6), 735-750, 2018 (published Nov 29).
- [21] Y. Saiki, M. F. Sanjuán and J. A. Yorke, “Low-dimensional paradigms for high-dimensional hetero-chaos,” *Chaos* 28(10), 103110:1-7, 2018 (published online Oct 18).
- [20] K. Nakai and Y. Saiki, “Machine-learning inference of fluid variables from data using reservoir computing,” *Physical Review E* 98(2), 023111:1-6, 2018 (published online Aug 31).
- [19] N. Nakano, M. Inatsu, S. Kusuoka and Y. Saiki, “Empirical evaluated SDE modelling for dimensionality reduction systems and its predictability estimates,” *Japan Journal of Industrial and Applied Mathematics* 35(2), 553-589, 2018 (published online Feb 23/ published July).
- [18] K. Esashi, T. Onozaki, Y. Saiki and Y. Sato, “Intermittent transition between synchronization and desynchronization in multi-regional business cycles,” *Structural Change and Economic Dynamics* 44, 68-76, 2018 (published March 17).
- [17] S. Das, Y. Saiki, E. Sander and J. A. Yorke, “Quantitative Quasiperiodicity,” *Nonlinearity* 30(11), 4111-4140, 2017 (published October 11).
- [16] M. U. Kobayashi and Y. Saiki, “Network analyses of chaotic systems through unstable periodic orbits,” *Chaos* 27(8), 081103:1-6, 2017 (published August 23).
- [15] Y. Saiki, E. Sander and J. A. Yorke, “Generalized Lorenz Equations on a Three-Sphere,” *European Physical Journal Special Topics* 226(9), 1751-1764, 2017 (published June 21).
- [14] S. Das, C. B. Dock, Y. Saiki, M. Salgado-Flores, E. Sander, J. Wu and J. A. Yorke, “Measuring quasiperiodicity,” *Europhysics Letters* 114(4), 40005:1-6, 2016.
- [13] Y. Saiki, M. Yamada, A. Chian, R. Miranda and E. Rempel, “Reconstruction of chaotic saddles by classification of unstable periodic orbits: Kuramoto-Sivashinsky equation,” *Chaos* 25(10), 103123:1-6, 2015.
- [12] M. U. Kobayashi and Y. Saiki, “Manifold structures of unstable periodic orbits and the appearance of periodic windows in chaotic systems,” *Physical Review E* 89(2), 022904:1-6, 2014.

- [11] Y. Saiki and K. Ishiyama, "Recognition of transition patterns in a business cycle model using unstable periodic orbits," *International Journal of Bifurcation and Chaos* 21(4), 1203-1214, 2011.
- [10] Y. Saiki, A. Chian and H. Yoshida, "Economic intermittency in a two-country model of business cycles coupled by investment," *Chaos, Solitons and Fractals* 44(6), 418-428, 2011.
- [9] Y. Saiki and M. U. Kobayashi, "Numerical identification of nonhyperbolicity of the Lorenz system through Lyapunov vectors," *JSIAM Letters* 2, 107-110, 2010.
- [8] A. Chian, R. Miranda, E. Rempel, Y. Saiki and M. Yamada, "Amplitude-Phase Synchronization at the Onset of Permanent Spatiotemporal Chaos," *Physical Review Letters* 104(25), 254102:1-4, 2010.
- [7] Y. Saiki and M. Yamada, "Reply to "Comment on 'Time averaged properties of unstable periodic orbits and chaotic orbits in ordinary differential equation systems'",," *Physical Review E* 81(1), 019202:1-2, 2010.
- [6] Y. Saiki and M. Yamada, "Time averaged properties of unstable periodic orbits and chaotic orbits in ordinary differential equation systems," *Physical Review E* 79(1),015201:1-4, 2009.
- [5] Y. Saiki and M. Yamada, "Time averaged properties along unstable periodic orbits and chaotic orbits in two map systems," *Nonlinear Processes in Geophysics* 15, 675-680, 2008.
- [4] M. Yamada and Y. Saiki, "Chaotic properties of a fully developed model turbulence," *Nonlinear Processes in Geophysics* 14, 631-640, 2007.
- [3] Y. Saiki, "Numerical detection of unstable periodic orbits in continuous-time dynamical systems with chaotic behaviors," *Nonlinear Processes in Geophysics* 14, 615-620, 2007.
- [2] K. Ishiyama and Y. Saiki, "Unstable Periodic Orbits embedded in a Chaotic Economic Dynamics Model: A Typical Structure of a Generalized Goodwin Model," *Applied Economics Letters* 12(12), 749-753, 2005.
- [1] K. Ishiyama and Y. Saiki, "Unstable periodic orbits and chaotic economic growth," *Chaos, Solitons and Fractals* 26(1), 33-42, 2005.

Invited review papers

- [2] Y. Saiki, "Unstable periodic orbits embedded in ordinary differential equation systems: properties and numerical detection," *Keio journal of economics* 101(3), 93-109, 2008 (in Japanese).
- [1] Y. Saiki, "Extraction unstable cycles from ordinary differential equation systems," *Seminar on Mathematical Sciences Keio University* 37, 19-34, 2008.

Proceeding papers

- [5] N. Nakano, M. Inatsu, S. Kusuoka, Y. Saiki, "Time-series analysis and predictability estimates by empirical SDE modelling," *Proceedings of the ISCIE International Symposium on Stochastic Systems Theory and its Applications*, 332-339, 2016.
- [4] S. Das, Y. Saiki, E. Sander and J. A. Yorke, "Quasiperiodicity: Rotation Numbers," Chapter 7, *The Foundations of Chaos Revisited: From Poincare to Recent Advancements (Understanding Complex Systems)*, Springer, 103-117, 2016.
- [3] Y. Saiki, "Unstable periodic orbits in a nonhyperbolic system: Cycle expansion for the Henon map," *Reports of RIAM Symposium* 25AO-S2, 91-100, 2014 (in Japanese).
- [2] Y. Saiki and M. Yamada, "Time Averaged Properties Along Unstable Periodic Orbits of the Kuramoto-Sivashinsky Equation," *Nankai Series in Pure, Applied Mathematics and Theoretical Physics* Volume 10, World Scientific, 145-154, 2013.
- [1] K. Ishiyama and Y. Saiki, "Unstable Periodic orbits and chaotic transitions among growth patterns of an economy," *the Practical Fruits of Econophysics: Proceedings of the Third Nikkei Econophysics Symposium*, Springer (H.Takayasu Ed.), 339-343, 2006.

Preprints/Papers in preparation

- [5] K. Nakai and Y. Saiki, Data-driven modeling from biased small training data using periodic orbits, *submitted*.
- [4] T. Suematsu, K. Nakai, T. Yoneda, D. Takasuka, T. Jinno, Y. Saiki and H. Miura, "Machine learning prediction of the MJO extends beyond one month," *submitted*.
- [3] M. Muto, T. Onozaki and Y. Saiki, "Identifying deterministic behavior in exchange rate volatility time series using machine learning," *submitted*.

- [2] N. Tsutsumi and K. Nakai and Y. Saiki, “Data-driven ODE modeling of the high-frequency complex dynamics of a fluid flow,” *submitted*.
- [1] Y. Saiki, H. Takahasi, K. Yamamoto and J. A. Yorke, “The dynamics of the heterochaos baker maps,” *submitted*.