

Patrick Callaghan

 Scholar |  GitHub |  Personal |  callaghan@cmu.edu

RESEARCH EXPERIENCE

Learning expressive reward functions from diverse interaction types Nov 2021 - Present

*Human and Robot Partners Lab & Intelligent Autonomous Manipulation Lab,
Carnegie Mellon University*

Co-Advisors: Profs. Henny Admoni & Oliver Kroemer

- Studying novel means of learning nonlinear human reward functions via diverse interaction types (e.g. demonstrations, preference queries, corrections, binary critiques)
- Mathematically formalized a particle filter approach to learning from diverse interaction types
- Quantified the effects of four different sampling approaches in two domains and four interaction types
- Thoroughly tested and analyzed the effects of different task featurizations and reward function structures
- Designed and conducted a pilot study to inform formal user study design

Actively selecting interaction types to learn a human's reward function Nov 2021 - Jun 2022

*Human and Robot Partners Lab & Intelligent Autonomous Manipulation Lab,
Carnegie Mellon University*

Co-Advisors: Profs. Henny Admoni & Oliver Kroemer

- Used information gain to model and actively select among demonstrations, preference queries, corrections, and binary critiques to learn a simulated human's reward function
- Implemented baseline methods
- Implemented three domains in which our method was compared against various baselines
- Collected and analyzed various performance data in simulation

MoonRanger

Sep 2019 - Dec 2020

Field Robotics Center, Carnegie Mellon University

Principal Investigators: Profs. Red Whittaker & David Wettergreen

- Student-lead of software team (May 2020-August 2020)
- Planning and navigation sub-team lead (September 2019-August 2020)
- Helped develop local motion-planning software using motion primitives, forward simulation, and cost-reward tradeoffs
- Led field tests of rover mapping, planning, and navigation
- Presented to over 50 people from NASA and CMU during an official NASA Preliminary Design Review
- Analyzed stereo and navigation data from simulated and real-world autonomous traversals
- Developed ROS/C++ global-to-local planning and navigation prototype
- Spent 7 days in Utah's remote West Desert collecting imagery data for novel methods of 3D modeling of lunar pits

CubeRover

Dec 2018 - Dec 2019

Field Robotics Center, Carnegie Mellon University

Principal Investigator: Prof. Red Whittaker

- Led systems-engineering efforts of avionics documentation, coordination, fault analysis, and software/hardware implementations
- Assisted in physical testing for wheel actuation and grouser efficiency

Advanced Wireless Research Experience (REU)

May 2019 - July 2019

Wireless Institute, University of Notre Dame

Principal Investigator: Prof. Thomas Pratt

- Researched novel conceptualization of dual-polarized monopulse radar for target-acquisition and radar-jamming countermeasures
- Conceived, implemented, and built upon original models of monopulse radar and target-acquisition with various environmental constraints
- Conducted literature reviews to confirm methodological approach, to identify appropriate algorithms for creating accurate simulations, and to uncover comparable research
- Synthesized radar signal-processing data between MATLAB and FEKO software packages

PUBLICATIONS

Ford, J., **Callaghan, P.**, Wong, U., Jones, H., Whittaker, W. C., & Whittaker, W. L. (2020). Dataset of the west desert sinkhole: An analog for steep-walled planetary pits. *3rd International Planetary Caves Conference*. <https://www.hou.usra.edu/meetings/3rdcaves2020/pdf/1062.pdf>

Fitzgerald, T., Koppol, P., **Callaghan, P.**, Wong, R. Q., Simmons, R., Kroemer, O., & Admoni, H. (2022). INQUIRE: Interactive querying for user-aware informative reasoning. *6th Conference on Robot Learning*. <https://openreview.net/forum?id=3CQ3Vt0v99>

EDUCATION

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|----------------|------------------------------------------------------------|----------------|
| 2021 - present | MS (Robotics) at Carnegie Mellon University | (GPA: 4.2/4.0) |
| 2020 - 2021 | CS coursework at University of Pittsburgh | (GPA: 3.8/4.0) |
| 2018 - 2020 | Coursework at Community College of Allegheny County | (GPA: 4.0/4.0) |
| 2016 | BA (English & Economics) at University of Virginia | (GPA: 3.3/4.0) |

HONORS, AWARDS, & PRESENTATIONS

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|--------------------------------------------------------------------------|-------------------------|
| MoonRanger/NASA Preliminary Design Review (PDR) presenter | Aug 2020 |
| Presented poster at Notre Dame Undergraduate Research Symposium | Aug 2019 |
| 1 of 2 research projects selected to present at annual CCAC Honors forum | May 2019 |
| Allegheny County Council Endowed Scholarship | Fall 2019 |
| NASA Community College Aerospace Scholar | Fall 2019 - Spring 2019 |
| Daniel B. Krochmal Endowed Scholarship | Spring 2019 |

PROFESSIONAL EXPERIENCE

Teaching Fellow

Aug 2017 - Jun 2018

Culver Academies, Culver, Indiana, USA

- Spent 85 minutes/day leading section of 16 students through new material pertaining to Humanities; taught elements of writing basic analytical essay
- Planned lessons and overall course trajectory through evaluative assessments of class' current understandings
- Identified students' struggles; subsequently prioritized research and teaching of certain skills and content

SERVICE

CMU HRI Reading Group Co-Organizer Sep 2022 - Present

CMU HRI Social Organizer June 2022 - Present

PROGRAMMING SKILLS

Languages Python, C++, Java

Frameworks Frankapy, Torch, ROS