

# 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 update its belief state through observations of human-provided feedback
- Quantified the effects of four different resampling 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 design of formal user study
- Work to be submitted to 2nd Workshop on Human-Interactive Robot Learning (HRI 2023)

**Actively selecting interaction types to learn a human’s reward function** Nov 2021 - June 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
- Work accepted for publication at the 6th Conference on Robot Learning (CoRL)

**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, identify appropriate algorithms for creating accurate simulations, and 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>

**Callaghan, P.**, Kroemer, O., & Admoni, H. (2023). Filtering expressive reward functions with diverse human feedback. *2nd Workshop on Human-Interactive Robot Learning: International Conference on Human Robot Interaction (to be submitted)*.

## EDUCATION

---

2021 - present	MS (Robotics) at <b>Carnegie Mellon University</b>	(GPA: 4.2/4.3)
2020 - 2021	CS coursework at <b>University of Pittsburgh</b>	(GPA: 3.8/4.0)
2018 - 2020	Coursework at <b>Community College of Allegheny County</b>	(GPA: 4.0/4.0)
2016	BA (English & Economics) at <b>University of Virginia</b>	(GPA: 3.3/4.0)

## HONORS, AWARDS, & PRESENTATIONS

---

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