Changhan He, Ph.D.

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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**)

Education

2016 – 2021 **Ph.D., Arizona State University**, Applied Mathematics.
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.

Research Interests

- **Multi-scale Mathematical Modeling in Biology**
  Modeling of cell-cell communication, bacteria pattern formation, and cancer dynamics.
- **Data Science for Biology**
  Developing computational methods for analyzing single-cell and image data.
- **Differential Equations and Dynamical Systems**
  ODE & Reaction-diffusion equation modeling, traveling wave and bifurcation analysis.

Research Publications

(* *corresponding author*)

Publications

1. 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. doi:10.1021/acssynbio.3c00420
2. **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. doi:10.1007/s11538-023-01163-2
3. **He**, **C.**, Zhou, P., & Nie, Q. (2023). exFINDER: Identify external communication signals using single-cell transcriptomics data. *Nucleic Acids Research*, gkad262. doi:10.1093/nar/gkad262
4. 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. doi:10.1137/22M1509631
5. 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. doi:10.1007/s11538-022-01022-6

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. doi:10.1016/j.heliyon.2022.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. doi:10.1021/acssynbio.1c00041

8. **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. doi:10.1109/lcsys.2020.3046612

9. 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. doi:10.3934/dcdss.2020140

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*, *16*(5), 5307. doi:10.3934/mbe.2019265

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. doi:10.3934/mbe.2019010

Under revision

1. Phan, T. A. Q., Avila, A. U., Origer, N., **He**, **C.**, Aleman, E., Shao, H., … Downing, T. L. (2024). *Adhesome signaling mediates stemness acquisition through dynamic regulation of cell communication and fate trajectories*. Under 2nd round revision for *Nature Communication*.

2. Wu, F., **He**, **C.**, Fang, X., Baez, J., Ohnmacht, T., Zhang, Q., … Wang, X. (2019). *A synthetic biology approach to sequential stripe patterning and somitogenesis.* Under revision for *Science*.

Preprints

1. **He**, **C.**, Luo, S., & Nie, Q. (2024). *Organ-organ communication through single cells.* Preprint.

2. **He**, **C.**, Simpson, C., Cossentino, I., Zhang, B., Tkachev, S., Eddins, D. J., … Orlova, D. (2024). *Cell signaling networks discovery from multi-modal data.* Preprint.

3. **He**, **C.**, Tucker, R. T., Eshghi, S., Rovira, M., Mularoni, L., Nie, Q., & Parsons, M. (2024). *Single-cell analysis identifies distinct subpopulations of centroacinar cells in the adult zebrafish pancreas.* Preprint.

4. **He**, **C.**, Subramanian, A., Nayak, P., Miller, C., Tatarakis, D., Nie, Q., & Schilling, F. T. (2024). *Identification of the transition states in zebrafish neural crest development via single-cell analysis.* Preprint.

Patents

Methods and Systems for Generating Complex Spatial Patterns
U.S. Patent Application No. 63/055,321
Pub. No.: US 2022/0025385 A1
Authors: Wu, F., Bayakhmetov, S., **He, C.**, Zhang, Q., Chen, X., Kuang, Y., Wang, X..

Grants and Awards

2021 **Block Grant Research Award Summer 2021**
Award amount: $4234.00.

Teaching-related Experience

Instructor of the following courses and workshop at UCI:

2025 spring (scheduled) Intro to Programming for Numerical Analysis
2024.09 Workshop on scRNA-seq data and cell-cell communication analysis
2023 fall Intro to Programming for Numerical Analysis

Teaching assistant of the 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)

Presentations

2024 **The NIDDK Information Network (dkNET) Webinar**, virtual presentation.
Title: *Inference and Analysis of the External Communication Signals Using exFINDER*

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.*

Scientist talk at Cell Signaling Technology, Inc., Boston, United States.
Title: *Data-driven identification and analysis of the cell signaling networks using multi-model data.*

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

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

Mentoring and Services

2024.06 - 2024.07 **Math ExpLR (summer research program)**, UC Irvine. (**Mentor**)
Mentoring high school students on the project "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**)
Mentoring students from Westminster High School (a **Title 1** High School) on the project "BioCanvas: Synthesizing Organic Pigment from Flavobacterium Bacteria" (**Best Real World Application Award**). Mentees: Nicholas Nguyen, Kathleen Pham, Nathan Truong.

2023.12 **SCUDEM VIII 2023**, United States. (**Judge**)
Judge of the SCUDEM contest, in which nationwide college undergraduates to differential equations modeling in real-world problems.

2023.06 - 2023.08 **AWIS Summer STEM Career Mentorship Program**, UC Irvine. (**Mentor**)
Mentoring UCI Ph.D. students on career development. Mentees: Angel Balam Benitez Mata, Anita Ghandehari.

2023.04 **ASU Math Bio Club Alumni Panel**, Arizona State University. (**Invited panelist**)
Providing advice on professional development to graduate students interested in mathematical biology.

2023.02 **MATHCOUNTS Regional Competition**, UC Irvine. (**Volunteer**)
Helping organize the competition for local public middle school students.

Skills

Coding R, MATLAB, Python, …