Hyukpyo Hong **Last updated: Mar. 27, 2026**

CONTACT INFORMATION

Department of Mathematics
University of Wisconsin–Madison
322 Van Vleck Hall, 480 Lincoln Dr
Madison, Wisconsin 53706, United States

E-mail: hhong78@wisc.edu
Web: `https://people.math.wisc.edu/~hhong78`

APPOINTMENTS

University of Wisconsin–Madison, Madison, Wisconsin, USA

Van Vleck Assistant Professor, Department of Mathematics — Aug. 2023–present

EDUCATION

KAIST, Daejeon, South Korea

Ph.D. in Mathematical Sciences — Feb. 2018–Aug. 2023
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. 2013–Feb. 2018

RESEARCH INTERESTS

Fields of research: Mathematical biology, ODEs, Stohastic processes, Bayesian statistics, Digital medicine

Research interests: Steady states of ODEs, stationary distribution of continuous-time Markov chains, Koopman operator theory, MCMC methods, parameter estimation for non-Markovian stochastic models, Metabolic control analysis, Homeostasis and adaptation in biological systems, Neurodegenerative disease-related alteration of human motor activity

PAPERS

†: (co-)1st author, *: (co-)corresponding author.

In preparation or preprint:

1. Ella Buelling, Wolfram Liebermeister, **Hyukpyo Hong**, Connections between structural sensiticity analysis and metabolic control analysis, *in preparation*
2. **Hyukpyo Hong**, Seewoo Lee, Necessary and sufficient conditions of the existence of finite dimensional subspace invariant under polynomial ODEs, *in preparation*
3. **Hyukpyo Hong**, Matthew Colbrook, Qin Li, Hanbaek Lyu, Efficient algorithm for finding a finite-dimensional Koopman representation, *in preparation*
4. **Hyukpyo Hong**, Diego Rojas La Luz, Gheorghe Craciun, Ubiquitous asymptotic robustness in biochemical systems, *Under review*; [arXiv]

Published or accepted:

1. Dongju Lim†, Kyeong Tae Ko†, **Hyukpyo Hong**, Hyojung Lee, Boseung Choi, Won Chang, Sunhwa Choi*, Jae Kyoung Kim*, A history-dependent approach for accurate initial condition estimation in epidemic models, *PLoS Computational Biology*, 2025; [journal]
2. **Hyukpyo Hong**†, Seokhwan Moon†, Yuji Hirono†,*, Jae Kyoung Kim*, Topological criterion for robust perfect adaptation of reaction fluxes in biological networks, *iScience*, 2025; [arXiv, journal]
3. **Hyukpyo Hong**†, Eunjin Eom†, Hyojung Lee, Sunhwa Choi*, Boseung Choi*, Jae Kyoung Kim*, Overcoming bias in estimating epidemiological parameters with realistic history-dependent disease spread dynamics, *Nature Communications*, 2024; [journal]
4. Hyeontae Jo†, **Hyukpyo Hong**†, Hyung Ju Hwang, Won Chang, Jae Kyoung Kim*, Density physics-informed neural networks reveal sources of cell heterogeneity in signal transduction, *Patterns*, 2023; [bioRxiv, journal]

5. **Hyukpyo Hong**†, Mark Jayson Cortez, Yu-Yu Cheng, Hang J. Kim, Boseung Choi*, Krešimir Josić*, Jae Kyoung Kim*, Inferring delays in partially observed gene regulation processes, *Bioinformatics*, 2023; [bioRxiv, journal]
6. **Hyukpyo Hong**, Bryan S. Hernandez, Jinsu Kim, Jae Kyoung Kim*, Computational translation framework identifies biochemical reaction networks with special topologies and their long-term dynamics, *SIAM Journal on Applied Mathematics*, 2023; [arXiv, journal]
7. **Hyukpyo Hong**†, Ji Yun Noh†, Hyojung Lee, Sunhwa Choi, Boseung Choi, Jae Kyoung Kim*, Eui-Cheol Shin*, Modeling incorporating the severity-reducing long-term immunity: higher viral transmission paradoxically reduces severe COVID-19 during endemic transition, *Immune Network*, 2022 [medRxiv, journal]
8. Dae Wook Kim†, **Hyukpyo Hong**†, Jae Kyoung Kim*, Systematic inference identifies a major source of heterogeneity in cell signaling dynamics: the rate-limiting step number, *Science Advances*, 2022; [journal]
9. Yun Min Song†, **Hyukpyo Hong**†, Jae Kyoung Kim*, Universally valid reduction of multiscale stochastic biochemical systems with simple non-elementary propensities, *PLoS Computational Biology*, 2021; [bioRxiv, journal]
10. Mark Jayson Cortez†, **Hyukpyo Hong**, Boseung Choi*, Jae Kyoung Kim*, Krešimir Josić*, Hierarchical Bayesian models for inference in biochemical reactions with delays, *Bioinformatics*, 2021; [bioRxiv, journal]
11. Jaehyoung Hong†, Su Jung Choi†, Se Ho Park, **Hyukpyo Hong**, Victoria Booth, Eun Yeon Joo*, Jae Kyoung Kim*, Personalized sleep-wake patterns aligned with circadian rhythm relieve daytime sleepiness, *iScience*, 2021; [bioRxiv, journal]
12. **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; [bioRxiv, journal]

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.

Research Grants

2019–2023 National Research Foundation of Korea, NRF-2019-Fostering Core Leaders of the Future Basic Science Program/Global Ph.D. Fellowship Program, 2019H1A2A1075303, **Principal Investigator** ($120,000)
Title: *Development of Stochastic Model Reduction Methodology and its Application to an Optogenetic System*

Honors and Awards

2025 Postdoctoral Excellence in Teaching Award, UW–Madison

2025 KMS Excellent Dissertation Award, KMS

2024 KSIAM Next Generation Researcher Award, KSIAM

2022 SIAM Student Travel Awards, SIAM

2022 Blood Donor Hall of Fame for 100 times of blood donations, Korean Red Cross

2019–2023 Global Ph.D. Fellowship (Full Tuition), NRF

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,

Teaching

UW–Madison

- Spring 2026: [Instructor] Introductory Probability (MATH331)
- Fall 2025: [Instructor] Introductory Probability (MATH331)
- Spring 2025: [Instructor] Introductory Probability (MATH331)
- Fall 2024: [Instructor] Elementary Matrix and Linear Algebra (MATH340)
- Spring 2024: [Instructor] Linear Algebra and Differential Equations (MATH320)
- Fall 2023: [Instructor] Linear Algebra and Differential Equations (MATH320)

KAIST

- 2019 Spring: [Teaching Assistant] Differential Equations and Applications (MAS201)
- 2018 Fall: [Teaching Assistant] Differential Equations and Applications (MAS201) & Introduction to Mathematical Biology (MAS480)
- 2018 Spring: [Teaching Assistant] Introduction to Linear Algebra (MAS109), Linear Algebra (MAS212)

Mentoring

UW–Madison

- June 2024–present: Ella Buelling, a junior student at Edgewood High School
  Mentoring a talented and passionate high school student. Working on connections between the hypergraph representation of biochemical reaction networks and metabolic control analysis.

KAIST

- June 2023–March 2025: Seokhwan Moon, who was an undergraduate student in the Department of Mathematics at POSTECH
  We investigated how bacteria and plants maintain robust intracellular functioning despite environmental fluctuations. We derived structural conditions under which the steady-state solutions of a system of ODEs remain independent of system parameters. This work was published in the interdisciplinary journal *iScience*.
- Spring 2019: Minyoo Kim, who was an undergraduate student in the Department of Mathematics at KAIST
  Discussed with and guided the student to investigate *the total quasi-steady-state approximation for a competitive system*. The student won a poster presentation prize at the 2019 KSIAM spring conference and a prize in the URP final evaluation.

Invited talks

February 26, 2026: Mathematics of Reaction Networks (MoRN) Seminar Online
Ubiquitous Asymptotic Robustness in Biochemical Systems

November 21, 2025: Duke University Math Bio Seminar Durham, NC, USA
Identifying major sources of heterogeneity in antibiotic cell responses
via Bayesian inference and Physics-informed neural networks

November 20, 2025: NC State Univ. TPB Cluster Durham, NC, USA
Bridging Mathematical Theory and Biological Challenges:
From intracellular networks to human-scale dynamics

November 19, 2025: NC State Univ. Dept. of Math. Durham, NC, USA
Leveraging Koopman Operator Theory and Graph Representation for
Deeper Insight into Complex Dynamical Systems

November 13, 2025: Seminar at Seoul National University Seoul, Korea
Finite-Dimensional Representations of the Koopman Operator:
Equation- and Data-Driven Approaches

October 31, 2025: UW–Madison Appl. Comput. Math Seminar Madison, WI, USA
Finite-Dimensional Representations of the Koopman Operator:
Equation- and Data-Driven Approaches

October 28, 2025: Midwest Mathematical Biology Seminar Online
Ubiquitous Asymptotic Robustness in Biochemical Systems

October 1, 2025: Seminar at Korea University Seoul, Korea
Leveraging Koopman Operator Theory and Graph Representation
for Deeper Insight into Complex Dynamical Systems

September 27, 2025: 2025 GLSIAM Meeting Chicago, IL, USA
Digital biomarker of cognitive impairment: fractal patterns of
human activity data

July 17, 2025: SMB Annual Meeting Edmonton, Canada
Inferring delay distributions in partially observed biological processes.

July 8, 2025: SIAM Conference on Applied Algebraic Geometry Madison, WI, USA
Ubiquitous Asymptotic Robustness in Biochemical Systems

June 20, 2025: Pusan National University Math Seminar Busan, Korea
Parameter inference in Markovian and non-Markovian models

June 4, 2025: KAIST Brain & Cognitive Sciences Seminar Daejeon, Korea
Digital biomarker of cognitive impairment: fractal patterns of human activity data

June 2, 2025: Konkuk University Math Seminar Seoul, Korea
Parameter inference in Markovian and non-Markovian models

May 17, 2025: KSIAM Spring Conference Seoul, Korea
KSIAM Next Generation Researcher Award speech

May 15, 2025: SIAM Conference on Appl. Dyn. Sys. Denver, CO, USA
Network Translation of a Stochastic Reaction Network to
Reveal Stationary Distributions

March 3, 2025: Computational and Applied Math / Data Science seminar in the School of Math and Stats at Arizona State University Online
Koopman representation: Linear representation of nonlinear dynamics

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 [link] — 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 [video] 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

Academic Service

June 13–17, 2021: Support Staff, SMB Annual Meeting
Hosted Zoom sessions for the Asia time zone.

Outreach

September 16, 2022: Science Slam-D Public Lecture at Yongsan High School, Daejeon, Korea
Delivered a public lecture for high school students. Hosted by NST (National Research Council of Science and Technology), IBS (Institute for Basic Science), Daejeon MBC (TV network) and Hello DD (STEM-focused news organization).
Title: *Mathematics Meets Biology: Discovering the Optimal Sleep Pattern through Mathematical Modeling.*

April 27, 2021: Mobile Science Classroom with the National Research Foundation of Korea [video]
Delivered a public lecture for middle school students. Hosted by NRF Korea.
Title: *Mathematical Biology: Bridging Mathematics and the Life Sciences.*

Peer Review

PLoS Computational Biology, Acta Biotheoretica, Stat, PCI Math Comp Biol