

Micah Corah

ACTIVE PERCEPTION · MULTI-ROBOT SYSTEMS · AERIAL ROBOTICS

✉ micahcorah@gmail.com | 🎓 Micah Corah

Education

Carnegie Mellon University

PH.D. IN ROBOTICS

Pittsburgh, PA

September 2020

M.S. IN ROBOTICS

December 2017

- Thesis (Ph.D.): *Sensor Planning for Large Numbers of Robots*
- Advisor: *Prof. Nathan Michael*

Rensselaer Polytechnic Institute

B.S. IN COMPUTER SCIENCE

Troy, NY

May 2015

B.S. IN MECHANICAL ENGINEERING

May 2015

Skills

- Robotics** Multi-robot systems, Aerial robots, Informative planning, Active sensing, Mapping, Exploration
- Foundations** Information theory, Control theory, Submodular optimization
- Languages** C++, Julia, Matlab, Python, LaTeX

Experience

Carnegie Mellon University

POSTDOCTORAL RESEARCHER

Pittsburgh, PA

Jan 2022–Present

Advisor: *Prof. Sebastian Scherer*

- I am leading an NSF-sponsored project, developing teams of drones that film and reconstruction motion of groups of dynamic actors ([link](#))
- Applications include sports videography, study of animal group behaviors, or capture of artistic and improvisational performances
- My focus on this project includes aerial multi-robot systems and planning and coordination for multi-robot teams

NASA Jet Propulsion Laboratory, California Institute of Technology

POSTDOCTORAL RESEARCHER

Pasadena, CA

Dec 2020–Dec 2021

Advisor: *Dr. Ali-akbar Agha-mohammadi*

- Member of team [CoSTAR](#), competing in the [DARPA Subterranean Challenge](#)
- Responsibilities: aerial autonomy, coverage planning, radio communication, field test scouting and planning
- Our team placed 5th (alongside very capable competition) in the DARPA Subterranean Challenge Finals

Carnegie Mellon University

RESEARCH ASSISTANT

Pittsburgh, PA

Aug 2015–Sept 2020

Advisor: *Prof. Nathan Michael*

- Developed algorithms and analysis techniques for multi-robot sensing, coverage, exploration, and target tracking based on submodular maximization, higher-order monotonicity conditions, and spatial locality
- Design and analysis of a planner for exploration at high speed (2.25 m/s) with an aerial robot in collaboration with Kshitij Goel and Curtis Boirum. This system was tested in simulation and on a hexrotor robot, outdoors, on the CMU campus
- Developed a system for multi-robot exploration combining Cauchy-Schwarz mutual information for ranging sensors, Monte-Carlo tree search for path planning, and multi-robot planning via submodular maximization
- Implemented core components of a system providing control and autonomy for aerial robots. Contributions include trajectory representation and management and a modular finite state machine

TEACHING ASSISTANT

Aug–Dec 2017

Instructor: *Prof. Michael Erdmann*

- Course: Mathematical Fundamentals for Robotics (16-811)
- Responsibilities: grading assignments, holding office hours
- Prepared and gave a lecture on submodular maximization

Carnegie Mellon University (Internships)

RESEARCH INTERN: PERSISTENT COVERAGE

Pittsburgh, PA

May–Aug 2014

Advisor: *Prof. Nathan Michael*

- NSF Research Experience for Undergraduates (REU)
- Implemented minimum snap, collision free, multi-vehicle trajectory generation
- Implemented controller for tracking of discretized trajectories

RESEARCH INTERN: WING ASSEMBLY

May–Aug 2013

Advisor: *Prof. Reid Simmons*

- Developed a simulation of multi-robot assembly of an airplane wing-ladder
- Implemented an autonomous behavior where a mobile robot attaches and aligns to an airplane wing spar

Rensselaer Polytechnic Institute

Troy, NY

INDEPENDENT STUDY: ROBOTIC CATCHING

Aug–Dec 2013

Advisor: *Prof. Jeff Trinkle*

- Modeling and simulation of contact-oriented catching of a sliding object

UNDERGRADUATE RESEARCHER: SCIENTIFIC COMPUTING

Sept 2012–Dec 2013

- Implemented threaded mesh I/O for the Parallel Unstructured Mesh Interface

UNDERGRADUATE TEACHING ASSISTANT (COMPUTER SCIENCE 1)

Aug 2012–May 2013

- Assisted students with lab work and graded results

Service

RSS Pioneers 2022: Organizing Committee

N/A

PROGRAM COMMITTEE MEMBER

July 2021–Present

- After participating in RSS Pioneers 2021, I am looking forward to contributing to the organization of the program for the 2022 edition

AAAI 2022 Student Abstract and Poster Program

N/A

PROGRAM COMMITTEE MEMBER

Fall 2021

- As a committee member, I was responsible for reviewing several abstracts submitted by early career researchers

RSS 2018: Graduate Student Volunteer

Pittsburgh, PA

INDUSTRY RECEPTION

May 2017–June 2017

- Coordinated logistics and placements for the industry reception in the foyer of the Carnegie Music Hall

Mentorship

Rebecca Martin

Robotics Institute, CMU

PH.D. STUDENT, ROBOTICS

Summer 2022

- I am advising Rebecca while she works on the multi-robot filming and reconstruction
- Currently, Rebecca is working on safe navigation for filming moving actors

Skyler Hughes

Robotics Institute, CMU

ROBOTICS INSTITUTE SUMMER SCHOLARS

Summer 2022

- Skyler is an undergraduate intern from the *New Mexico Institute of Mining and Technology* working on greedy, submodular coordination for multi-robot filming

Hannah Noh, Andrew (Yifan) Su

Robotics Institute, CMU

SUMMER UNDERGRADUATE RESEARCH APPRENTICESHIP

Summer 2022

- Andrew and Hannah are rising sophomores on the multi-robot filming project. They have been developing RTK-GPS tracking backpacks that will transmit locations of actors being filmed as well as contributing to several other areas of our systems

Michael Tatum

Robotics Institute, CMU

M.S. THESIS COMMITTEE

2020

- Thesis: *Communications Coverage in Unknown Underground Environments*
- I met with Michael regularly while he performed his thesis work
- Michael's thesis developed greedy methods for placing communication nodes to maximize coverage in the DARPA Subterranean Challenge

Honors & Awards

2021 **RSS Pioneers**, Research statement accepted into prestigious workshop for early-career roboticists

Virtual Workshop

Select Presentations

Talking Robotics

Virtual

ACTIVE PERCEPTION AND EXPLORATION WITH TEAMS OF ROBOTS: FROM SIMULATION TO SUBTERRANEAN

Oct 2021

- Seminar on active perception for one or more robots and lessons learned from the Subterranean Challenge. [Video](#).

Publications

THESIS

Micah Corah. **Sensor planning for large numbers of robots**. PhD thesis, Carnegie Mellon University, 2020. [Video](#).

JOURNAL

Micah Corah and Nathan Michael. **Distributed matroid-constrained submodular maximization for multi-robot exploration: theory and practice**. *Autonomous Robots*, 2019.

Micah Corah, Cormac O'Meadhra, Kshitij Goel, and Nathan Michael. **Communication-efficient planning and mapping for multi-robot exploration in large environments**. *Robotics and Automation Letters*, 2019. [Video](#).

Erik Nelson, **Micah Corah**, and Nathan Michael. **Environment model adaptation for mobile robot exploration**. *Autonomous Robots*, 2018.

CONFERENCE

Micah Corah and Nathan Michael. **Scalable distributed planning for multi-robot, multi-target tracking**. *International Conference on Intelligent Robots and Systems*, 2021. [Presentation](#).

Micah Corah and Nathan Michael. **Volumetric objectives for multi-robot exploration of three-dimensional environments**. *International Conference on Robotics and Automation*, 2021. [Presentation](#).

Hyungho Chris Choi, Inhwon Wee, **Micah Corah**, Sahand Sabet, Taeyeon Kim, Thomas Touma, David Hyunchul Shim, and Ali-akbar Agha-mohammadi. **BAXTER: Bi-modal aerial-terrestrial hybrid vehicle for long-endurance versatile mobility**. *Proc. of the Intl. Sym. on Exp. Robot.*, 2021.

Kshitij Goel, **Micah Corah**, Curtis Boirum, and Nathan Michael. **Fast exploration using multirotors: Analysis, planning, and experimentation**. *Field and Service Robotics*, 2019. Videos: [Sim](#), [Real](#).

Micah Corah and Nathan Michael. **Distributed submodular maximization on partition matroids for planning on large sensor networks**. *Conference on Decision and Control*, 2018.

Micah Corah and Nathan Michael. **Efficient online multi-robot exploration via distributed sequential greedy assignment**. *Robotics: Science and Systems*, 2017.

Micah Corah and Nathan Michael. **Active estimation of mass properties for safe cooperative lifting**. *International Conference on Robotics and Automation*, 2017.

Wennie Tabib, **Micah Corah**, Nathan Michael, and Red Whittaker. **Computationally efficient information-theoretic exploration of pits and caves**. *International Conference on Intelligent Robots and Systems*, 2016.

Derek Mitchell, **Micah Corah**, Nilanjan Chakraborty, Katia Sycara, and Nathan Michael. **Multi-robot long-term persistent coverage with fuel constrained robots**. *International Conference on Robotics and Automation*, 2015.