





Changhan He, Ph.D.





 Department of Mathematics, University of California, Irvine

 Irvine, California, 92614




 changhh3@uci.edu

 www.changhanhe.com



Professional Experience

- 2023.07 – present  **Visiting Assistant Professor.** Department of Mathematics, University of California, Irvine. (Mentor: **Prof. Qing Nie**)
- 2021.07 – 2023.06  **Postdoctoral Scholar.** Department of Mathematics, University of California, Irvine. (Mentor: **Prof. Qing Nie**)
- 2019.07 – 2021.06  **Graduate Research Associate.** Department of Mathematics, Arizona State University.
- 2016.09 – 2019.06  **Teaching Associate.** Department of Mathematics, Arizona State University.

Research Interests

-  **Multi-scale Mathematical Modeling in Biology**
Including cell-cell communication, bacteria pattern formation, and cancer dynamics.
-  **Computational Biology**
Method development and topological data analysis (single-cell transcriptomics data & image data).
-  **Differential Equations and Dynamical Systems**
ODE & Reaction-diffusion equation modeling, traveling wave and bifurcation analysis.






Education

- 2016 – 2021  **Ph.D., Arizona State University**, Applied Mathematics (GPA:4.0).
Thesis title: *Spatial Temporal Patterning and Dynamics of E. coli Growth with Nutrient Variation*. (Advisor: **Prof. Yang Kuang**)
- 2012 – 2016  **B.S., University of Science and Technology of China**, Applied Mathematics (GPA:3.4).

Research Publications

(* corresponding author)

Publications

-  Chen, X., **He, C.**, Zhang, Q., Bayakmetov, S., & Wang, X. (2024). Modularized design and construction of tunable microbial consortia with flexible topologies. *ACS Synthetic Biology*, 13(1), 183–194.
-  Harris, D. C., **He, C.**, Preul, M. C., Kostelich, E. J., & Kuang, Y. (2023). Critical patch size of a two-population reaction-diffusion model describing brain tumor growth. *SIAM journal on applied mathematics*, S249–S268.
-  **He, C.**, Zhou, P., & Nie, Q. (2023). exFINDER: Identify external communication signals using single-cell transcriptomics data. *Nucleic Acids Research*, gkad262.
-  **He, C.***, Han, L., Harris, D., Wang, X., & Kuang, Y. (2023). Reaction-diffusion modeling of *E. Coli* colony growth based on nutrient distribution and agar dehydration. *Bulletin of Mathematical Biology*, 85(7), 61.
-  Han, L., **He, C.**, Dinh, H., Fricks, J., & Kuang, Y. (2022). Learning biological dynamics from spatio-temporal data by gaussian processes. *Bulletin of mathematical biology*, 84(7), 1–20.

- 6 Phan, T., He, C., Loladze, I., Prater, C., Elser, J., & Kuang, Y. (2022). Dynamics and growth rate implications of ribosomes and mrnas interaction in e. coli. *Heliyon*, 8(7), e09820.
- 7 Melendez-Alvarez, J., He, C., Zhang, R., Kuang, Y., & Tian, X.-J. (2021). Emergent damped oscillation induced by nutrient-modulating growth feedback. *ACS Synthetic Biology*, 10(5), 1227–1236.
- 8 Han, L., He, C., & Kuang, Y. (2020). Dynamics of a model of tumor-immune interaction with time delay and noise. *Discrete & Continuous Dynamical Systems-S*, 13(9), 2347.
- 9 He, C., Bayakhmetov, S., Harris, D., Kuang, Y., & Wang, X. (2020). A predictive reaction-diffusion based model of *E. Coli* colony growth control. *IEEE Control Systems Letters*, 5(6), 1952–1957.
- 10 Han, L., Eikenberry, S., He, C., Johnson, L., Preul, M. C., Kostelich, E. J., & Kuang, Y. (2019). Patient-specific parameter estimates of glioblastoma multiforme growth dynamics from a model with explicit birth and death rates. *Mathematical biosciences and engineering: MBE*, 16(5), 5307.
- 11 Phan, T., He, C., Martinez, A., & Kuang, Y. (2019). Dynamics and implications of models for intermittent androgen suppression therapy. *Mathematical Biosciences and Engineering*, 16(1), 187–204.

Preprints

- 1 Phan, T. A. Q., He, C., Jin, S., Avila, A. U., Nie, Q., & Downing, T. L. (2023, submitted). *Adhesive signaling mediates stemness acquisition through dynamic regulation of cell communication and fate trajectories*.
- 2 Wu, F., He, C., Fang, X., Baez, J., Ohnmacht, T., Zhang, Q., ... Wang, X. (2019, under revision for *Science*). *A synthetic biology approach to sequential stripe patterning and somitogenesis*.
[doi:https://doi.org/10.1101/825406](https://doi.org/10.1101/825406)



Other Notable Projects

- 2023 - present ▮ **Identifying multiple transition states during the differentiation of zebrafish early neural crest cells via single-cell transcriptomic data**
 Developing a computational pipeline to identify multiple transition states during the neural crest differentiation using single-cell transcriptomic data, and infer the corresponding critical signaling pathways.
- 2022 - present ▮ **Identifying external communication signals using spatial transcriptomics data**
 Developing a computational method identify and analyze external communication signals and their corresponding gene regulatory networks.
- ▮ **Multiscale modeling of the differentiation of zebrafish early neural crest cells via single-cell transcriptomic data**
 Inferring the gene regulatory network using single-cell transcriptomic data, developing its corresponding ODE system, and integrating it into a novel agent-based model.
- ▮ **Modeling daphnia growth with multi-resource limitations**
 Using ecological stoichiometry (ODE) models to describe Daphnia's growth governed by multiple intracellular resources (such as carbon and phosphorous).

Patents


- ▮ **Methods and Systems for Generating Complex Spatial Patterns**
 U.S. Patent Application No. 63/055,321
 Pub. No.: US 2022/0025385 A1
 Authors: Fuqing Wu, Samat Bayakhmetov, **Changhan He**, Qi Zhang, Xingwen Chen, Yang Kuang, Xiao Wang

Grants and Awards




- 2021  **Block Grant Research Award Summer 2021**
Award amount: \$4234.00.
-  **Graduate College Travel Award**
Award amount: \$150.00.
- 2018  **Graduate College Travel Award**
Award amount: \$500.00.
- 2017  **Graduate College Travel Award**
Award amount: \$450.00.

Teaching Related Experience








Instructor of following courses at UCI:

- 2023 fall  Intro to Programming for Numerical Analysis (Section A & B).

Teaching assistant of following courses at ASU:

- 2018 fall  Differential Equations II (graduate level).
- 2018 spring  Applied Analysis (graduate level).
- 2017 fall,spring  Applied Linear Algebra (undergraduate level).





Selected Presentations

- 2024  **SIAM Conference on the Life Sciences (LS24)**, Portland, United States.
Title: *Data-driven identification of the external communication signals and analysis of their associated signaling networks using exFINDER.*
- 2023  **SIAM Conference on Applications of Dynamical Systems (DS23)**, Portland, United States.
Title: *Reaction-diffusion Modeling of E. Coli Colony Growth based on Nutrient Distribution and Agar Dehydration.*
- 2022  **Mathematical Biology Seminar Series**, Arizona State University.
Title: *Inferring cell-cell communication and identifying external signals using single-cell transcriptomics data.*
-  **CMB Mathematical Biology Seminar Series**, University of Alberta. (Virtual presentation)
Title: *A mathematical modeling approach on studying E. coli colony growth and synthetic patterning.*
- 2021  **The 2021 American Control Conference.** (Virtual presentation)
Title: *A predictive reaction-diffusion based model of E. coli colony growth control.*
- 2020  **Biological Stoichiometry: From gene to ecosystem** (joint online seminar hosted by University of Montana, Arizona State University and Oklahoma State University.)
Title: *"Top down" & "Bottom up" – the role of cell growth rate in different biological approaches.*
- 2019  **ICMA-VII: Seventh International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems**, Arizona State University, Tempe, United States.
Title: *Reaction-diffusion based pattern formation modeling and its basic dynamical behavior.*
- 2018  **The Sixth G. J. Butler International Conference**, University of Alberta, Edmonton, Canada.
Title: *Reaction-diffusion based pattern formation from synthetic gene networks.*







Other Conferences and Workshops

- 2023  **Mathematical and Computational Workshop (ICERM)**, Brown University, Providence, United States.







Other Conferences and Workshops (continued)

- 2020  **PI4: Data Science Boot Camp** (NSF-Founded online workshop virtually hosted by University of Illinois, Urbana-Champaign).
- 2019  **Fourth Workshop on Parameter Estimation for Mechanistic Biological Models**, North Carolina State University, Raleigh, United States.
- 2018  **1st Annual Cell Fate Symposium** (NSF-Simons Center for Multiscale Cell Fate Research), University of California Irvine, Irvine, United States.
- 2017  **ICMA-VI: Sixth International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems**, University of Arizona, Tucson, United States.



Journal Referee

-  SIAM Journal on Applied Mathematics
-  Journal of Theoretical Biology
-  Mathematical Biosciences and Engineering
-  Discrete and Continuous Dynamical Systems - Series B
-  Bioinformatics
-  Mathematical Biosciences

Services

- 2024.06 - 2024.07  **Math ExpLR**, UC Irvine. (**Mentor**)
Mentor of the high school summer research program. Title: Analysis of Cell-Cell Communication in Renal Cell Carcinoma using CellChat. Mentees: Harriet Lai, Eddie Zhang, Lucas Chi.
- 2023.09 - 2024.03  **ROTO OCSEF Mentorship Program**, UC Irvine. (**Mentor**)
Mentored students from Westminster High School (a **Title 1** High School) with their projects for the Orange County Science & Engineering Fair (OCSEF). Mentees: Nicholas Nguyen, Kathleen Pham, Nathan Truong.
- 2023.12  **SCUDEM VIII 2023**, United States. (**Judge**)
Judge of the SCUDEM contest, in which college undergraduates to engage in a differential equations modeling experience using real-world modeling problems.
- 2023.06 - 2023.08  **AWIS Summer STEM Career Mentorship Program**, UC Irvine. (**Mentor, Q&A event panelist**)
Mentored grad students at UCI on career development. Mentees: Angel Balam Benitez Mata (Ph.D. candidate), Anita Ghandehari (Ph.D. candidate).
- 2023.02  **MATHCOUNTS Regional Competition**, UC Irvine. (**Volunteer**)
Helped organizing the competition of local public middle school students.
- 2023.04  **ASU Math Bio Club Alumni Panel**, Arizona State University. (**Invited panelist**)
Provided advises on professional development to graduate students who have interests in the mathematical biology area.

Skills

- Languages  Mandarin Chinese (Native), English (Professional proficiency).
- Coding  R, Python, MATLAB, \LaTeX , ...