

# Alec Kirkley

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Department of Urban Planning and Design  
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## EDUCATION

- Ph.D. Physics, University of Michigan, 2021  
Advisor: Mark Newman  
Thesis: “Complex Networks: Structure and Inference”  
National Defense Science and Engineering Graduate (NDSEG) Fellow
- M.S. Physics, University of Michigan, 2018
- B.S. Physics *summa cum laude*, University of Rochester, 2017
- B.A. Mathematics *summa cum laude*, University of Rochester, 2017

## APPOINTMENTS

- 2022– University of Hong Kong  
Assistant Professor, Musketeers Foundation Institute of Data Science, 2022–  
Assistant Professor, Department of Urban Planning and Design, 2022–
- 2022–22 City University of Hong Kong  
Assistant Professor, School of Data Science

## RESEARCH INTERESTS

1. Developing statistically principled unsupervised learning methods for noisy network data
2. Improving the efficiency and interpretability of network model fitting and evaluation
3. Modelling urban mobility networks and their impact on city prosperity and resilience
4. Characterizing heterogeneity and correlations in urban spatial data with network methods

## PUBLICATIONS

### Summary

Journals: Science Advances, Nature Communications, Communications Physics, PNAS Nexus, Physical Review E, Physical Review Research, Proceedings of the Royal Society A, Journal of the Royal Society Interface, Scientific Reports, Journal of Complex Networks

Contributions: 17 articles as first or corresponding author. 5 articles as sole author. 22 peer-reviewed publications.

## Preprints

26. **A. Kirkley**, Fast nonparametric inference of network backbones for graph sparsification. *Preprint arXiv:2409.06417* (2024).
25. M. Jerdee, **A. Kirkley**, and M. E. J. Newman, Mutual information and the encoding of contingency tables. *Preprint arXiv:2405.05393* (2024).
24. H. Felipe, F. Battiston, and **A. Kirkley\***, Network mutual information measures for graph similarity. *Preprint arXiv:2405.05177* (2024).
23. M. Jerdee, **A. Kirkley**, and M. E. J. Newman, Normalized mutual information is a biased measure for classification and community detection. *Preprint arXiv:2307.01282* (2023).

## Peer Reviewed Journal Articles

22. S. Morel-Balbi and **A. Kirkley\***, Bayesian regionalization of urban mobility networks. *Physical Review Research* **6**, 033307 (2024).
21. L. Hébert-Dufresne, J.G. Young, A. Daniels, **A. Kirkley**, and A. Allard, Network compression with configuration models and the minimum description length. *Physical Review E* **110**, 034305 (2024).
20. **A. Kirkley**, Inference of dynamic hypergraph representations in temporal interaction data. *Physical Review E* **109**, 054306 (2024).
19. **A. Kirkley**, Identifying hubs in directed networks. *Physical Review E* [Editor's Suggestion] **109**, 034310 (2024).
18. M. Jerdee, **A. Kirkley**, and M. E. J. Newman, Improved estimates for the number of non-negative integer matrices with given row and column sums. *Proceedings of the Royal Society A* **480**, 20230470 (2024).
17. B. Poudyal, G. Ghoshal, and **A. Kirkley\***, Characterizing network circuitry among heterogeneous urban amenities. *Journal of the Royal Society Interface* **20**, 20230296 (2023).
16. G. T. Cantwell, **A. Kirkley**, and F. Radicchi, Heterogeneous message passing for heterogeneous networks. *Physical Review E* **108**, 034310 (2023).
15. T. P. Peixoto and **A. Kirkley\***, Implicit models, latent compression, intrinsic biases, and cheap lunches in community detection. *Physical Review E* **108**, 024309 (2023).
14. **A. Kirkley\***, A. Rojas, M. Rosvall, and J-G. Young, Compressing network populations with modal networks reveals structural diversity. *Communications Physics* **6**, 148 (2023).
13. **A. Kirkley**, Spatial regionalization based on optimal information compression. *Communications Physics* **5**, 249 (2022).
12. S. Mimar, D. Soriano-Paños, **A. Kirkley**, H. Barbosa, A. Sadilek, A. Arenas, J. Gómez-Gardeñes, and G. Ghoshal, Connecting intercity mobility with urban welfare. *PNAS Nexus* **1**, pgac178 (2022).

11. **A. Kirkley\*** and M. E. J. Newman, Representative community divisions of networks. *Communications Physics* **5**, 40 (2022).
10. J. Aguilar, A. Bassolas, G. Ghoshal, S. Hazarie, **A. Kirkley**, M. Mazzoli, S. Meloni, S. Mimar, V. Nicosia, J. J. Ramasco, and A. Sadilek, Impact of urban structure on infectious disease spreading. *Scientific Reports* **12**, 3816 (2022).
9. J-G. Young, **A. Kirkley<sup>†</sup>**, and M. E. J. Newman, Clustering of heterogeneous populations of networks. *Physical Review E* **105**, 014312 (2022).
8. **A. Kirkley\***, G. T. Cantwell, and M. E. J. Newman, Belief propagation for networks with loops. *Science Advances* **7**, eabf1211 (2021).
7. G. T. Cantwell, **A. Kirkley**, and M. E. J. Newman, The friendship paradox in real and model networks. *Journal of Complex Networks* **9**, cnab011 (2021).
6. S. Feng and **A. Kirkley<sup>†,\*</sup>**, Integrating online and offline data for crisis management: Online geolocalized emotion, policy response, and local mobility during the COVID crisis. *Scientific Reports* **11**, 8514 (2021).
5. A. A. Klishin, **A. Kirkley**, D. J. Singer, and G. van Anders, Robust design from systems physics. *Scientific Reports* **10**, 14334 (2020).
4. **A. Kirkley**, Information theoretic network approach to socioeconomic correlations. *Physical Review Research* **2**, 043212 (2020).
3. S. Feng and **A. Kirkley<sup>†,\*</sup>**, Mixing patterns in interdisciplinary co-authorship networks at multiple scales. *Scientific Reports* **10**, 7731 (2020).
2. **A. Kirkley\***, G. T. Cantwell, and M. E. J. Newman, Balance in signed networks. *Physical Review E* **99**, 012320 (2019).
1. **A. Kirkley**, H. Barbosa, M. Barthelemy, and G. Ghoshal, From the betweenness centrality in street networks to structural invariants in random planar graphs. *Nature Communications* **9**, 2501 (2018).

<sup>†</sup> denotes shared first authorship, \* denotes corresponding authorship

## GRANTS AND AWARDS

### Awards and Honors

2022	HKU-100 Scholar
2017	Summa cum laude, University of Rochester
2016	Phi Beta Kappa, University of Rochester
2016	Physics Honors Prize, University of Rochester

### Grants and Fellowships

2025–27	PI. General Research Fund (GRF) Project No. 17301024, Hong Kong Research Grants Council (481,834 HKD).
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- 2025-27 PI. Young Scientist Fund Project No. 12405044, National Science Foundation of China (327,857 HKD).
- 2024–26 PI. Early Career Scheme (ECS) Project No. 27302523, Hong Kong Research Grants Council (538,415 HKD).
- 2024–26 PI. Urban Systems Institute Fellowship Grant, University of Hong Kong (200,000 HKD).
- 2024–26 Co-I. General Research Fund (GRF) Project No. 17603323, Hong Kong Research Grants Council (1,168,000 HKD).
- 2023–25 Co-PI. Data Science Research Seed Fund, University of Hong Kong (300,000 HKD).
- 2022–25 PI. HKU-100 Scholars Start Up Grant, University of Hong Kong (3,000,000 HKD).
- 2019–21 National Defense Science and Engineering Graduate (NDSEG) Fellowship, United States Department of Defense (115,200 USD).
- 2019 National Science Foundation Graduate Research Fellowship (NSF GRFP), US National Science Foundation (111,000 USD; declined in order to accept NDSEG fellowship).
- 2019 Rackham Research Grant, University of Michigan (3,000 USD).

## **CONFERENCE ACTIVITY**

### **Peer Reviewed Conference Contributions**

- 2024 “Constructing hypergraphs from temporal data” (talk). NetSci. Quebec City, Canada. June 2024.
- 2023 “Compressing network populations with modal networks reveals structural diversity” (talk). NetSci. Vienna, Austria. July 2023.
- 2022 “Regionalization through optimal information compression on spatial networks” (talk). NetSci. Shanghai, China. July 2022.
- 2021 “The Paradox of Interdisciplinary Collaboration” (talk, with Shihui Feng). NetSci. Indiana University, USA. July 2021.
- 2021 “Multimodal Community Structure in Networks” (talk). NetSci. Indiana University, USA. July 2021.
- 2020 “Probabilistic Models on Networks with Loops” (talk). NetSci. Rome, Italy. September 2020.
- 2019 “Balance in Signed Networks” (poster). NetSci. University of Vermont, USA. May 2019.

### **Conference Organization**

- 2024 NetSci 2024, Statistical Inference for Network Models organizing committee and Main Program PC member. Quebec City, Canada. June 2024.
- 2024 Urban Systems Institute Conference 2024, Urban AI section chair. Hong Kong SAR, China. January 2024.

- 2023 NetSci 2023, Network Models section chair. Vienna, Austria. July 2023.
- 2022 NetSci 2022, Spatial Analysis section chair. Shanghai, China. July 2022.

### INVITED TALKS

- 2024 “From Hubs to Hypergraphs: Nonparametric Inference for Network Data with the MDL Principle”. Network Science Institute, Northeastern University. May 2024.
- 2024 “Nonparametric Inference for Network Data with the Minimum Description Length Principle”. Department of Mathematics and Statistics, University of Vermont. April 2024.
- 2024 “Principled Identification of Network Hubs”. Complex Data Laboratory, Vermont Complex Systems Center, University of Vermont. April 2024.
- 2023 “Improved algorithms for statistical inference with complex network data: Loopy graphical models and parameter-free regionalization”. Department of Physics, Hong Kong University of Science and Technology. February 2023.
- 2022 “Complex Network Inference: Efficient Algorithms and Insights for Urban Spatial Segregation”. Department of Physics and Astronomy, University of Rochester. November 2022.
- 2022 “Networks in Urban Systems”. Urban Analytics Program, University of Hong Kong. October 2022.
- 2022 “Complex Network Inference: Efficient Algorithms and Insights for Urban Spatial Segregation”. Institute of Data Science Seminar Series, University of Hong Kong. August 2022.
- 2022 “Advancing Urban Analytics and Fundamental Data Science with Complex Networks”. Institute of Data Science and Department of Urban Planning, University of Hong Kong. February 2022.
- 2022 “Summarizing Heterogeneous Landscapes of Network Community Divisions”. Centre for Complexity and Complex Networks, City University of Hong Kong. February 2022.
- 2022 “Introduction to Social Network Analysis”. Social Data Science Program, University of Hong Kong. January 2022.
- 2021 “Complex Networks: From Theoretical Modelling to Applications in Urban Data Science”. School of Data Science, City University of Hong Kong. February 2021.
- 2020 “Information Theoretic Network Approach to Socioeconomic Correlations”. Network Science Institute, Northeastern University. December 2020.
- 2020 “Statistical Physics and Social Systems”. Social Data Science Program, University of Hong Kong. January 2020.

### ACADEMIC WORKSHOPS AND SCHOOLS

- 2020 *Network Epidemiology in the Time of Coronavirus (Net-COVID)*. University of Maryland and University of Vermont, Online. April 2020.

- 2019 *Complex Networks Winter Workshop*. Laval University, Quebec City, Canada. December 2019.
- 2019 *Santa Fe Institute Complex Systems Summer School*. Santa Fe Institute, New Mexico, USA. June 2019.

## **MEMBERSHIPS AND OTHER AFFILIATIONS**

Asian Network of Complexity Scientists  
Center for Complexity and Complex Networks, City University of Hong Kong (External Member)  
Network Science Society  
Society of Young Network Scientists  
Urban Systems Institute Fellow, University of Hong Kong

## **TEACHING AND MENTORSHIP**

### **Courses Taught at University of Hong Kong**

Statistical Inference and Machine Learning for Network Data (Data Science PhD/MPhil)  
Transport Network Analysis and Modelling (Urban Design and Transport MSc)  
Science of Cities (Urban Analytics MSc)  
Introduction to Bayesian Inference and Complex Networks (Data Science Summer Institute)  
Data Science for Smart Societies (Data Science Summer Institute)

### **Courses Taught at University of Michigan**

Network Theory (Physics PhD/MS), Teaching Assistant  
Mechanics (Undergraduate), Lab Instructor

### **Courses Taught at University of Rochester**

Mechanics (Undergraduate), Teaching Assistant  
Introductory General Physics (Undergraduate), Workshop Leader  
Tutor for Department of Mathematics

### **Teaching Awards and Certifications**

2022 Professional Certificate in Teaching and Learning in Higher Education, HKU

### **Graduate Student and Postdoc Supervision**

2024– Seongmin Kim, Postdoctoral Fellow  
2024– Baiyue He, PhD student  
2024– Jiayu Weng, PhD student (Hong Kong PhD Fellowship recipient)

2024– Yanting Zhang, PhD student  
2024– Jianrui Wu, MPhil student  
2023– Sebastian Morel-Balbi, Postdoctoral Fellow

#### **Other Doctoral Committee Service**

2023– Dining Liu, HKU Department of Urban Planning and Design (PhD co-supervisor)  
2024 Yuebing Liang, HKU Department of Urban Planning and Design (PhD examiner)  
2023 Puyuan Zhang, HKU Faculty of Education (PhD examiner)

## **SERVICE**

### **Editorship**

Guest Editor, Journal of Physics: Complexity. Focus Issue on Statistical Inference and Machine Learning for Complex Networks

### **Academic Journal Peer Review**

**Multidisciplinary Sciences:** Proceedings of the National Academy of Sciences, Science Advances, Nature Communications, PNAS Nexus, Philosophical Transactions of the Royal Society A, Journal of the Royal Society Interface, Royal Society Open Science, Scientific Reports, PLOS One, IEEE Access, Humanities and Social Sciences Communications, Heliyon

**Physics and Network Science:** Physical Review Letters, Communications Physics, Physical Review E, Physical Review Research, Chaos, Journal of Complex Networks, Applied Network Science, PCI Network Science, Entropy

**Engineering and Geography:** International Journal of Geographical Information Science, ACM Transactions on Knowledge Discovery from Data, Knowledge and Information Systems, Geospatial Information Science

### **Funding Agency Peer Review**

Natural Sciences and Engineering Research Council of Canada (NSERC)

### **Outreach and Community Collaborations**

2022 *Learning Classroom Series for Secondary School Students: Smart Cities*, City University of Hong Kong.

2020–21 *Michigan Data Informed Cities for Everyone (M-DICE)*, University of Michigan and City of Detroit, MI.

2019–20 *Michigan Data Science Team*, University of Michigan.