Seokhwan Moon

77 Cheongam-ro, Nam-gu, Pohang – 37673 – Republic of Korea

✉ mseokhwan@postech.ac.kr • 🌐 seokhwan-moon.github.io • in sh-moon

Education

Pohang University of Science and Technology   **Feb 2019 – Feb 2025 (Expected)**
B.S. in Mathematics (Summa Cum Laude)   *(Military Service : 2021 - 2022)*
Pohang, Republic of Korea

University of Illinois, Urbana-Champaign   **Jan 2024 – May 2024**
Exchange student, Department of Mathematics
Champaign, Illinois

Gwangju Science Academy for the Gifted   **Mar 2016 – Feb 2019**
Gwangju, Republic of Korea

Research Interest

Mathematical Interest : Mathematical biology, Probability, Dynamical Systems, Stochastic Process, Reaction Network Theory, Markov Chain, Evolutionary Game Theory

Biological Interest : Systems Biology, Biological Circuit, Evolutionary Dynamics, Pattern Formation

Papers/Preprints

† : (co-)first author (for interdisciplinary journals), * : (co-)corresponding author

1. Hyukpyo Hong†, **Seokhwan Moon**†, Yuji Hirono†, and Jae Kyoung Kim*. Topological Criterion for Robust Perfect Adaptation of Reaction Fluxes in Biological Networks. Under review in *Cell*.
2. Minjoon Kim, **Seokhwan Moon**, and Jinsu Kim*. Exponential ergodicity of one-dimensional stochastic reaction networks. *In preparation*.

Research Experience

Spatial Models of Evolutionary Dynamics   **Jan 2024 – Ongoing**
- As a participant of Illinois Mathematics Lab, co-work with Daniel Cooney
- Formulate a PDE model for evolutionary game with spatial dynamics, and analyze spatial patterns
- Studied evolutionary dynamics, game theory, PDE, linear/nonlinear stability analysis

Exponential ergodicity for 1D stochastic reaction networks   **Dec 2023 – Ongoing**
- Co-work with Minjoon Kim and Jinsu Kim
- Proving that in 1D stochastic reaction network, ergodic reaction networks are always exponential ergodic
- Studied about the ergodicity of continuous-time Markov chain, birth-death process, and mixing time

Variance control of stochastic reaction networks   **Sep 2023 – Ongoing**
- Co-work with Jinsu Kim, Yun Min Song, Dongju Lim and Jae Kyoung Kim
- Convert deterministic theorem to stochastic theorem, and applied control theoretic viewpoint
- Studied antithetic integral feedback motif, infinitesimal generator, and control theory

Robust perfect adaptation of reaction fluxes   **Jun 2023 – Sep 2023**
- Co-work with Hyukpyo Hong, Yuji Hirono, and Jae Kyoung Kim
- As an undergraduate research intern in the Biomedical Mathematics Group, Institute of Basic Science
- Identifying the structural conditions for the RPA of fluxes, and finding its biological meaning
- Studied robust perfect adaptation, reaction networks, and how to apply mathematics to biology

Moment closure method for stochastic reaction networks　　　　　**Jan 2023 - Nov 2023**
- ○ Advised by Jinsu Kim
- ○ Applying various moment closure approximation to stochastic reaction networks
- ○ Studied chemical reaction network theory, moment closure, stationary distribution of reaction network
- ○ Notes for this project is available here

Presentations

Contributed Talk

Exponential ergodicity of stochastic chemical reaction networks with a single species　　**Jul 2024**
2024 Society for Mathematical Biology Annual Meeting

Poster

Topological Criterion for Robust Perfect Adaptation of　　　　　　　　　**Jun 2024**
Reaction Fluxes in Biological Networks
2024 SMB Satellite Workshop : Recent Advances in Methods for Biomedical Mathematics

Spatial Models of Evolutionary Dynamics　　　　　　　　　　　　　　**Apr 2024**
2024 UIUC Undergraduate Research Symposium

Robust Perfect Adaption of Reaction Fluxes Ensured by Network topology　　**Aug 2023**
ICIAM 2023 Satellite Workshop : Stochastic Modeling and Data Analysis for Biological Systems

Seminars

Reading Group on PDE Models in Mathematical Biology, UIUC　　　　　**Apr 2024**
Woolley, Thomas E. "Boundary conditions cause different generic bifurcation structures
in Turing systems." Bulletin of Mathematical Biology 84.9 (2022): 101.

Reading Group on PDE Models in Mathematical Biology, UIUC　　　　　**Feb 2024**
Hillen, Thomas, and Kevin J. Painter. "A user's guide to PDE models for chemotaxis."
Journal of mathematical biology 58.1-2 (2009): 183-217.

Journal Club for stochastic analysis of biochemical systems, POSTECH　　**Nov 2023**
Briat, Corentin, Ankit Gupta, and Mustafa Khammash. "Antithetic proportional-integral
feedback for reduced variance and improved control performance of stochastic reaction networks."
Journal of The Royal Society Interface 15.143 (2018)

Journal Club, IBS Biomedical Mathematics Group　　　　　　　　　　**Aug 2023**
Ankit Gupta, and Mustafa Khammash. "The Internal Model Principle for Biomolecular
Control Theory", IEEE Open Journal of Control Systems 2 (2023): 63-69

POSTECH SIAM Student Chapter　　　　　　　　　　　　　　　　**May 2023**
What is the chemical master equation, and how to solve it?

Journal Club for stochastic analysis of biochemical systems, POSTECH　　**Mar 2023**
Lee, Chang Hyeong, Kyeong-Hun Kim, and Pilwon Kim. "A moment closure method
for stochastic reaction networks." The Journal of chemical physics 130.13 (2009)

Scholarship/Award

Exchange Program Scholarship, POSTECH Mathematics ($2,500)	*Sep 2024*
Exchange Program Scholarship, POSTECH ($2,500)	*Apr 2024*
Dean's List, POSTECH Mathematics	*Fall 2023*
Dean's List, POSTECH Mathematics	*Spring 2023*
National Scholarship of Excellence (Science & Engineering)	*Feb 2023 – Continued*
Jigok Scholarship	*Feb 2019 – Jan 2023*

Teaching/Mentoring

Student Mentoring Program, POSTECH   **Sep 2023 – Dec 2023**
Tutor for MATH203 *Applied Linear Algebra*

Student Advisor, POSTECH   **Mar 2023 – Dec 2023**
Teaching Assistant for MSUS102, MSUS103 *Future Planning for College Life I, II*

Educational Outreach Organization, POSTECH   **Mar 2023 – Dec 2023**
Visited local children's center weekly and taught math and science

1st Pohang Academy of AI and Mathematics, POSTECH MINDS   **Jan 2021 – Feb 2021**
Teaching Assistant for the practice section using Python

Student Mentoring Program, POSTECH   **Mar 2020 – Jun 2020**
Tutor for MATH203 *Applied Linear Algebra*

Educational Outreach Organization, POSTECH   **Sep 2019 – Dec 2019**
Visited local middle school weekly and help learning math and science

2019 Summer Educational Outreach Science Camp, POSTECH   **Jul 2019 – Aug 2019**
Invited middle school students, teaching scientific program and lead the students

Other Activities attended

Workshop on chemical reaction network theory: satellite workshop of SMB 2024   **Jul 2024**
Pohang, Republic of Korea

2023 KSIAM Annual Meeting   **Nov 2023**
Gwangju, Republic of Korea

The 8th CIJK Conference on Mathematical and Theoretical Biology   **Jun 2023**
Jeju, Republic of Korea

2023 KSIAM-NIMS School on Biomathematics : Statistical Tools   **Jun 2023**
for Mathematical Modeling
Jeju, Republic of Korea

2023 KMS Spring Meeting   **Apr 2023**
Daejeon, Republic of Korea

Extracurricular Activities

Educational Outreach Organization   **Jul 2019 – Ongoing**
○ Helping local student's study in math and science
○ Continued except for inevitable reasons (COVID, Military Service, Exchange student)

Signal Intelligence Soldier at ROK Defense Security Agency   **Feb 2021 – Nov 2022**
○ Mandatory military service
○ Worked with 303rd Intelligence Squadron at the OSAN Air Base

POSTECH Baseball Club   **Mar 2019 – Dec 2023**
○ 1st and 3rd Basemen
○ Played as a university representative player in official events

POSTECH Freshmen Student Council   **2019 Fall – 2020 Spring**
○ Worked as a member of the Design force

Skills/Languages

Korean, English, C, Python, Matlab, LaTeX, Julia, Mathematica

References

Prof. Jinsu Kim, jinsukim@postech.ac.kr
○ *Assistant professor* at Department of Mathematics, POSTECH.

Prof. Jae Kyoung Kim, jaekkim@kaist.ac.kr
○ *Associate Professor* at Department of Mathematical Sciences, KAIST.
○ *Chief Investigator* at BIomedical MAthematics Group (BIMAG), Center for Mathematical and Computational Sciences, Institute for Basic Sciences (IBS)

Prof. Daniel Cooney, dbcoone2@illinois.edu
○ *Assistant Professor* at Department of Mathematics, University of Illinois Urbana-Champaign

Prof. Hyukpyo Hong, hhong78@wisc.edu
○ *Assistant Professor* at the Department of Mathematics, University of Wisconsin–Madison