

Dae Wook Kim

CONTACT INFORMATION

Department of Mathematics
Sogang University Seoul
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EDUCATION

Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea
Biomedical Mathematics Research Group, IBS, Daejeon, Republic of Korea

Ph.D. in Mathematical Sciences (Mathematical Biology), 2016–2021

- Advisor: Jae Kyoung Kim
- Dissertation: Deterministic and Stochastic Mathematical Modeling and Analysis of Cellular Systems with Time Delay

Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea

Bachelor of Science in Mathematical Sciences, 2012–2016

ACADEMIC APPOINTMENT

Department of Brain and Cognitive Sciences, KAIST, Daejeon, Republic of Korea

Assistant Professor, 2024 –

Department of Mathematics, Sogang University, Seoul, Republic of Korea

Assistant Professor, 2024

Department of Mathematics, University of Michigan, Ann Arbor, Michigan, USA

James Van Loo Postdoctoral Fellow and Assistant Professor, 2021 – 2024

RESEARCH INTERESTS

Wearable technologies, Computational psychiatry, Sleep-wake cycle, Computational neuroscience, Chronotherapy, Precision medicine, Longitudinal data analysis, Mathematical modeling, Machine learning and deep learning, Anomaly detection, Stochastic processes, Nonlinear dynamics, Systems biology, Biochemical networks, Circadian rhythms, DNA damage and p53-rhythms

HONORS AND AWARDS

2023 SMB Poster Prize, Society for Mathematical Biology

2022 S-OIL Dissertation Excellence Award (grand prize), S-OIL and Korean Academy of Science and Technology

2022 KMS Dissertation Excellence Award, Korean Mathematical Society

2021 KSIAM Young Researcher Award, Korean Society for Industrial and Applied Mathematics

2020 SRBR Merit Award, Society for Research on Biological Rhythms

2019 SMB Landahl Travel Grant, Society for Mathematical Biology

2017–2022 Global Ph.D. Fellowship, National Research of Foundation of Korea

2012–2016 The National Scholarship for Science and Engineering, Korea Student Aid Foundation

PUBLICATIONS

*: co-1st author, +: co-corresponding author

Seokjoo Chae*, **Dae Wook Kim**, Oleg A. Igoshin, Seunggyu Lee, Jae Kyoung Kim⁺, Beyond microtubules: The cellular environment at the endoplasmic reticulum attracts proteins to the nucleus, essential for nuclear transport, *iScience* (2024).

Dae Wook Kim, Minki P. Lee, and Daniel B. Forger⁺, Wearable data assimilation to estimate the circadian phase, *SIAM J. Applied Math.* (2023).

Dae Wook Kim^{*,+}, Caleb Mayer^{*}, Minki P. Lee, Sung Won Choi, Muneesh Tewari, and Daniel B. Forger, Efficient assessment of real-world dynamics of circadian rhythms in heart rate and body temperature from wearable data, *J. R. Soc. Interface* (2023).

Seokjoo Chae^{*}, **Dae Wook Kim**, Seunggyu Lee, and Jae Kyoung Kim⁺, Spatially coordinated collective protein behaviors enable robust signaling from cell membrane to nucleus, *iScience* (2023).

Dae Wook Kim^{*}, Ja Min Byun^{*}, Jeong-Ok Lee, Jae Kyoung Kim⁺, and Youngil Koh⁺, Chemotherapy delivery time affects anti-lymphoma treatment outcome in a sex-dependent manner, *JCI insight* (2023).

Yasuko O. Abe^{*}, Hikari Yoshitane⁺, **Dae Wook Kim**, Michinori Koebis, Atsu Aiba, Jae Kyoung Kim⁺, and Yoshitaka Fukada⁺, Rhythmic transcription of Bmal1 stabilizes the circadian timekeeping system in mammals, *Nat. Commun.* (2022).

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).

Miao Lin Pay^{*}, **Dae Wook Kim**^{*}, Jae Kyoung Kim⁺, and Mathias Foo⁺, Modeling of plant circadian clock for characterizing hypocotyl growth under different light quality conditions, *in silico Plants* (2022).

Stephen Beesley^{*}, **Dae Wook Kim**^{*}, Matthew D'Alessandro, Yuanhu Jin, Kwangjun Lee, Hyunjeong Joo, Yang Young, Robert J. Tomko Jr, John Faulkner, Joshua Gamsby, Jae Kyoung Kim⁺, and Choogon Lee⁺, Wake-sleep cycles are severely disrupted by diseases affecting cytoplasmic homeostasis, *PNAS* (2020) (Editor's choice of Sci. Transl. Med. and Commun. Biol.).

Dae Wook Kim^{*}, Eder Zavala⁺, and Jae Kyoung Kim⁺, Wearable technology and systems modeling for personalized chronotherapy, *Curr. Opin. Syst. Biol.* (2020).

Xianlin Zou^{*}, **Dae Wook Kim**, Tetsuya Gotoh, Jingjing Liu, Jae Kyoung Kim, and Carla V. Finkielstein⁺, A systems biology approach identifies hidden regulatory connections between the circadian and cell-cycle checkpoints, *Front. Physiol.* (2020).

Dae Wook Kim^{*}, Cheng Chang⁺, Xian Chen, Angela C. Doran, Francois Gaudreadult, Travis Wager, George J. DeMarco, and Jae Kyoung Kim⁺, Systems approach reveals photosensitivity and PER2 level as determinants of clock-modulator efficacy, *Mol. Syst. Biol.* (2019; Cover article).

IN PREPARATION

Minki P. Lee^{*}, **Dae Wook Kim**^{*,+}, Yu Fang, Ruby Kim, Amy Bohnert, Srijan Sen, Daniel B. Forger⁺, The association between real-world behavior-induced circadian disruption and depression risks: A large-scale cohort study of training physicians, *In revision, npj Digital Medicine*.

Minki P. Lee^{*}, **Dae Wook Kim**^{*,+}, Olivia Walch, and Daniel B. Forger, The combination of topological data analysis and mathematical modeling improves sleep stage prediction from consumer-grade wearables, *In revision, J. Biol. Rhythms*, [bioRxiv](#).

Caleb Mayer^{*}, **Dae Wook Kim**^{*}, Mina Zhang, Minki P. Lee, Daniel B. Forger, Helen J. Burgess, Chooza Mon⁺, Predicting circadian phase in later life adults at home through mathematical models and wearable data, *Under review, J. Sleep Res.*

Ruby Kim^{*}, Yu Fang, Minki P. Lee, **Dae Wook Kim**, Zhengxu Tang, Srijan Sen, Daniel B. Forger⁺, Predicting inter-individual differences in photoperiodic encoding and shift work adaptation in medical interns, *Submitted*.

Song-Yi Jeong*, **Dae Wook Kim***, Seokmin Ha*, Gyeongik Ahn, Gyeong-Im Shin, Cam Chau Nguyen, Joon-Yung Cha, Jae Kyoung Kim⁺, and Woe-Yeon Kim⁺, Unraveling strong circadian rhythms: synergy in protein degradation and synthesis, *To be submitted*.

Dae Wook Kim*, Caleb Mayer*, Sung Won Choi, Muneesh Tewari, and Daniel B. Forger⁺, Deep learning-based real-time detection of aberrant physiological signals associated with diseases from wearable data, *In preparation*.

Dae Wook Kim*, and Daniel B. Forger⁺, Statistical Tests to determine if a human rhythm is circadian, *In preparation*.

Sanghyeok Park*, **Dae Wook Kim**, Jae Kyoung Kim⁺, Ji Min Lee⁺, Time-of-day effects on surgical outcomes of Glioblastoma, *In preparation*.

RESEARCH
EXPERIENCE

Ji Min Lee/ KAIST **2023-**

- Investigating time-of-day effects on surgical outcomes of Glioblastoma

Chooza Moon/ Univ. of Iowa **2023-**

- Investigating the circadian dynamics in the elderly population using DLMO and wearable measurements

Srijan Sen/ Univ. of Michigan & Daniel B. Forger/ Univ. of Michigan **2022-**

- Analyzing large-scale longitudinal wearable data

Sung Won Choi/ Univ. of Michigan, Muneesh Tewari/ Univ. of Michigan & Daniel B. Forger/ Univ. of Michigan **2022-2023**

- Developing an efficient algorithm to analyze noisy wearable temperature and heart rate data

Sung Won Choi/ Univ. of Michigan, Muneesh Tewari/ Univ. of Michigan & Daniel B. Forger/ Univ. of Michigan **2021-**

- Developing deep learning-based real-time anomaly detection algorithms

Daniel B. Forger/ Univ. of Michigan **2021-2023**

- Developing a level set Kalman filter algorithm to infer the internal clock state

Daniel B. Forger/ Univ. of Michigan **2021-**

- Developing a neural network sleep stage prediction algorithm based on topological data analysis and mathematical model

Hikari Yoshitane/Univ. of Tokyo and TMIMS, Yoshitaka Fukada/Univ. of Tokyo and TMIMS & Jae Kyoung Kim/KAIST **2021-2022**

- Researched the mammalian circadian timekeeping systems in the absence of rhythmic Bmal1 gene expression

Choogon Lee/Florida State Univ., Seokjoo Chae/KAIST & Jae Kyoung Kim/KAIST **2021-2022**

- Researched the role of PER multimerization in the circadian clock

Seunggyu Lee/Korea Univ. Sejong Campus, Seokjoo Chae/KAIST & Jae Kyoung Kim/KAIST **2021-**

- Researching the robustness of intracellular signaling dynamics to spatiotemporal noise

- Youngil Koh/Seoul National Univ. & Jae Kyoung Kim/KAIST** **2020-2022**
 • Researched sex-dependent variability in the effect of cancer chronotherapeutics
- Hyukpyo Hong/KAIST & Jae Kyoung Kim/KAIST** **2020-2022**
 • Researched inference of non-Markovian signaling dynamics
- Carla V. Finkielstein/Virginia Tech & Jae Kyoung Kim/KAIST** **2019-**
 • Researching the effect of DNA damage in circadian rhythms
- Mathias Foo/Univ. of Warwick & Jae Kyoung Kim/KAIST** **2018-2022**
 • Researched the effect of light wavelength on the circadian outputs of Arabidopsis
- Woe Yeon Kim/Gyeongsang National Univ. & Jae Kyoung Kim/KAIST** **2018-**
 • Researching the post-translational regulation of TOC1 via its interaction with GI, ZTL and PRR3
- Choogon Lee/Florida State Univ. & Jae Kyoung Kim/KAIST** **2018–2020**
 • Researched the robustness of circadian rhythms to noise in the cellular environment
- Cheng Chang/Pfizer, Jae Kyoung Kim/KAIST & George J. DeMarco/Univ. of Massachusetts Med. Sch.** **2016–2019**
 • Researched the difference in the effect of CK1 inhibitor on circadian rhythms between diurnal and nocturnal mammals

TEACHING
EXPERIENCE

- Applied Statistics with Computer (Spring 2024)**
Instructor Sogang University, Seoul, Korea
- Introduction to Linear Algebra (Spring 2024)**
Instructor Sogang University, Seoul, Korea
- Honors Calculus I (Fall 2023)**
Instructor (Teaching evaluation score: 4.96/5.00) University of Michigan, Ann Arbor, USA
- Introduction to Probability (Fall 2022)**
Instructor (Teaching evaluation score: 4.67/5.00) University of Michigan, Ann Arbor, USA
- Math Modeling in Biology (Fall 2021)**
Instructor (Teaching evaluation score: 4.94/5.00) University of Michigan, Ann Arbor, USA
- Methods of Applied Mathematics (Spring 2018)**
Teaching Assistant (Teaching evaluation score: 4.71/5.00) KAIST, Daejeon, Korea
 – Developed and graded homework assignments and quizzes.
- Academic Counseling (Fall 2016 & Spring 2017)**
Academic Counselor KAIST, Daejeon, Korea
 – Counseled undergraduate and graduate students 2 hours weekly
 – Organized official events of the Department of Mathematical Sciences, such as open lab ceremony
- Calculus I (Spring 2015)**
Undergraduate Teaching Assistant KAIST, Daejeon, Korea
 – Provided tutoring to students in Calculus I course 4 hours weekly
 – Graded quizzes.

Calculus I (Spring 2013) and Calculus II (Spring 2014 & Fall 2013-2015)

Mathematics tutor

KAIST, Daejeon, Korea

– Provided tutoring to students in Calculus I and II courses 4 hours weekly.

MENTORING

Minki P. Lee (University of Michigan, Ann Arbor, USA) 2021-

Joint BA/MA program, Department of Mathematics

Research interests: Circadian rhythms, Wearables, and Computational psychiatry.

He received [the Barry M. Goldwater Scholarship](#) in 2023.

Seokmin Ha (MIT, Cambridge, USA) 2020-

Ph.D. student, Department of Mathematics

Bachelor of Science in Mathematical Sciences, KAIST

Research interests: Circadian rhythms, Sleep, Machine learning and deep learning, Wearables, and Causality detection.

He received the Grand Prize from the KAIST Long-Term URP Workshop in 2021.

Oleg Mages (KAIST, Daejeon, Korea) 2017-2018

Undergraduate student, Department of Mathematical Sciences

Research interests: Circadian rhythms and Machine learning and deep learning.

He won third place at the Long-Term URP Workshop in 2017.

PRESENTATION

2024 Annual meeting of Society for Mathematical Biology, Minisymposium, Konkuk University, Seoul, Korea

2024 Mathematics Colloquium, Sogang University, Seoul, Korea

2024 Life Science Colloquium, Sogang University, Seoul, Korea

2024 Spring meeting of Korean Society for Industrial and Applied Mathematics, Panel discussion, Kyungpook National University, Daegu, Korea

2024 Annual Meeting of Korean Mathematical Society, Invited lecture, KAIST, Daejeon, Korea

2023 SIAM NNP Annual Meeting, Minisymposium, New Jersey Institute of Technology, Newark, USA

2023 ICIAM Satellite Workshop: Stochastic Modeling and Data Analysis for Biological Systems, IBS, Daejeon, Korea

2023 Annual meeting of Society for Mathematical Biology, Poster, The Ohio State University, Columbus, USA

2023 IBS Applied Mathematics Seminar, IBS, Daejeon, Korea

2023 Applied Mathematics Seminar, Chungbuk National University, Cheongju, Korea

2023 Applied Mathematics Colloquium, Pusan National University, Busan, Korea

2023 POSTECH MINDS Colloquium, POSTECH, Pohang, Korea

2023 Spring Meeting of Korean Mathematical Society, Special session, Deajeon, Korea

2023 Mathematical Biology Seminar, University of Iowa, Virtual

2022 Mini-workshop on Recent Trends in Pure and Applied Mathematics, Daejeon, Korea

2022 Cognitive Fatigue MURI Research Forum, Ann Arbor, USA

2022 SIAM Conference on the Life Sciences, Minisymposium, Pittsburgh, USA

2022 SIAM Student Minisymposium in Applied Mathematics, University of Michigan, Ann Arbor, USA

2022 Meeting of Society for Research on Biological Rhythms, Fernandina Beach, USA
 2022 Meeting of Society for Research on Biological Rhythms, Poster, Fernandina Beach, USA
 2021 IBS Applied Mathematics Seminar, IBS, Daejeon, Korea
 2021 NIMS Applied Mathematics Seminar, NIMS, Daejeon, Korea
 2021 Applied Mathematics Colloquium, University of Cincinnati, Cincinnati, USA
 2021 Capsule Research Talks, University of Michigan Ann Arbor, Minisymposium, Virtual
 2021 Spring meeting of Korean Society for Industrial and Applied Mathematics, Invited talk, Young Researcher Award talk, Gangneung-si, Korea
 2021 Annual meeting of Society for Mathematical Biology, Minisymposium, Virtual
 2021 BRIC Webinar, Invited talk, Virtual
 2020 Annual Meeting of Korean Mathematical Society, Minisymposium, Virtual
 2020 Annual Conference of Korean Society for Industrial and Applied Mathematics, Poster, Virtual

 2020 Meeting of Society for Research on Biological Rhythms, Poster, Virtual
 2019 Annual meeting of Society for Mathematical Biology, Minisymposium, Montreal, Canada
 2019 Spring meeting of Korean Society for Industrial and Applied Mathematics, Special session, Seoul, Korea
 2019 A3 Workshop on Mathematical Biology, General session, Beijing, China
 2018 Annual meeting of Society for Mathematical Biology, Minisymposium, Sydney, Australia
 2018 Annual Conference of Korean Society for Mathematical Biology, Special session, Busan, Korea

 2018 Meeting of Society for Research on Biological Rhythms, Poster, Fernandina Beach, USA
 2018 International Workshop on Mathematical Biology, Poster, Cebu, Philippines
 2018 Spring meeting of Korean Society for Industrial and Applied Mathematics, Contributed talk, General session, Daejeon, Korea
 2017 Annual Conference of Korean Society of Sleep Medicine, Poster, Seoul, Korea
 2017 Annual Conference of Korean Society for Industrial and Applied Mathematics, Poster, Busan, Korea
 2017 Innovative Statistics and Machine Learning for Precision Medicine, Poster, Minneapolis, USA
 2017 Annual Conference of Korean Society for Mathematical Biology, Poster, Jeju, Korea
 2017 Spring meeting of Korean Society for Industrial and Applied Mathematics, Poster, Seoul, Korea
 2017 A3-NIMS Joint Workshop on Mathematical Biology, Short talk, General session, Daejeon, Korea

ADVISORY ACTIVITY	Development of pharmacology systems model, RES Group	2020
	Development of pharmacology systems model, Pfizer Inc.	2016–2019
PROFESSIONAL ACTIVITY	Tech support staff in 2021 Annual Meeting of Society for Mathematical Biology, Virtual	2021

Attended International Chronobiology Summer School, Virtual	2020
Attended International GNU Symposium on Agrobiotechnology, Gyeongsang National Univ.	2019
Attended Applied Algebraic Topology 2017, Hokkaido Univ.	2017
Attended Industrial Mathematics Summer Program, Konkuk Univ.	2016
Attended Mathematical Modeling Summer Program, Chonnam National Univ.	2016
Attended Biological Physics Summer Program, POSTECH	2016
Member of Korean Mathematical Society	2020–present
Member of Society for Industrial and Applied Mathematics	2019–present
Member of Society for Mathematical Biology	2018–present
Member of Society for Research on Biological Rhythms	2018–present
Member of Korean Society for Industrial and Applied Mathematics	2017–present
Member of Korean Society for Mathematical Biology	2017–present

RESEARCH FUND Development of mathematical model of the human circadian rhythms for developing a new drug, Global Ph.D. Fellowship, NRF (2017H1A2A1046381) 2017–2021

PEER REVIEW PLOS Computational Biology
Scientific Reports
Journal of Theoretical Biology