Micah Corah

Active Perception · Multi-Robot Systems · Aerial Robotics

720-270-3901 | micahcorah@gmail.com | Micah Corah

Education

Carnegie Mellon University — *Pittsburgh, PA*

Ph.D. in Robotics — *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 — *Troy, NY*

B.S. in Computer Science — *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 — *Pittsburgh, PA*

Postdoctoral Researcher — *Jan 2022–Present*

Advisor: *Prof. Sebastian Scherer*

- I am working on a project involving multi-drone visual tracking and reconstruction of groups of dynamic actors
- Applications include sports videography, recording and 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 the multi-robot team

NASA Jet Propulsion Laboratory, California Institute of Technology — *Pasadena, CA*

Postdoctoral Researcher — *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 5^{th} (alongside very capable competition) in the DARPA Subterranean Challenge Finals

Carnegie Mellon University — *Pittsburgh, PA*

Research Assistant — *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)

Pittsburgh, PA

Research Intern: Persistent Coverage

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

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, Inhwan 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.