Associate Professor Hiroshi Teramoto
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Curriculum Vitae

Date of Birth: April 4, 1979
Citizenship: Japan
Education: M.Sc., The University of Tokyo, 2004
Ph.D., The University of Tokyo, 2007

Appointment History:

2017- : Associate Professor
Research Institute for Electronic Science
Hokkaido University, Sapporo

2008- : Assistant Professor
Research Institute for Electronic Science
Hokkaido University, Sapporo

2007- : Doctoral Research Fellow
Research Institute for Electronic Science
Hokkaido University, Sapporo

2007- : Doctoral Research Fellow
Department of Science
Kobe University, Kobe

Research Interests:

Development of analytic and numerical methods for complex nonlinear dynamical systems and chemical reaction dynamics

Contributed to nonlinear dynamical systems theory in the following areas: Lie Canonical Perturbation Theory, Normally Hyperbolic Invariant Manifolds and their Breakdown, Markov Partition, Mode-Selective Chemical Reactions, Semi-classical Theory, Analysis of Kinematic Effect in terms of Riemann Geometry, Fluctuation-Dissipation Theorem, Harada-Sasa Equality, and Singularity Theory.

Professional Service:

Workshop organizer (with Prof. Masanao Yamaoka), AIMaP Workshop "Non Neumann type computer, Theory and Application", Sapporo, Japan (2019).

Workshop organizer (with Prof. Holger Waalkens, Dr. Jason Green, Prof. Tamiki Komatsuzaki and Prof. Stephen Berry), "Geometry of Chemical Reaction Dynamics in Gas and Condensed Phases", Telluride, United States (2018).

Workshop organizer (with Prof. Masanao Yamaoka), AIMaP Workshop "Non Neumann type computer, Theory and Application", Sapporo, Japan (2018).

Workshop organizer, "Understandings and Controls of Chemical Reaction in Molecules with Large Degrees of Freedom (The Cooperation with Mathematics Program, The Institute of Statistical Mechanics)", Sapporo, Japan (2015).

Workshop organizer (with Prof. Holger Waalkens and Prof. Srihari Keshavamurthy), "Geometry of Chemical Reaction Dynamics in Gas and Condensed Phases", Telluride, United States (2015).

Organizing committee member of "The 31st Symposium on Chemical Kinetics and Dynamics" (2015).

Workshop organizer, "Dynamical Systems and Computation 2015", Sapporo, Japan (2014).

Workshop organizer, "Lagrangian Coherent Structures and Dynamical Systems", Sapporo, Japan (2014).

Organizing committee member of "The 14th RIES international symposium", Sapporo, Japan (2013).

Workshop organizer (with Prof. Holger Waalkens and Prof. Srihari Kesha vamurthy), "Geometry of Chemical Reaction Dynamics in Gas and Condensed Pha ses", Telluride, United States (2013).

Editorial committee member of Biophysics in Hokkaido Branch (2012).

Organizing committee member of "Annual Meeting of Japan Society for M olecular Science" (2011).

Reviewer for Mathematical Review (2015-).

Reviewer for Physical Review Letters (2015); Journal of Physical Chemist ry B; (2015); Journal of Physics A (2014);

Teaching Experience:

Analytical Mechanics (undergraduate level, Hokkaido University) (2009, 2 010).

Information Theory (undergraduate level, Hokkaido University) (2010, 201 1).

Chemistry I (undergraduate level, Hokkaido University) (2010).

Physics I (undergraduate level, Hokkaido University) (2015).

Introduction to Nanotechnology and Nanoscience (graduate level, Hokkaid o University) (2015).

Nano-Material Science (undergraduate level, Hokkaido University) (2017).

Introduction to Linear Algebra (undergraduate level Hokkaido University) (2018).

Calculus II (undergraduate level, Hokkaido University) (2017, 2018).

Exercises on Basic Mathematics D (undergraduate level, Hokkaido Univer sity) (2017)

Research Projects Supervised: (Contract expenditures)

2009-2011 Grant-in-Aid for Young Scienticts (B) (Principal Investigator)
$34,000/year

2011-2011 The Office of the President of Hokkaido University through a pri ority distribution fund for research support (Principal Investigator)
$8,000/year

2008-2011 Grant-in-Aid for Scientific Research (B) (Co-Investigator, Principal Investigator: Prof. Tamiki Komatsuzaki)
$10,000/year

2012-2015 Grant-in-Aid for Scientific Research (B) (Co-Investigator, Principal Investigator: Prof. Tamiki Komatsuzaki)

$10,000/year

2015-2017 Grant-in-Aid for Scientific Research (B) (Generative Research Fiel ds) (Co-Investigator, Principal Investigator: Prof. Tamiki Komatsuzaki)

$10,000/year

2016-2019 JST, PRESTO Grant Number JPMJPR16E8 (Principal Investigato r)

$100,000/year

List of Research Achievements:

Publications

Books:

1. Shinnosuke Kawai, Hiroshi Teramoto, Chun-Biu Li, Tamiki Komatsuzaki, Mikito Toda, "Dynamical Reaction Theory based on Geometric Structure s of Phase Space", ***Advances in Chemical Physics***, **145**, 123-170 (2011).

Peer-Reviewed Journals Articles:

1. Hiroshi. Teramoto, Asahi. Tsuchida, Kenji. Kondo, Shyuichi. Izumiya, Mikito. To da, and Tamiki. Komatsuzaki, Application of Singularity Theory to Bifurcation of Band Structures in Crystals, J. Singularity, 21, 268 (2020).
2. Shyuichi Izumiya, Masatomo Takahashi, and Hiroshi Teramoto, METHODS AND APPLICATIONS OF ANALYSIS, 25, 337, (2018).
3. Hiroshi Teramoto, Kenji Kondo, Shyuichi Izumiya, Mikito Toda, and Tamiki Ko matsuzaki, “Classification of Hamiltonians in neighborhoods of band crossings in terms of the theory of singularities”, J. Math. Phys. 58, 073502 (2017); J. Mat h. Phys. 60, 129901 (2019).
4. Alireza Hadjighasem, Daniel Karrasch, Hiroshi Teramoto, and George Haller, “Sp ectral-clustering approach to Lagrangian vortex detection”, Phys. Rev. E 93, 0631 07 (2016).
5. Yutaka Nagahata, Satoshi Maeda, Hiroshi Teramoto, Takashi Horiyama, Tetsuya T aketsugu, Tamiki Komatsuzaki, “Deciphering Time Scale Hierarchy in Reaction N etworks”, J. Phys. Chem. B, 120, 1961 (2016).
6. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “Understandings of ch

emical reaction dynamics in terms of dynamical systems theory", AIP Conf. Pro c., **1702**, 090042 (2015).

7. Hiroshi Teramoto, Mikito Toda, Masahiko Takahashi, Hirohiko Kono, and Tamiki Komatsuzaki, "Mechanism and Experimental Observability of Global Switching Between Reactive and Nonreactive Coordinates at High Total Energies", Phys. R ev. Lett., **115**, 093003 (2015).
8. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, "Breakdown mechanis m of normally hyperbolic invariant manifolds in terms of unstable periodic orbits and homoclinic/heteroclinic orbits in Hamiltonian systems", Nonlinearity **28**, 267 7 (2015).
9. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, "A coarse graining met hod to extract cooperative modes of water molecules", ASTE; Advances in Scien ce, Technology and Environmentology, Special issue on New Challenges in Com plex Systems Science **B11**, 7 (2015).
10. Preetom Nag, Hiroshi Teramoto, Chun-Biu Li, Joseph Z. Terdik, Norbert F. Sche rer and Tamiki Komatsuzaki, "Local-heterogeneous response and transient dynami cs of cage breaking and formation in colloidal fluids", J. Chem. Phys. **141**, 104 907 (2014).
11. Hiroshi Teramoto, Mikito Toda and Tamiki Komatsuzaki, "A New Metho d to Improve Validity Range of Lie Canonical Perturbation Theory", Theo r. Chem. Acc., **133**, 1571 (2014).
12. Tahmina Sultana, Hiroaki Takagi, Miki Morimatsu, Hiroshi Teramoto, Chu n-Biu Li, Yasushi Sako and Tamiki Komatsuzaki, "Non-Markovian propert ies and multiscale hidden Markovian network buried in single molecule ti me series", J. Chem. Phys., **139**, 245101 (2013).
13. Hiroshi Teramoto, George Haller and Tamiki Komatsuzaki, "Detecting Inv ariant Manifolds as Stationary Lagrangian Coherent Structures in Autono mous Dynamical Systems", Chaos, **23**,043107 (2013) .
14. Yutaka Nagahata, Hiroshi Teramoto, Chun-Biu Li, Shinnosuke Kawai and Tamiki Komatsuzaki, "Reactivity Boundaries to Separate the Fate of a Che mical Reaction Associated with an Index-two saddle", Phys. Rev. E, **87**, 0 62817 (2013).
15. Yutaka Nagahata, Hiroshi Teramoto, Chun-Biu Li, Shinnosuke Kawai and Tamiki Komatsuzaki, "Reactivity boundaries for chemical reactions associat ed with higher-index and multiple saddles", Phys. Rev. E, **88**, 042923 (201 3).

16. Naoki Miyagawa, Hiroshi Teramoto, Chun-Biu Li and Tamiki Komatsuzaki, "Decomposability of Multivariate Interactions" ***Complex Systems*** **20**, 165 −179 (2011).
17. Naoki Miyagawa, Hiroshi Teramoto, Chun-Biu Li and Tamiki Komatsuzaki, "Spatial Heterogeneity of Multivariate Dependence", AIP Conf. Proc. **1389**, 991 (2011).
18. Hiroshi Teramoto, Mikito Toda, Tamiki Komatsuzaki, "A Dynamical Switching of a Reaction Coordinate to Carry the System Through to a Different Product State at High Energies", Phys. Rev. Lett., **106**, 054101 (2011).
19. Hiroshi Teramoto and Tamiki Komatsuzaki, "How does a choice of Markov partition affect the resultant symbolic dynamics?", Chaos **20**, 037113 (2010).
20. Hiroshi Teramoto and Tamiki Komatsuzaki, "Exploring Remnants of Invariants Buried in a Deep Potential Well in Chemical Reactions", J. Chem. Phys., **129**, 094302 (2008).
21. Hiroshi Teramoto and Tamiki Komatsuzaki, "Probing Remnants of Invariants to Mediate Energy Exchange in Highly-Chaotic Many-dimensional Systems", Phys. Rev. E , **78**, 017202 (2008).
22. Hiroshi Teramoto and Kazuo Takatsuka, "Local integrals and their globally connected invariant structure in phase space giving rise to a promoting mode of chemical reaction", J. Chem. Phys., **126**, 124110 (2007).
23. Hiroshi Teramoto and Kazuo Takatsuka, "A semiclassical theory for nonseparable rovibrational motions in curved space and its application to energy quantization of nonrigid molecules", J. Chem. Phys., **125**, 194301 (2006).
24. Hiroshi Teramoto and Shin-ichi Sasa, "Microscopic description of the equality between violation of fluctuation-dissipation and energy dissipation", Phys. Rev. E (R), **72**, 060102 (2005).
25. Hiroshi Teramoto and Kazuo Takatsuka, "Dynamical and statistical effects of the intrinsic curvature of internal space of molecules", J. Chem. Phys., **122**, 074101 (2004).

Invited plenary talks:

1. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, Understandings of chemical reaction in terms of invariant manifolds, RIMS worksho p, Kyoto, September 27 (2012).

Other invited lectures:

1. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “Classificatio n of Electron Energy Level Crossings in terms of the Theory of Singul arities and Analysis of Non-Adiabatic Transitions around the Crossing s”, ICCMSE 2016, Metropolitan Hotel, Athens, Greece, March 17-20 (20 15).
2. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “Dynamical Reaction Theory: Beyond the conventional perturbation theory”, Theory of Gas Phase Scattering and Reactivity for Astrophysics, Colloquium on kinetics and scattering theory for astrophysics, Garching, Germany, November 27 (2015).
3. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “A Global Dynamical Switching of a Reaction Coordinate and its Experimental O bservability”, Telluride summer workshop “Geometry of Chemical Reac tion Dynamics”, Telluride, United States, August 1 (2015).
4. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “Understand ings of chemical reaction dynamics in terms of dynamical systems the ory”, ICCMSE 2015, SESSION: Computational Chemistry (CC) Symposi um, Metropolitan Hotel, Athens, Greece, March 20-23 (2015)
5. Hiroshi Teramoto, Alireza Hadjighasem, Daniel Karrasch, George Halle r, and Tamiki Komatsuzaki, “Identifying Different Reaction Processes i n terms of Graph Laplacian”, Illuminyating 2015, Universidad Polytécn ica de Madrid (UPM) & Instituto de Ciencias Mathemáticas (ICMAT), May 7 (2015).
6. Hiroshi Teramoto, Mikito Toda, and Tamiki Komatsuzaki, “Reaction C oordinate Switching Mechanism, on the Possibility of Its Experimental Verification and Its Quantum Manifestation”, The 10th AIMS Conferen ce on Dynamical Systems, Differential Equations and Applications, Uni versidad Autónoma de Madrid, Madrid, Spain, July 8 (2014)
7. Hiroshi Teramoto, Mikito Toda, Tamiki Komatsuzaki, “Extracting Coop erative modes between a biological molecule and water molecules”, Int ernational Workshop "Over the Barriers of Transition Paths: Dynamical Processes in Proteins and Complex Molecular Systems", Tokyo Institut e of Technology, Yokohama, Kanagawa, June 28 (2014)
8. Hiroshi Teramoto, "Analysis of dynamical systems with large degrees of freedom in terms of hyperbolic invariant manifolds and their break

down", *International symposium on anomalous statistics, generalized entropies and information geometry*, Nara, March 3-7 (2012).

9. Hiroshi Teramoto, Preetom Nag, Chun-Biu Li and Tamiki Komatsuzaki, "Coherent Dynamics in Colloidal Fluids in terms of Lagrangian Coherent Structure", Telluride Summer Workshop "The Complexity of Dynamics and Kinetics in Many Dimensions", Telluride, June 19 (2013).
10. Hiroshi Teramoto, "Breakdown of Normally Hyperbolic Invariant Manifolds, its Consequences and Quantum Manifestation", Telluride Summer Workshop "Geometry of Chemical Reaction Dynamics in Gas and Condensed Phases", Telluride, June 19 (2013).
11. Hiroshi Teramoto, "Detecting and analyzing methods of normally hyperbolic invariant manifolds", XXXIII Dynamics Days Europe, Madrid, June 5 (2013).
12. Hiroshi Teramoto, "Detecting and analyzing methods of normally hyperbolic invariant manifolds", IlLuminayating 2013: Dynamical Perspectives on Molecular Processes, Loughborough, May 8 (2013).
13. Hiroshi Teramoto, "Detecting Invariant Manifolds as Stationary Lagrangian Coherent Structures in Autonomous Dynamical Systems", The 11th CTDS seminar (Control Theory and Dynamical Systems), Tokyo, May 15 (2013).
14. Hiroshi Teramoto, "Non-perturbative construction of stable and unstable manifolds in terms of Stationary Lagrangian Coherent Structure", The mathematical Society of Japan, Hokkaido, December 6 (2012).
15. Hiroshi Teramoto, "Contra-variant Lyapunov vectors and construction of normally repelling invariant manifolds in terms of them, The 33rd CREST seminar, Tohoku, July 5 (2012).
16. Hiroshi Teramoto, "High-dimensional folding patterns of stable/unstable manifolds and their physical implications", Workshop on dynamical systems theory and reaction dynamics toward large systems, Kyoto, January 5 (2010).