

Hyukpyo Hong

CONTACT INFORMATION	Department of Mathematics University of Wisconsin–Madison 322 Van Vleck Hall, 480 Lincoln Dr Madison, Wisconsin 53706, United States	<i>E-mail:</i> hhong78@wisc.edu <i>Web:</i> https://people.math.wisc.edu/~hhong78
APPOINTMENTS	University of Wisconsin–Madison , Madison, Wisconsin, United States Van Vleck Assistant Professor, Department of Mathematics	Aug. 2023 – present
EDUCATION	KAIST , Daejeon, South Korea Ph.D. in Mathematical Sciences Advisor: Jae Kyoung Kim (jaekkim@kaist.ac.kr) Thesis: Development of stochastic model reduction framework for analysis and inference of biochemical reaction networks B.S. in Mathematical Sciences	Mar. 2018 – Aug. 2023 Mar. 2013 – Feb. 2018
RESEARCH INTERESTS	My research focuses on central problems in deterministic and stochastic models for complex biological systems. For example, how do we efficiently analyze long-term dynamics of a model despite the huge number of parameters, variables, and equations? In order to answer this, I study continuous-time Markov chains and ordinary differential equations. The techniques I have developed span the fields of probability, queueing theory, Bayesian inference, and dynamical systems. Beyond the mathematical and statistical topics, I work closely with biologists and medical doctors in order to address biological problems related to cognitive impairment and COVID-19.	
PAPERS	†: (co-)1st author, *: (co-)corresponding author. One can enter an article web page by clicking the underlined title of a paper.	
	<ol style="list-style-type: none">Yuji Hirono†,*, Hyukpyo Hong†,*, Jae Kyoung Kim†,*, <u>Robust perfect adaptation of reaction fluxes ensured by network topology</u>, <i>arXiv</i>, 2023Hyukpyo Hong†, Eunjin Eom†, Hyojung Lee, Sunhwa Choi*, Boseung Choi*, Jae Kyoung Kim*, <u>Overcoming bias in estimating epidemiological parameters with realistic history-dependent disease spread dynamics</u>, <i>Nature Communications</i>, 2024Hyeontae Jo†, Hyukpyo Hong†, Hyung Ju Hwang, Won Chang, Jae Kyoung Kim*, <u>Density physics-informed neural networks reveal sources of cell heterogeneity in signal transduction</u>, <i>Patterns</i>, 2023Hyukpyo Hong†, Mark Jayson Cortez, Yu-Yu Cheng, Hang J. Kim, Boseung Choi*, Krešimir Josić*, and Jae Kyoung Kim*, <u>Inferring delays in partially observed gene regulation processes</u>, <i>Bioinformatics</i>, 2023Hyukpyo Hong, Bryan S. Hernandez, Jinsu Kim, and Jae Kyoung Kim*, <u>Computational translation framework identifies biochemical reaction networks with special topologies and their long-term dynamics</u>, <i>SIAM Journal on Applied Mathematics</i>, 2023Hyukpyo Hong†, Ji Yun Noh†, Hyojung Lee, Sunhwa Choi, Boseung Choi, Jae Kyoung Kim*, Eui-Cheol Shin*, <u>Modeling incorporating the severity-reducing long-term immunity: higher viral transmission paradoxically reduces severe COVID-19 during endemic transition</u>, <i>Immune Network</i>, 2022Dae Wook Kim†, Hyukpyo Hong† and Jae Kyoung Kim*, <u>Systematic inference identifies a major source of heterogeneity in cell signaling dynamics: the rate-limiting step number</u>, <i>Science Advances</i>, 2022	

8. Yun Min Song[†], **Hyukpyo Hong**[†] and Jae Kyoung Kim^{*}, Universally valid reduction of multiscale stochastic biochemical systems with simple non-elementary propensities, *PLoS Computational Biology*, 2021
9. Mark Jayson Cortez[†], **Hyukpyo Hong**, Boseung Choi^{*}, Jae Kyoung Kim^{*}, and Krešimir Josić^{*}, Hierarchical Bayesian models for inference in biochemical reactions with delays, *Bioinformatics*, 2021
10. Jaehyoung Hong[†], Su Jung Choi[†], Se Ho Park, **Hyukpyo Hong**, Victoria Booth, Eun Yeon Joo^{*}, and Jae Kyoung Kim^{*}, Personalized sleep-wake patterns aligned with circadian rhythm relieve daytime sleepiness, *iScience*, 2021
11. **Hyukpyo Hong**[†], Jinsu Kim[†], M. Ali Al-Radhawi, Eduardo D. Sontag, Jae Kyoung Kim^{*}, Derivation of stationary distributions of biochemical reaction networks via structure transformation, *Communications Biology*, 2021.

BOOK CHAPTERS

1. **Hyukpyo Hong**, Boseung Choi, and Jae Kyoung Kim, Beyond the Michaelis-Menten: Bayesian inference for enzyme kinetic analysis, Quentin Vanhaelen (Ed.), *Computational Methods for Estimating the Kinetics Parameters of Biological Systems*, Methods in Molecular Biology, vol 2385. Humana, New York, NY.

HONORS AND AWARDS

- 2022 SIAM Student Travel Awards, SIAM
- 2022 Blood Donor Hall of Fame for 100 times of blood donations, Korean Red Cross
- 2021 KSIAM Conference Poster Presentation Award, KSIAM
- 2019 - 2023 Global Ph.D. Fellowship (Full Tuition), NRF
- 2017 HAAFOR Challenge for Applied and Financial Math Problems 4th place, HAAFOR
- 2017 36th National Undergraduate Mathematics Competition Silver Award, KMS
- 2014 33rd National Undergraduate Mathematics Competition Silver Award, KMS
- 2016 Mirae Asset Global Exchange Scholarship, Mirae Asset Park Hyeon Joo Foundation
- 2014 Dean's List Award, College of Natural Sciences, KAIST
- 2013 32nd National Undergraduate Mathematics Competition Silver Award, KMS
- 2013 – 2017 The National Scholarship for Science and Engineering (Full Tuition), KOSAF

Abbreviations

- NRF: National Research Foundation of Korea,
- KMS: Korean Mathematical Society
- KSIAM: Korean Society for Industrial and Applied Mathematics
- KOSAF: Korea Student Aid Foundation,

INVITED TALKS

- October 25, 2024: Applied Math Seminar at the University of Cincinnati** Cincinnati, OH, USA
Koopman representation: Linear representation of nonlinear dynamics
- October 7, 2024: Seminar at the University of the Philippines Diliman** Online
Accurate epidemiological parameters estimation with realistic history-dependent disease spread dynamics
- August 1, 2024: Seminar at Pusan National University** Busan, Korea
Analysis of dynamical systems using “easier” representations
- July 31, 2024: Biomedical Mathematics Seminar at Institute for Basic Science** Daejeon, Korea

Koopman representation: Linear representation – not an approximation – of nonlinear dynamics	
July 2–4, 2024: SMB Annual Meeting	Seoul, Korea
1. Inferring delays in partially observed gene regulation processes 2. Density-PINNs reveal that multiple pathways reduce cell-to-cell heterogeneity in antibiotic responses	
June 4, 2024: Data Computational Sciences Special Lecture at Korea University, Sejong Campus	Sejong, Korea
How to sample random numbers from a target distribution	
June 3, 2024: Data Science Seminar at Sogang University	Seoul, Korea
Analysis of dynamical systems using “easier” representations	
May 23, 2024: Center for Mathematical Machine Learning and its Applications (CM2LA) Seminar at POSTECH	Pohang, Korea
Analysis of dynamical systems using “easier” representations	
April 25, 2024: Mathematical Biology Seminar at UIUC	Champaign, IL, USA
Analyzing long-term behavior of dynamical systems using “easy-to-handle” representations	
August 17, 2023: ICIAM 2023 Satellite Workshop: Stochastic Modeling and Data Analysis for Biological Systems	Daejeon, Korea
Network translation allows for revealing long-term dynamics of stochastic reaction networks	
July 17, 2023: SMB Annual Meeting	Columbus, OH, USA
Network translation allows for revealing long-term dynamics of stochastic reaction networks	
June 27, 2023: The 8th CIJK International Conference on Mathematical and Theoretical Biology	Jeju, Korea
Things we have been overlooking in infectious disease modeling	
May 19, 2023: KSIAM Spring Conference	Pyeongchang, Korea
Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition	
December 19, 2022: Mini-workshop on Recent Trends in Pure and Applied Mathematics	Daejeon, Korea
Inferring delays in partially observed gene regulatory networks	
November 21, 2022: Population Approach Group Korea Annual Meeting	Seoul, Korea
Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition	
October 19, 2022: Global KMS International Conference	Seoul, Korea
Systematic inference identifies a major source of heterogeneity in non-Markovian cell signaling dynamics	
June 25, 2022: KSMB Annual Meeting	Yeosu, Korea
Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition	
June 22, 2022: BRIC Webinar	Online
Systematic inference for cell signalling pathways identifies a key determinant of cell-to-cell variability	
May 28, 2022: KSIAM Spring Conference	Daejeon, Korea
Systematic inference for cell signalling pathways identifies a key determinant of cell-to-cell variability	
August 27, 2021: KSMB Annual Meeting	Jeju, Korea

	Inference of stochastic dynamics in biochemical reaction networks	
	June 16, 2021: SMB Annual Meeting	Online
	Inference of stochastic dynamics in biochemical reaction networks	
	May 27, 2021: SIAM Conference on Applications of Dynamical Systems	Online
	Derivation of stationary distributions of stochastic chemical reaction networks via network translation	
	May 13, 2021: Seminar on the Mathematics of Reaction Networks [link]	Online
	Derivation of stationary distributions of stochastic chemical reaction networks via network translation.	
	October 24, 2020: KMS Annual Meeting	Online
	Derivation of stationary distributions of biochemical reaction networks via structure transformation	
CONTRIBUTED TALKS AND POSTERS	June 27, 2024: KSMB-SMB Satellite Workshop: Tutorials for Recent Advances in Methods of Biomedical Mathematics	Daejeon, Korea
	Inferring delays in partially observed gene regulation processes	Poster
	June 10, 2024: SPT Workshop on Reaction Networks	Cagliari, Italy
	Network translation allows for revealing long-term dynamics of stochastic reaction networks	Poster
	July 14, 2023: Dynamical Systems in the Life Sciences	Columbus, OH, USA
	Systematic inference identifies a major source of heterogeneity in non-Markovian cell signaling dynamics	Poster
	December 6, 2022: Workshop on Non-equilibrium Phenomena in Physics and Biology	Gyeongju, Korea
	Network translation allows for revealing long-term dynamics of stochastic reaction networks	Poster
	November 26, 2022: KSIAM Annual Conference	Jeju, Korea
	Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition	General session
	October 11, 2022: International Conference on Systems Biology	Berlin, Germany
	Systematic inference identifies a major source of heterogeneity in non-Markovian cell signaling dynamics: the rate-limiting step number	Short talk
	July 14, 2022: SIAM Conference on the Life Sciences	Pittsburgh, USA
	Systematic inference identifies a major source of heterogeneity in non-Markovian cell signaling dynamics: the rate-limiting step number	Contributed talk
	May 17, 2022: SRBR Biennial Conference	Jacksonville, USA
Personalized sleep-wake patterns aligned with circadian rhythm relieve daytime sleepiness	Poster	
December 17, 2021: KSMB Winter Conference	Jeju, Korea	
Derivation of stationary distributions of stochastic chemical reaction networks via network translation	Poster	
December 04, 2021: KSIAM Annual Conference	Busan, Korea	
Derivation of stationary distributions of stochastic chemical reaction networks via network translation	Poster	
September 28, 2021: Non-equilibrium collective phenomena workshop	Gyeongju, Korea	
Derivation of stationary distributions of stochastic chemical reaction networks via network translation	Poster	
June 26, 2021: KSIAM Spring Conference	Gangneung, Korea	
Derivation of stationary distributions of biochemical reaction networks via		

structure transformation	Contributed talk
November 13, 2020: KSIAM Annual Meeting	Online
Derivation of stationary distributions of biochemical reaction networks via structure transformation	Poster
August 20, 2020: SMB Annual Meeting	Online
Derivation of stationary distributions of biochemical reaction networks via structure transformation	Contributed talk
July 23, 2019: SMB Annual Meeting	Montreal, Canada
Product-form stationary distributions for non-complex balanced networks	Poster
July 8, 2019: Chemical Reaction Networks Workshop	Torino, Italy
Product-form stationary distributions for non-complex balanced networks	Short talk
May 18, 2019: KSIAM Spring Conference	Seoul, Korea
Product-form stationary distributions for non-complex balanced networks	Contributed talk
May 11, 2019: A3 Workshop on Mathematical Life Science	Beijing, China
Product-form stationary distributions for non-complex balanced networks	Student talk

TEACHING
EXPERIENCE

UW–Madison

- 2025 Spring (planned): [Instructor] Linear Algebra and Differential Equations (MATH320)
- 2024 Fall: [Instructor] Elementary Matrix and Linear Algebra (MATH340)
- 2024 Spring: [Instructor] Linear Algebra and Differential Equations (MATH320)
- 2023 Fall: [Instructor] Linear Algebra and Differential Equations (MATH320)

KAIST

- 2019 Spring: [Mentor] Undergraduate Research Program (URP)
 - Mentoring an undergraduate student. Discussed with and guided the student to investigate *the total quasi-steady-state approximation for a competitive system*. The student won poster presentation prize at the 2019 KSIAM Spring conference and a prize in the URP final evaluation.
- 2019 Spring: [Teaching Assistant] Differential Equations and Applications (MAS201)
- 2018 Fall: [Teaching Assistant] Differential Equations and Applications (MAS201)
- 2018 Spring: [Teaching Assistant] Introduction to Linear Algebra (MAS109), Linear Algebra (MAS212)

SERVICE

June 13-17, 2021: Support Staff, SMB Annual Meeting Online
Host zoom links of sessions for Asia time zone.

PEER REVIEW

PLoS Computational Biology, Stat