Hongru Du

Assistant Professor, Department of Systems and Information Engineering, University of Virginia, VA, USA

qdc4kc@virginia.edu | 443-808-7381 | Personal Website | Google Scholar |

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 Social Systems**
- **Modeling Human Behavior in Complex Systems**

Appointment

Assistant Professor — July 2025 –
University of Virginia, Department of Systems and Information Engineering

Education

Johns Hopkins University, USA, Ph.D. in Systems Engineering — Sept 2019 – June 2025

- Advisor: Prof. Lauren Gardner
- **Thesis:** From Data to Decisions: Engineering Pathways to Equitable and Resilient Public Health Systems

University of Wisconsin-Madison, USA, M.Sc in Industrial Engineering — Sept 2017 – Jan 2019

- Advisor: Prof. Vicki Bier

University of Edinburgh, UK, B.Sc in Material Chemistry — Sept 2013 – May 2017

Tianjing University, China, B.Eng in Chemical Engineering — Sept 2013 – May 2017

Awards

- **INFORMS 2024 Poster Competition Second Place Award**, INFORMS 2024 *2024*
- **Best Demonstration Project Award**, Data Science and AI Institute *2024*
- **Graduate Student Teaching Award Nominee**, Johns Hopkins University *2023*
- **ESRI Making a Difference Award**, ESRI *2020*
- **Richard D. Hickman Fellowship**, Johns Hopkins University *2019*
- **Tianjin Environmental Protection Science and Technology Award** *2016*
- **International Student Scholarship**, University of Edinburgh *2015*

Publications

Under Reviewed Articles: * Co-first author, † Corresponding author

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, pp.2024-11.
2. Xu, S., **Du, H.**, Dong, E., Wang, X., Zhang, L. and Gardner, L.M., 2025. A Multi-pathogen Hospitalization Forecasting Model for the United States: An Optimized Geo-Hierarchical Ensemble Framework. medRxiv, pp.2025-01.
3. 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
4. Hou, A., **Du, H.**, Wang, Y., Zhang, J., Liang, P., Khashabi, D., Gardner, L.M., and He, T., Can Generative Multi-Agent Systems Assist in Public Policy Making? A Case Study on Vaccine Hesitancy.
5. Ma, C.*, **Du, H.***, Luan, S., Gardner, L.M., and Gernay, T., A Comprehensive Data-Driven Study on Fire Risk: Occurrences and Consequences.
6. **Du, H.**, Xu, S., Rankin, N., Yang, H., and Gardner, L.M., Behavioral Shifts and Response Disparities Impacted by the Pandemic: Insights from Activity Time Series Data.

Peer-Reviewed Articles:

7. **Du, H.***, Zhao, Y.*, Zhao, J.*, Xu, S., Lin, X., Chen, Y., Gardner, L.M. and Yang, H.F., 2025. Advancing real-time infectious disease forecasting using large language models. *Nature Computational Science*, pp.1-14.
8. 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.
9. 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.
10. **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.
11. **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.
12. 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.
13. 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*.
14. 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.
15. Dong, E., **Du, H.** and Gardner, L., 2020. An interactive web-based dashboard to track COVID-19 in real time. *The Lancet infectious diseases*.
16. Bier, V.M., Zhou, Y. and **Du, H**., 2019. Game-theoretic modeling of pre-disaster relocation. *The Engineering Economist*, pp.1-25.
17. 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.

Invited Talks

- *Department of Civil and Environmental Engineering, Case Western Reserve University* *2025*
- *Department of Systems and Information Engineering, University of Virginia* *2024*
- *Department of Industrial Engineering, Tsinghua University* *2024*
- *Tuanshan Hill Anti-XID Forum, China CDC, Online* *2024*
- *Applied Micro Brownbag Seminar, Department of Economics, Johns Hopkins University, Baltimore, MD, USA* *2024*
- *Biostatistics first-year seminar, Bloomberg School of Public Health, Baltimore, MD, USA* *2024*
- *Johns Hopkins Alumni virtual weekend, Baltimore, MD, USA [link]* *2021*
- *2021 ABET SYMPOSIUM, Online (Closing Keynote Speaker [link])* *2021*
- *Johns Hopkins Biomedical Engineering Spring Speaker Series, Baltimore, MD, USA* *2020*

Conference Activities

Presentation:

- *MIDAS Annual Meeting, DC, USA* *2024*
  Incorporate Human Behavior into Infectious Disease Modeling.
- *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.
- *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.
- *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.
- *Epidemics 8 Conference, Online* *2022*
  A Deep Learning Approach to Forecast Short-Term COVID-19 Cases and Death in the US.
- *INFORMS Annual Meeting, Pheonix, AZ, USA* *2018*
  Game-theoretic modeling of pre-disaster relocation.

Posters:

- *APHA Annual Meeting, Minneapolis, MN, USA* *2024*
  Advancing Real-time Pandemic Forecasting Using Large Language Models.
- *INFORMS Annual Meeting, Seattle, WA, USA* *2024*
  Poster competition: Advancing Real-time Pandemic Forecasting Using Large Language Models.
  Second Place Award.
- *IDM Annual Symposium, Seattle, WA, USA* *2024*
  Advancing Real-time Infectious Disease Forecasting Using Large Language Models.

- *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.
- *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.
- *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.
- *AI in Healthcare Symposium, Baltimore, MD, USA* *2019*
  Data-driven Vehicle-routing Approach to Connect Chronically-ill Patients.

Research Mentorship

Samee Saiyed, Ph.D. candidate, Johns Hopkins University	2022 – present
Naomi Rankin, Ph.D. candidate, Johns Hopkins University	2023 – present
Shaochong Xu, Ph.D. candidate, Johns Hopkins University	2023 – present
Liyue Zhang, Master's student, Johns Hopkins University	2024 – present

Teaching Experience

Applied Modeling for Public Health 2023 Workshop, Instructor	October, 2023
EN.560.653 An Introduction to Network Modeling, Teaching Assistant	2020, 2021, 2022

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

Serve as reviewer for 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*, *Applied Economics*, *ACS ES&T Water*, *Systems Engineering*.

Serve as reviewer for conferences: *MIDAS 2024*, *APHA 2024*, *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 (APHA)
- Member, Models of Infectious Disease Agent Study (MIDAS)
- Member, Institute for Operations Research and the Management Sciences (INFORMS)