Zirou Qiu

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Research Interests

Foundations of large-scale social systems, dynamical systems, optimization, machine learning, game theory, computational social science, pandemic science

Publications

Efficient PAC Learnability of Dynamical Systems Over *Multilayer* Networks [pdf]
In Submission

- Authors: ***Zirou Qiu***, Abhijin Adiga, Madhav Marathe, S.S. Ravi, Daniel Rosenkrantz, Richard Stearns, and Anil Vullikanti.
- Summary: We propose efficient PAC algorithms with provable guarantees for learning dynamical systems over *multilayer* networks.

Learning the *Topology* and *Behavior* of Discrete Dynamical Systems [pdf]
*AAAI Conference on Artificial Intelligence (**AAAI**) – 2024* *(Acc rate: 23.8%)*

- Authors: ***Zirou Qiu***, Abhijin Adiga, Madhav Marathe, S.S. Ravi, Daniel Rosenkrantz, Richard Stearns, and Anil Vullikanti.
- Summary: We propose rigorous methods for learning both the *topology* and *behavior* of a black-box dynamical system.

Assigning Agents to Increase Network-Based Neighborhood *Diversity* [pdf]
*Intl. Conf. on Autonomous Agents and Multiagent Systems (**AAMAS**) – 2023* *(Acc rate: 23.3%, Oral)*

- Authors: ***Zirou Qiu***, Andrew Yuan, Chen Chen, Madhav Marathe, S.S. Ravi, Daniel Rosenkrantz, Richard Stearns, and Anil Vullikanti.
- Summary: We present rigorous methods to allocate public goods on networks while maintaining a high social *diversity*.

Networked Anti-Coordination Games Meet Graphical Dynamical Systems: *Equilibria* and *Convergence* [pdf]
*AAAI Conference on Artificial Intelligence (**AAAI**) – 2023* *(Acc rate: 19.6%, Oral)*

- Authors: ***Zirou Qiu***, Chen Chen, Madhav Marathe, S.S. Ravi, Daniel Rosenkrantz, Richard Stearns, and Anil Vullikanti.
- Summary: We provide tight analyses on the *equilibria* and *convergence* of the anti-coordinations games, which model strategic situations such as social competition.

Airborne disease transmission during *indoor gatherings* over multiple time scales: Modeling framework and policy implications [pdf]
*Proceedings of the National Academy of Sciences (**PNAS**) – 2023*

- Authors: Avinash Dixit, Baltazar Espinoza, ***Zirou Qiu***, Anil Vullikanti, and Madhav Marathe.
- Summary: We propose a modeling framework that couples the fast dynamics of the viral load in enclosed spaces and the slow dynamics of disease progression at the population level. We derive *policy guidelines* to lessen the negative impact of epidemics.

Understanding the *Co-evolution* of Mask-wearing and Epidemics: A Network Perspective [pdf]
*Proceedings of the National Academy of Sciences (**PNAS**) – 2022*

- Authors: ***Zirou Qiu***, Baltazar Espinoza, Vitor V. Vasconcelos, Chen Chen, Sara M. Constantino, Stefani A. Crabtree, Luojun Yang, Anil Vullikanti, Jiangzhuo Chen, Jörgen Weibull, Kaushik Basu, Avinash Dixit, Simon Levin, Madhav Marathe.

- Summary: We present a framework that models the dueling dynamics of non-pharmaceutical interventions and disease on *multilayer* graphs. We then derive *policy guidelines* to suppress the ongoing epidemic and prevent its future revival.

Finding *Nontrivial Minimum* Fixed Points in Networked Dynamical Systems [pdf]
*AAAI Conference on Artificial Intelligence (**AAAI**) – 2022* *(Acc rate: 15%, Oral: 4.8%)*

- Authors: ***Zirou Qiu***, Chen Chen, Madhav Marathe, S.S. Ravi, Daniel Rosenkrantz, Richard Stearns, and Anil Vullikanti.
- Summary: We propose theoretically sound methods to find a nontrivial equilibrium in a dynamical system with the minimum number of infected vertices.

Efficiently Learning the Topology and Behavior of a Networked Dynamical System Via *Active Queries* [pdf]
*International Conference on Machine Learning (**ICML**) — 2022* *(Acc rate: 22%)*

- Authors: Daniel Rosenkrantz, (α-β) Abhijin Adiga, Madhav Marathe, ***Zirou Qiu***, S.S. Ravi, Richard Stearns, and Anil Vullikanti.
- Summary: We introduce *active* learning methods with provable guarantees to infer the network topology and the behavior of a dynamical system.

ELRUNA: Elimination Rule-based Network Alignment [pdf]
*ACM Journal of Experimental Algorithmics (**ACM-JEA**) – 2021.*

- Authors: ***Zirou Qiu***, Ruslan Shaydulin, Xiaoyuan Liu, Yuri Alexeev, Christopher S. Henry, Ilya Safro.
- Summary: We propose algorithms for the topology-based network alignment problem that outperforms the state-of-the-art methods.

Research Experience

University of Virginia *Advisor: Prof. Madhav Marathe*
Graduate Research Assistant *Fall 2020 – Present*

- Topic: Graph problems in dynamical systems, machine learning, pandemic science, and computational social science.

Clemson University *Advisor: Prof. Ilya Safro*
Graduate Research Assistant *Jan 2019 - May 2020*

- Topic: Combinatorial optimization and computational biology.

Argonne National Laboratory *Host: Chris Henry*
Graduate Research Aide *Summer 2019*

- Topic: Combinatorial optimization and computational biology.

Education

University of Virginia *Charlottesville, VA*
Ph.D. in Computer Science *Aug 2020 – Present*
Overall GPA: 4.0/4.0

Clemson University *Clemson, SC*
M.S. in Computer Science *Aug 2018 - May 2020*
Overall GPA: 3.75/4.0

Southeast Missouri State University *Cape Girardeau, MO*
B.S. in Computer Science – Dean's List, Cum Laude *Aug 2013 - May 2018*
Major GPA: 3.878/4.0; Overall GPA: 3.708/4.0

Skills

Mathematical skills: Design and analysis of algorithms; network science; combinatorics; game theory; foundations of machine learning; mathematical modeling of large socio-technical systems

Programming skills: Data science; C++; PyTorch; foundation models; Matlab; R