HONGRU DU

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Department of Civil & Systems Engineering
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RESEARCH INTERESTS

My research bridges the fields of **Systems Engineering** and **Public Health**, where I develop **computational and artificial intelligence methods** to tackle broader societal challenges. Specifically, my research focuses on:

- **Data-Driven Decision-Making**
- **Multimodal Machine Learning for Public Health**
- **Modeling Human Behavior in Complex Systems**

EDUCATION

Johns Hopkins University, Baltimore, MD, USA *Sept. 2019 - Present*
Ph.D. Systems Engineering *Expected: May 2025*
Advisor: Professor Lauren Gardner
Dissertation: From Data to Decisions: Engineering Approaches to Equitable and Resilient Public Health Systems

University of Wisconsin-Madison, Madison, WI, USA *Sept. 2017 - Jan. 2019*
M.Sc. Industrial Engineering
Advisor: Professor Vicki Bier

University of Edinburgh, Edinburgh, UK *Sept. 2015 - May 2017*
B.Sc. Material Chemistry

Tianjin University, Tianjin, China *Sept. 2013 - May 2015*
B.Eng. Chemical Engineering

AWARDS

- **INFORMS 2024 Poster Competition Second Place Award** *2024*
  INFORMS Annual Meeting, Seattle, WA, USA
- **Best Demonstration Project Award** *2024*
  Data Science and AI Institute, Johns Hopkins University, Baltimore, MD, USA
- **Graduate Student Teaching Award Nominee** *2023*
  Johns Hopkins University, Baltimore, MD, USA
- **ESRI Making a Difference Award** *2020*
  ESRI, Redlands, CA, USA
- **Richard D. Hickman Fellowship** *2019*
  Johns Hopkins University, Baltimore, MD, USA
- **Tianjin Environmental Protection Science and Technology Award** *2016*
  Tianjin Environmental Science Society, Tianjin, China
- **International Student Scholarship** *2015*
  University of Edinburgh, Edinburgh, UK

PUBLICATIONS

Under Reviewed Journal Articles:

1. **Du, H.***, Zahn, M.*, Loo, S., Alleman, T., Truelove, S.A., Patenaude, B., Gardner, L.M., Papageorge, N. and Hill, A.L., 2024. Modeling dynamic disease-behavior feedbacks for improved epidemic prediction and response. medRxiv.

2. Xu, S., **Du, H.**, Dong, E., Wang, X., and Gardner, L.M., A Multi-Pathogen Model to Forecast Hospitalizations in the US: An Optimized GeoHierarchical Ensemble Framework.

Peer Reviewed Articles:

3. **Du, H.***, Zhao, J.*, Zhao, Y.*, Xu, S., Lin, X., Chen, Y., Gardner, L.M. and Yang, H., 2024. Advancing Real-time Pandemic Forecasting Using Large Language Models: A COVID-19 Case Study. arXiv preprint arXiv:2404.06962, 2024. (Accepted in Principle *Nature Computational Science*.)

4. Rankin, N., Saiyed, S., **Du, H.** and Gardner, L.M., 2025. A multi-city COVID-19 categorical forecasting model utilizing wastewater-based epidemiology. *Science of The Total Environment*, 960, p.178172.

5. Hamilton, A., Haghpanah, F., Tulchinsky, A., Kipshidze, N., Poleon, S., Lin, G., **Du, H.**, Gardner, L. and Klein, E., 2024. Incorporating endogenous human behavior in models of COVID-19 transmission: A systematic scoping review. *Dialogues in Health*, p.100179.

6. **Du, H.**, Saiyed, S. and Gardner, L.M., 2024, Association between vaccination rates and COVID-19 health outcomes in the United States: a population-level statistical analysis. *BMC Public Health*, 24(1), pp.1-14.

7. Badr, H.S., Zaitchik, B.F., Kerr, G.H., Nguyen, N.L.H., Chen, Y.T., Hinson, P., Colston, J.M., Kosek, M.N., Dong, E., **Du, H.** and Marshall, M., ..., Gardner, L.M., 2023. Unified real-time environmental epidemiological data for multiscale modeling of the COVID-19 pandemic. *Scientific Data*, 10(1), p.367.

8. **Du, H.**, Dong, E., Badr, H.S., Petrone, M.E., Grubaugh, N.D. and Gardner, L.M., 2023. Incorporating variant frequencies data into short-term forecasting for COVID-19 cases and deaths in the USA: a deep learning approach. *eBioMedicine*, 89.

9. Dong, E., Ratcliff, J., Goyea, T.D., Katz, A., Lau, R., Ng, T.K., Garcia, B., Bolt, E., Prata, S., Zhang, D., Murray, R.C., Blake, M.R., **Du, H.**, ..., Gardner, L.M., 2022. The Johns Hopkins University Center for Systems Science and Engineering COVID-19 Dashboard: data collection process, challenges faced, and lessons learned. *The Lancet Infectious Diseases*.

10. Badr, H.S., **Du, H.**, Marshall, M., Dong, E., Squire, M.M. and Gardner, L.M., 2020. Association between mobility patterns and COVID-19 transmission in the USA: a mathematical modelling study. *The Lancet Infectious Diseases*, 20(11), pp.1247-1254.

11. Dong, E., **Du, H.** and Gardner, L., 2020. An interactive web-based dashboard to track COVID-19 in real time. *The Lancet infectious diseases*.

12. Bier, V.M., Zhou, Y. and **Du, H**., 2019. Game-theoretic modeling of pre-disaster relocation. *The Engineering Economist*, pp.1-25.

13. Kou, H., Luo, H., **Du, H.**, Du, P., Lang. F., and Lin, B., 2016. Effects of inlet water temperature of air source carbon dioxide heat pump on system performance under low-temperature climate conditions. *CIESC Journal*, 67(S2), p.378.

Articles Under Preparation:

14. Ma, C.*, **Du, H.***, Luan, S., Gardner, L.M., and Gernay, T., A Comprehensive Data-Driven Study on Fire Risk: Occurrences and Consequences.
15. **Du, H.**, Xu. S., Rankin, N., and Gardner, L.M., The Unequal Impact of COVID-19 on Population Lifestyle: A Timeseries Clustering Analysis of Activities Across the United States.
16. Hou, A., **Du, H.**, Wang, Y., Zhang, J., Liang, P., Khashabi, D., Gardner, L.M., and He, T., Simulate Vaccination Attitude with Generative Agents.
17. Wang., P., Zhao, Y., Zhao, Y., **Du, H.**, and Yang, H., Customizing Data-centric Large Language Models for Traffic Crash Event Learning and Factor Attribution

Patent:

18. Lang, f., **Du, H.**, Yan, Y., Ding, W., Du, P., 2016. Carbon dioxide heat pump system for improving heating efficiency by utilizing gas-liquid two-phase separator. CN Patent 105485951A.

INVITED TALKS

1. *Department of Systems and Information Engineering, University of Virginia* *2024*
2. *Department of Industrial Engineering, Tsinghua University* *2024*
3. *Tuanshan Hill Anti-XID Forum, China CDC, Online* *2024*
4. *Applied Micro Brownbag Seminar, Department of Economics, Johns Hopkins University* *2024*
5. *Biostatistics first-year seminar, Bloomberg School of Public Health* *2024*
6. *Johns Hopkins Alumni virtual weekend, Baltimore, MD, USA* [link] *2021*
7. *2021 ABET SYMPOSIUM, Online* *2021*
   Closing Keynote Speaker. [link]
8. *Johns Hopkins Biomedical Engineering Spring Speaker Series, Baltimore, MD, USA* *2020*

CONFERENCE ACTIVITY

Presentations:

1. *MIDAS Annual Meeting, DC, USA* *2024*
   Incorporate Human Behavior into Infectious Disease Modeling.
2. *INFORMS Annual Meeting, Seattle, WA, USA* *2024*
   Invited talk for section "Integration of Human, Knowledge and Systems for Quality".
   Modeling dynamic disease-behavior feedback for improved epidemic prediction and response.
3. *Data Science and AI Institute, Baltimore, MD, USA* *2024*
   Advancing Real-time Pandemic Forecasting Using Large Language Models: A COVID-19 Case Study.
   Best Demonstration Project Award.
4. *INFORMS Annual Meeting, Phoenix, AZ, USA* *2023*
   Association Between Vaccination Rates and Covid-19 Health Outcomes in the United States: A Population-level Statistical Analysis.
5. *Epidemics 8 Conference, Online* *2022*
   A Deep Learning Approach to Forecast Short-Term COVID-19 Cases and Death in the US.
6. *INFORMS Annual Meeting, Pheonix, AZ, USA* *2018*
   Game-theoretic modeling of pre-disaster relocation.

Posters:

7. *APHA Annual Meeting, Minneapolis, MN, USA* *2024*
   Advancing Real-time Pandemic Forecasting Using Large Language Models.
8. *INFORMS Annual Meeting, Seattle, WA, USA* *2024*
   Poster competition: Advancing Real-time Pandemic Forecasting Using Large Language Models. ***Second Place Award.***
9. *IDM Annual Symposium, Seattle, WA, USA* *2024*
   Advancing Real-time Infectious Disease Forecasting Using Large Language Models.
10. *MIDAS Annual Meeting, Atlanta, GA, USA* *2023*
    Association Between Vaccination Rates and Covid-19 Health Outcomes in the United States: A Population-level Statistical Analysis.
11. *Ecology and Evolution of Infectious Diseases, University Park, PA, USA* *2023*
    Association between vaccination rates and severe COVID-19 health outcomes in the United States: a population-level statistical analysis.
12. *IDM Annual Symposium, Seattle, WA, USA* *2023*
    Incorporating variant frequencies data into short-term forecasting for COVID-19 cases and deaths in the USA: a deep learning approach.
13. *AI in Healthcare Symposium, Baltimore, MD, USA* *2019*
    Data-driven Vehicle-routing Approach to Connect Chronically-ill Patients.

RESEARCH MENTORSHIP EXPERIENCES

- Samee Saiyed, Ph.D. Candidate, Johns Hopkins University *2022 to now*
  Infectious Disease Forecasting and Human Mobility.
- Naomi Rankin, Ph.D. candidate, Johns Hopkins University *2023 to now*
  Infectious Disease Forecasting and Statistical Inference.
- Shaochong Xu, Ph.D. candidate, Johns Hopkins University *2023 to now*
  Real-time Flu Forecasting and Timeseries Clustering.
- Xianglong Wang, Graduate student, Johns Hopkins University *2023*
  Real-time Flu Forecasting.
- Liyue Zhang, Graduate student, Johns Hopkins University *2024 to now*
  Vaccine Hesitancy.

TEACHING EXPERIENCE

Applied Modeling for Public Health 2023 Workshop *October, 2023*
Johns Hopkins International Vaccine Access Center, Baltimore, MD
Instructor

EN.560.653 An Introduction to Network Modeling *Fall 2020, 2021, 2022*
Teaching Assistant
Responsibilities: Design homework, exams, and weekly labs. Giving formal lectures.

MEDIA

- **Effects of varying COVID-19 vaccination rates on population-level health outcomes across variant waves in the U.S.**
  News Medical Life Sciences [link] *2024*

- **Behind the Johns Hopkins University coronavirus dashboard**
  Nature Index [link] *2020*
- **Chinese overseas PhD students help map out pandemic situation**
  People's Daily Online [link] *2020*
- **Who has the most high-profile COVID-19 tracking map**
  CGTN [link] *2020*
- **Chinese students behind globally-shared COVID-19 data map**
  ecns.cn [link] *2020*

PROFESSIONAL SERVICE

Peer Review

Journals:

- BMC Public Health
- JMIR Public Health and Surveillance
- PLOS ONE
- BMJ Public Health
- Wellcome Open Research
- Virus Evolution
- Dialogues in Health
- Journal of Public Health Policy

Conferences:

- Models of Infectious Disease Agent Study (MIDAS) 2024
- American Public Health Association (APHA) 2024
- Transportation Research Board (TRB) 2023

To University

- *Representative*, Civil and Systems Engineering Graduate Association *2021 to 2022*
- *Communication Coordinator*, Center for Systems Science & Engineering *2022 to now*

To Community

- FluSight real-time influenza forecasting, CDC *2023 to now*
- Forecast Hub real-time COVID-19 forecasting, CDC *2021 to 2023*

PROFESSIONAL ASSOCIATIONS

- Member, American Public Health Association *2023 to present*
- Member, Models of Infectious Disease Agent Study *2021 to present*
- Member, Institute for Operations Research and the Management Sciences *2019 to present*