

# Timothy LaRock

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## Academic Appointments

**Oxford University Mathematical Institute**  
*Postdoctoral Research Associate*

**Oxford, UK**  
*April 2021 - Present*

## Education

**Northeastern University Network Science Institute**  
*PhD in Network Science*

**Boston, MA**  
*December 2021*

**Dissertation:** Representing and Analyzing Pathway Data Through Networks

**Committee:** Prof. Tina Eliassi-Rad (Advisor), Prof. Samuel V. Scarpino (Northeastern), Prof. Hongyang Zhang (Northeastern), Prof. Ingo Scholtes (University of Würzburg)

**The Honors College, University at Albany, State University of New York**  
*Bachelor of Science in Computer Science and Applied Mathematics*  
*Minor: Philosophy*

**Albany, NY**  
*May 2016*

**Advisors:** Prof. Petko Bogdanov & Prof. Mariya Zheleva

**Honors Thesis:** *Wireless Frequency Spectrum Characterization and Transmitter Detection Using Wavelets*

## Research Experience

**Network Science Institute, Northeastern University**  
*Research Assistant, Rad Lab*

**Boston, MA**  
*August 2016 - December 2021*

- Analyzing Anomalous Paths Through Networks Using Higher-Order Network Models
  - Worked with a team of 6 collaborators in developing methodology to identify statistically anomalous sequences of nodes traversed in a network using higher-order network representations.
  - Responsible for developing and implementing the statistical higher-order network model, as well as generating, analyzing, and writing about results of data analysis using the methodology.
  - Collaborated successfully resulting in a paper at *SIAM SDM '20* (see Peer-Reviewed Conference Papers).
- Sequential Motifs via DeBruijn Graphs (in-progress)
  - Developed methodology for computing motifs that respect patterns in sequential data, leveraging ensembles of DeBruijn Graphs to sample from an appropriate randomization.
  - Adapted node embedding methods using sequential motifs that can be used to predict node and edge attributes and analyzed results.
- Path-based Analysis of Global Container Shipping Routes (in-progress)
  - Worked with collaborators to develop methods for computing and analyzing realistic navigational trajectories for cargo traveling through the port-to-port shipping network.
  - Responsible for technical development and implementation of algorithms and analysis of results.
  - Paper submitted to a data science journal.
- Human Mobility and Physical Distancing during the COVID-19 Pandemic
  - Worked with a large research team in analyzing human mobility data from cellular GPS to understand mobility changes in response to the COVID-19 pandemic.
  - Collaborated to estimate mobility indices to be supplied directly to epidemiological models and posted to an online dashboard accessible to policy makers and the public. Assisted in writing multiple pre-publication reports (see Preprints) and a research article to be submitted.
- Reducing Network Incompleteness via Network Online Learning
  - Worked with a team of 5 collaborators in developing machine learning algorithms to grow incomplete networks through adaptive querying of partially observed nodes.
  - Responsible for model construction and implementation as well as conceiving of and executing simulations and collecting, analyzing, and writing about results.

- Collaborated successfully resulting in a peer-reviewed research article published in *Applied Network Science* (see Peer-Reviewed Journal Papers).

### **ETH Zürich/University of Zürich**

*Visiting Researcher - Chair of Systems Design/Data Analytics Group*

Supervisor: Prof. Ingo Scholtes

**Zürich, Switzerland**

*Summer 2018*

- Two month invited research visit to work directly with collaborators located in Switzerland on analyzing anomalous paths through networks via higher-order network models.

### **Computer Science Department, University at Albany, SUNY**

*Research Assistant, Data Management and Mining Lab*

**Albany, NY**

*Fall 2014 - Summer 2016*

- Airpress (Summer 2015 - Summer 2017)
  - Developed wavelet methods for real time transmitter detection and spectrum characterization to facilitate the use of Dynamic Spectrum Access devices based on FCC guidelines.
- Scalable Targeted Group Centrality (Spring 2015)
  - Devised a computationally efficient algorithm to compute group centrality in large scale graphs based on given targeting criteria.
  - Designed and conducted experiments to test our algorithm on a real world dataset.
- Adaptive Power Load Balancing in Cellular Networks (Fall 2014)
  - Analyzed cellular call data to identify load disparity between antennas in a real-world network.
  - Devised and tested an algorithm to adaptively adjust the power of cellular antennas based on neighborhood load disparity employing the concept of Power Diagrams.

### **NSF Research Experience for Undergraduates**

*Research Assistant*

**Siena College, Loudonville, NY**

*Summer 2014*

- Siena's Twitter Information Retrieval System (STIRS)
  - Implemented information retrieval algorithms and techniques in Java to develop the STIRS information retrieval system.
  - Resulted in a poster at the *2014 Text REtrieval Conference* (see Peer-Reviewed Conference Papers).

## **Teaching Experience**

### **Khoury College of Computer Sciences, Northeastern University**

*Instructor - CS 3000 - Algorithms & Data*

**Boston, MA**

*Summer 2020*

Course Website: <https://tlarock.github.io/teaching/cs3000/syllabus.html>

- Instructor of Record for a 7-week intensive summer course in algorithms for more than 80 undergraduate students in computer science.
- Converted course from in-person to remote instruction mode blending synchronous and asynchronous elements to accommodate students in multiple timezones.
- Managed 9 Teaching Assistants in administering the course.

### **Computer Science Department, University at Albany, SUNY**

*Teaching Assistant - ICSI 201 - Introduction to Computer Science*

**Albany, NY**

*Fall 2014*

## **Peer-Reviewed Journal Papers**

- **Timothy LaRock**, M. Xu, T. Eliassi-Rad, "A Path-based Approach to Analyzing the Global Liner Shipping Network", *EPJ Data Science*, 11:1, March 2022. <https://doi.org/10.1140/epjds/s13688-022-00331-z>
- **Timothy LaRock**, T. Sakharov, S. Bhadra, T. Eliassi-Rad, "Understanding the Limitations of Network Online Learning", *Applied Network Science*, 5:60, September 2020. <https://doi.org/10.1007/s41109-020-00296-w>

## **Peer-Reviewed Conference Papers**

- **Timothy LaRock**, V. Nanumyan, I. Scholtes, G. Casiraghi, T. Eliassi-Rad, F. Schweitzer, "HYPA: Efficient Detection of Path Anomalies in Time Series Data on Networks", *Proceedings of the 2020 SIAM International Conference on Data Mining (SDM)*. May 2020.
- M. Zheleva, **Timothy LaRock**, P. Schmitt, P. Bogdanov, "Efficient spectrum summarization using compressed spectrum scans", *2018 IEEE Conference on Computer Communications Poster and Demo (INFOCOM)*, April 2018. Poster.

- M. Zheleva, P. Bogdanov, **Timothy LaRock**, P. Schmitt, "AirVIEW: Unsupervised transmitter detection for next generation spectrum sensing", IEEE International Conference on Computer Communications (INFOCOM2018), April 2018.
- **Timothy LaRock**, P. Schmitt, P. Bogdanov, E. Belding, M. Zheleva, "AirPress: Towards Scalable Spectrum Inventory", 13th USENIX Symposium on Networked Systems Design and Implementation, March 2016. Poster.
- **Timothy LaRock**, L. Mathews, M. Roberts, D. Lim, S. Small, "Siena's Twitter Information Retrieval System: The 2014 Microblog Track", In Proceedings of the Twenty-Third Text REtrieval Conference (TREC), November 2014. Poster.

## Peer-Reviewed Workshop Papers

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- **Timothy LaRock**, T. Sakharov, S. Bhadra, T. Eliassi-Rad, "Reducing Network Incompleteness Through Online Learning: A Feasibility Study", 14th International Workshop on Mining and Learning with Graphs (MLG, co-located with The 24th ACM SIGKDD Conference on Knowledge Discovery and Data Mining), August 2018.

## Conference Presentations

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- **Timothy LaRock**, M. Xu, T. Eliassi-Rad, "Higher-order Representations of Liner Shipping Data," American Physical Society March Meeting, March 2022. Abstract & oral presentation.
- **Timothy LaRock**, M. Xu, T. Eliassi-Rad, "Analyzing Maritime Shipping Routes With Higher-order Network Analysis," Networks 2021: A Joint Sunbelt and NetSci Conference, June 2021. Abstract & oral presentation.
- **Timothy LaRock**, V. Nanumyan, I. Scholtes, T. Eliassi-Rad, "Frequency of Significant Sequential Motifs Reveal Patterns in Pathway Data", International Conference on Network Science (NetSci'20), September 2020. Abstract & oral presentation (video link).
- **Timothy LaRock**, R. Caceres, P. Morales, T. Eliassi-Rad, "Incompleteness in Networks: Biases, Skewed Results, and Some Solutions", 25th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD), August 4th, 2019. Peer-reviewed Tutorial.
- **Timothy LaRock**, V. Nanumyan, I. Scholtes, G. Casiraghi, T. Eliassi-Rad, F. Schweitzer, "Finding Over- and Under-represented Pathways in Higher Order Networks", International Conference on Network Science (NetSci), May 2019. Abstract & oral presentation.
- **Timothy LaRock**, T. Sakharov, S. Bhadra, T. Eliassi-Rad, "Limits of Learning in Incomplete Networks", International Conference on Network Science (NetSci), June 2018. Abstract & oral presentation.
- **Timothy LaRock**, T. Sakharov, S. Bhadra, T. Eliassi-Rad, "Learning to Complete Partially Observed Networks", 9th International Conference on Complex Networks (CompleNet), March 2018. Abstract & oral presentation.

## Invited Talks

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- **Timothy LaRock**, "Detecting Path Anomalies in Time Series Data on Networks", Higher Order Models in Network Science Satellite (HONS), May 2019.

## Preprints

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- S. McCabe, L. Torres, **Timothy LaRock**, et al., "netrd: A library for network reconstruction and graph distances", arXiv, October 2020. <https://arxiv.org/abs/2010.16019>.
- B. Klein, **Timothy LaRock**, S. McCabe, L. Torres, et al., "Reshaping a nation: Mobility, commuting, and contact patterns during the COVID-19 outbreak", MOBS Lab (self-published), May 2020. [https://www.mobs-lab.org/uploads/6/7/8/7/6787877/covid19mobility\\_report2.pdf](https://www.mobs-lab.org/uploads/6/7/8/7/6787877/covid19mobility_report2.pdf)
- B. Klein, **Timothy LaRock**, S. McCabe, L. Torres, et al., "Assessing changes in commuting and individual mobility in major metropolitan areas in the United States during the COVID-19 outbreak", MOBS Lab (self-published), March 2020. [https://www.mobs-lab.org/uploads/6/7/8/7/6787877/assessing\\_mobility\\_changes\\_in\\_the\\_united\\_states\\_during\\_the\\_covid\\_19\\_outbreak.pdf](https://www.mobs-lab.org/uploads/6/7/8/7/6787877/assessing_mobility_changes_in_the_united_states_during_the_covid_19_outbreak.pdf)
- **Timothy LaRock**, V. Nanumyan, I. Scholtes, G. Casiraghi, T. Eliassi-Rad, F. Schweitzer, "Detecting Path Anomalies in Time Series Data on Networks", arXiv, May 2019. <https://arxiv.org/abs/1905.10580>.

## Professional Activities

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*Workshop/Satellite Organizer*

- Networks 2021 Satellite on Dynamics and Motifs in Networks (DynaMo), June 2021
- Journal Referee*
- EPJ Data Science

## Awards & Honors

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### **Student-led Research on New Opportunities for Dynamic Spectrum Access Award**

*With Prof. Mariya Zheleva, Awarded by Dynamic Spectrum Alliance*

*Spring 2019*

### **Excellence in Undergraduate Research in Computer Science Award**

*Awarded to graduating students for research contributions.*

*Spring 2016*

### **University at Albany Presidential Undergraduate Award For Research**

*Project: Adaptive Power Load Balancing in Cellular Networks*

*Spring 2015*

### **Computer Sciences Corporation Scholarship Award**

*Chosen by UAlbany Computer Science Faculty - 2 students per year*

*Fall 2015*

### **University at Albany Presidential Honors Society**

*Invited after earning GPA above 3.8*

*Spring 2015 - Spring 2016*

### **University at Albany Dean's List**

*Maintained GPA above 3.5 through all semesters*

*Fall 2012 - Spring 2016*

## Skills

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- Technical writing
- Research communication, including articles, lectures, and presentations
- Network & Data analysis
- Programming Languages:
 

- Python	- Unix/Linux scripting	- Basic HTML/CSS/Javascript
- R	- Awk	- Julia
- C/C++	- Java	

## Interests

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| <ul style="list-style-type: none"> <li>• Science Communication</li> <li>• Network and Data Science</li> <li>• Algorithm Design</li> <li>• Science and Technology Studies</li> </ul> | <ul style="list-style-type: none"> <li>• Human Mobility and Disease Modeling</li> <li>• Ecological and Geospatial Networks</li> <li>• Climate Modeling and Intervention</li> <li>• Philosophy and Sociology of Science</li> </ul> |
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