Hyukpyo Hong

CONTACT INFORMATION

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APPOINTMENTS

University of Wisconsin–Madison, Madison, Wisconsin, United States

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

EDUCATION

KAIST, Daejeon, South Korea

Ph.D. in Mathematical Sciences — Mar. 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

My research focuses on central problems in stochastic models for complex biological systems. For example, how do we efficiently analyze a model despite the huge number of parameters, variables, and equations? In order to answer this, I have studied efficient analysis of stochastic models (i.e., continuous-time Markov chain) for biochemical systems by developing the accurate stochastic model reduction method and the Bayesian method to infer parameters of reduced Markovian or non-Markovian models. The techniques I 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.

1. **Hyukpyo Hong**†, Eunjin Eom†, Hyojung Lee, Sunhwa Choi*, Boseung Choi*, Jae Kyoung Kim*, Overcoming Bias in Estimating Epidemiological Parameters: A Bayesian Approach with Realistic History-Dependent Disease Spread Dynamics, *submitted*
2. Yuji Hirono†,*, **Hyukpyo Hong**†,*, Jae Kyoung Kim†,*, Robust perfect adaptation of reaction fluxes ensured by network topology, *arXiv*, 2023
3. 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
4. **Hyukpyo Hong**†, Mark Jayson Cortez, Yu-Yu Cheng, Hang J. Kim, Boseung Choi*, Krešimir Josić*, and Jae Kyoung Kim*, Inferring delays in partially observed gene regulation processes, *Bioinformatics*, 2023
5. **Hyukpyo Hong**, Bryan S. Hernandez, Jinsu Kim, and Jae Kyoung Kim*, Computational translation framework identifies biochemical reaction networks with special topologies and their long-term dynamics, *SIAM Journal on Applied Mathematics*, 2023
6. **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

7. Dae Wook Kim†, **Hyukpyo Hong**† and Jae Kyoung Kim*, Systematic inference identifies a major source of heterogeneity in cell signaling dynamics: the rate-limiting step number, *Science Advances*, 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, Korean Red Cross

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

2021 KSIAM Conference Poster Presentation Award, KSIAM

2017 HAAFOR Challenge for applied/financial math problem 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

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, United States
Network translation allows for revealing long-term dynamics of stochastic reaction networks Minisymposium

June 27, 2023: The 8th CIJK International Conference on Mathematical and Theoretical Biology — Jeju, Korea
Things we have been overlooking in infectious disease modeling — Minisymposium

May 19, 2023: KSIAM Spring Conference — Pyeongchang, Korea
Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition — Special session

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 — Special session

October 19, 2022: Global KMS International Conference — Seoul, Korea
Systematic inference identifies a major source of heterogeneity in non-Markovian cell signaling dynamics — Special session

June 25, 2022: KSMB Annual Meeting — Yeosu, Korea
Increasing viral transmission paradoxically reduces severe COVID-19 during endemic transition — Special session

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 — Special session

August 27, 2021: KSMB Annual Meeting — Jeju, Korea
Inference of stochastic dynamics in biochemical reaction networks — Special session

June 16, 2021: SMB Annual Meeting — Online
Inference of stochastic dynamics in biochemical reaction networks — Minisymposium

May 27, 2021: SIAM Conference on Applications of Dynamical Systems — Online
Derivation of stationary distributions of stochastic chemical reaction networks via network translation — Minisymposium

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 — Minisymposium

Contributed talks and Posters

July 14, 2023: Dynamical Systems in the Life Sciences — Columbus, OH, United States
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

- Spring 2024: [Instructor] Linear Algebra and Differential Equations (MATH320)
- Fall 2023: [Instructor] Linear Algebra and Differential Equations (MATH320)

KAIST

- Spring 2019: [Mentor] Undergraduate Research Program (URP)
  – Mentoring an undergraduate student. Discussed with and guided the student to investi-

gate *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.

- Spring 2019: [Teaching Assistant] Differential Equations and Applications (MAS201)
- Fall 2018: [Teaching Assistant] Differential Equations and Applications (MAS201)
- Spring 2018: [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