

RESEARCH INTEREST

I am primarily interested in collaborative multi-robot systems and how we can use optimization and machine learning across platforms to achieve more intelligent and resilient systems.

EDUCATION

University of Pennsylvania

Ph.D in Computer Science

Philadelphia, PA

2023–Present

- Advised by: Professor CJ Taylor

Fordham University

M.S. in Data Science, GPA: 3.88/4.00

New York, NY

2020–2021

- Thesis: An Algorithmic Foundation for Fair, Secure, and Differentially Private Distributed Discrete Optimal Transport

Fordham University

B.S. in Mathematics *Cum Laude*, GPA: 3.70/4.00, Major GPA: 3.90/4.00

Bronx, NY

2016–2020

- Minor: Computer Science

RESEARCH

United States Military Academy, Robotics Research Center

Robotics Research Fellow

West Point, NY

Sept. 2021–Aug. 2023

- Work with Carlos Nieto-Granda on *Information Based Exploration and Mapping for Multi-Robot Systems* and helped develop ROSTAK, a ros-to-cot bridge. Sponsored by: ARL-DCIST.
- Lead the development of the Collaborative Aerial Swarm Architecture (CASA), designed to be the most reliable swarm architecture for sUAS. Sponsored by: DHS-CBRN.
- Research how multi-agent systems can maintain multiple connections in a heterogeneous swarm.
- Co-advised by Dr. Christopher Korpela (COL) and Dr. Michael “Misha” Novitzky

Fordham University, Juntao Chen Group

Graduate Student Researcher

New York, NY

Sept. 2020–Aug. 2021

- Examined how to build a more robust distributed task allocation paradigm using optimal transport. We first applied fairness constraints, then used a game-theoretic approach to consider deceptive adversaries in the distributed systems, and leveraged differential privacy to keep node data private. Advised by Dr. Juntao Chen.

Fordham University Robotics & Computer Vision Lab

Undergraduate Student Researcher

Bronx, NY

Mar. 2019–Aug. 2020

- Studied how we can use low-cost IMUs to detect obstacles in micro-UAS using ML algorithms to learn the unsteadiness caused by the airflow of the UAS near the obstacle. We were not only able to detect obstacles but we could learn their relative direction too. Advised by Dr. Damian Lyons.

JOURNAL PAPERS

1. **J. Hughes**, J. Chen, C. Korpela, “Achieving Collaborative Resilience in Multi-Layer Heterogeneous Robotic Systems”, Under Review: *IEEE Robotics and Automation Letters*, December 2022.
2. **J. Hughes**, J. Chen, “Resilient and Distributed Discrete Optimal Transport with Deceptive Adversary: A Game-Theoretic Approach”, *IEEE Control Systems Letters*, vol. 6, pp. 1166 - 1171, 2022.

CONFERENCE PAPERS

1. **J. Hughes**, D. Kim, S. Henderson and P.Manjunath, “Towards Collaborative Aerial Swarming Architecture for Military Applications,” To Appear: The 23rd International Conference on Control, Automation and Systems (ICCAS), October 2023.
2. **J. Hughes** and J.Chen, “Security Investment over Networks with Bounded Rational Agents: Analysis and Distributed Algorithm”, 2023 Proceedings of the Conference on Control and its Applications (CT). 2023, 72-79.
3. **J. Hughes** and J.Chen, “Differentially Private ADMM-Based Distributed Discrete Optimal Transport for Resource Allocation”, IEEE Global Communications Conference (GLOBECOM), 2022, pp. 909-914.
4. B. Dubetsky, K. Fernandez, G. Christopher, L. Singh, **J. Hughes**, J. Cole, M. Novitzky, “Military Uniform Identification For Search And Rescue (SAR) through Machine Learning”, IEEE International Symposium on Technologies for Homeland Security (HST), Boston, MA, USA, 2022, pp. 1-4.
5. **J. Hughes**, D. Larkin, C. O'Donnell and C. Korpela, “Dynamic and Distributed Optimization for the Allocation of Aerial Swarm Vehicles”, *International Conference on Unmanned Aerial Systems (ICUAS)*, 2022, pp. 897-902.
6. N. Kaur, **J. Hughes** and J.Chen, “VaxEquity: A Data-Driven Risk Assessment and Optimization Framework for Equitable Vaccine Distribution”, 56th Annual Conference on Information Sciences and Systems (CISS), 2022, pp. 25-30.
7. **J. Hughes** and D. Lyons, “Wall Detection via Air-Disturbance Classification in Autonomous Quadcopters”, *The 7th International Conference on Control, Automation and Robotics (ICCAR)*, 2021, pp. 189-196.
8. **J. Hughes** and J. Chen, “Fair and Distributed Dynamic Optimal Transport for Resource Allocation over Networks”, *2021 55th Annual Conference on Information Sciences and Systems (CISS)*, 2021, pp. 1-6.
9. Q. Zhao, **J. Hughes** and D. Lyons, “Drone proximity detection via air disturbance analysis”, Proc. SPIE 11425, *Unmanned Systems Technology XXII*, Vol. 114250, 2020, pp. 141-149.

ORAL CONFERENCE PRESENTATIONS

- “Security Investment over Networks with Bounded Rational Agents: Analysis and Distributed Algorithm”, *SIAM Conference on Control and its Applications (CT)* Jul. 2023
- “Differentially Private ADMM-Based Distributed Discrete Optimal Transport for Resource Allocation”, *IEEE Global Communications Conference (GLOBECOMM)*. Dec. 2022
- “Dynamic and Distributed Optimization for the Allocation of Aerial Swarm Vehicles”, *International Conference on Unmanned Aircraft Systems (ICUAS)*. Jun. 2022
- “Resilient and Distributed Discrete Optimal Transport with Deceptive Adversary: A Game-Theoretic Approach”, *Conference on Decision and Control (CDC)*. Dec. 2021
- “Wall Detection via Air-Disturbance Classification in Autonomous Quadcopters”, *7th International Conference on Control, Automation and Robotics (ICCAR)*. Apr. 2021
- “Fair and Distributed Dynamic Optimal Transport for Resource Allocation over Networks”, *55th Annual Conference on Information Sciences and Systems (CISS)*. Mar. 2021

ADVISING

- United States Military Academy, Swarms Capstone, Sponsored by: US Army DEVCOM 2022 –Present
 - CDT Mark Eddy, CDT Joshua Reece
- United States Military Academy, Collaborative Path Planning 2022 –Present
 - CDT Adam Elahmadi
- United States Military Academy, Computer Vision Group, Sponsored by: ONR 2021 –2022
 - CDT Lakhan Singh, CDT Benjamin Dubetsky, CDT Garret Christopher, CDT Kevin Fernandez
- Fordham University, ExploreCSR 2020 –2021
 - Navpreet Kaur, Erin Yan, Maria Jara, Hailey Bober
- Fordham University, Robotics and Computer Vision Lab 2020 –2021
 - Meredith Coen

AWARDS & SCHOLARSHIPS

- US Army Research Labs Journeyman Fellowship 2021–2023
- ICCAR: Best Presentation Award April 2021
- Google’s Tri-State ExploreCSR: Second Place in Poster Competition (Advisor) April 2021
- Fordham University: Centennial Scholarship 2020–2021
- Fordham University: Summer Research Scholarship Summer 2019
- Pi Mu Epsilon: Mathematics Honors Society 2019–2020
- Fordham University: Dean’s List 2017–2020
- Fordham University: Dean’s Scholarship 2016–2020

PROGRAMMING LANGUAGES

- **Python:** numpy, pandas, scipy, JAX, matplotlib, rospy, rclpy, opencv, sqlite, OOP principles
- **C++:** eigen, roscpp, rclcpp, opencv, sqlite, OOP principles
- **MATLAB:** General scripting for optimization, plotting, solving ODEs/PDEs, numerical methods
- **R:** Scripting for data analysis and graphing

SKILLS

- **Linux:** Bash scripting, file system management
- **ROS:** ROS1, ROS2, mavros, px4-ros-com, RVIZ, RQT, Gazebo, Unity
- **Machine Learning:** PyTorch, TensorFlow/Keras, SciKit Learn, CNNs, Transformers
- **Robotic Platforms:** PX4 & Ardupilot based FCUs, Clearpath Jackal, Clearpath Warthog, Ghost Vision 60
- **Other:** L^AT_EX, Microsoft Office, Soldering, Woodworking

RELEVANT COURSEWORK

- **Graduate:** Algorithms for Data Science, Data Analytics: Tools & Scripting, Math for Data Science, Artificial Intelligence, Machine Learning, Data Visualization, Big Data Programming, Cloud Computing.
- **Undergraduate:** Multivariate Calculus I & II, Linear Algebra, Mathematical Modeling, Discrete Math, Differential Equations, Abstract Algebra, Numerical Analysis, Probability, Statistics, Partial Differential Equations, Computer Science I & II, Computer Organization, Data Mining, Programming for Math & Science.
- **Other:** Summer School on Neurosymbolic Programming (Caltech, 2022)

TECHNICAL REVIEWER

- American Control Conference 2022
- International Conference on Ubiquitous Robots 2022
- Conference on Control Technologies and Applications 2022
- IEEE Control System Letters 2021

PROFESSIONAL ORGANIZATIONS

- IEEE Member 2021 –Present
- IEEE Student Member 2020 –2021
- SIAM Student Member 2020 –2021