Michael S. Lee

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My research in explainable AI studies how to increase the ***transparency*** (i.e. understandability and predictability) of **AI decision making *to humans***. I operationalize principles from cognitive science and education into a computational model for teaching AI decision making to humans **using demonstrations**.

Education

PhD in Robotics, *Carnegie Mellon University* Expected Feb 2024
Advisers: Prof. Reid Simmons, Prof. Henny Admoni
Undergraduate research mentee: Vignesh Rajmohan (Everyday Robots / Google X intern, Automat AI)

Master of Science in Robotics, *Carnegie Mellon University* Aug 2018
Advisers: Prof. Red Whittaker, Prof. Nathan Michael
Thesis: Radiation Source Localization using a Gamma-ray Camera

BSE in Mech. & Aero. Engineering, Minor in Computer Science, *Princeton University* May 2016
Advisers: Prof. Robert Stengel, Prof. Nathan Michael
Thesis: Modeling Uncertainty in Stereo Vision for Precise and Robust State Estimation

Research Experience

Carnegie Mellon University

Improving the Transparency of Agent Decision Making to Humans using Demonstrations Aug 2018 –
- Developing algorithms for teaching AI policies to humans through informative demonstrations, toward transparency and accurate prediction of AI behavior by humans in unseen scenarios.
- Modeling humans as inverse reinforcement learners and using education techniques (e.g. scaffolding) to incrementally increase human knowledge with demonstrations of appropriate informativeness & difficulty.
- A user study finds that our demonstration-based teaching model reduces the regret in human predictions of AI behavior by 64% compared to a common baseline of directly communicating the AI's reward function.

***Radiation Source Localization using Gamma Camera** (R. Whittaker, N. Michael)* Aug 2016 – Aug 2018
- Developed novel gamma radiation map representation and source localization algorithm for efficient and autonomous radiological characterization of nuclear facilities using a gamma-ray camera equipped robot.

***Physically-assisted Navigation of the Elderly and Visually-Impaired** (Ralph Hollis)* Jun – Aug 2016
- Created a voice-controlled ROS SMACH state machine for a dynamically stable ballbot toward hand-assisted leading of the elderly and the visually impaired using speech and force-based communication.

***Predicting Feature-Based Visual Odometry Failure using Saliency** (Nathan Michael)* Jun – Aug 2015
- Identified and characterized three classes of sparse visual odometry failures through a suite of visual metrics that extracted relevant saliency information from incoming images.
- Trained classifiers to anticipate and label imminent visual odometry failures in support of robust visual state estimation and autonomous UAV flight.

Jet Propulsion Laboratory (NASA)

***Estimating Forest Biomass using Quadcopter** (Roland Brockers, Stephan Weiss, Adam Wolf)* Jun – Aug 2014
- Collected forest microclimate data using a custom sensor suite onboard a quadcopter, and developed interactive ecology maps over Google Earth based on the completed surveys.
- Extracted correlations between microclimate data and first-order estimates of forest biomass based on tree diameters estimated from stereo images.

Representative Publications

- **M. Lee**, R. Simmons, H. Admoni, *Closed-loop Teaching via Demonstrations to Improve Policy Transparency*, IEEE Robotics & Automation Letters, 2024. Under review.
- **M. Lee**, H. Admoni, R. Simmons, *Closed-loop Reasoning about Counterfactuals to Improve Policy Transparency*, ICML Workshop on Counterfactuals in Minds and Machines, 2023.
- R. Zhang, **M. Lee**, S. Chen, *Leveraging Contextual Counterfactuals Toward Belief Calibration*, ICML Workshop on Counterfactuals in Minds and Machines, 2023.
- **M. Lee**, H. Admoni, R. Simmons, *Reasoning about Counterfactuals to Improve Human Inverse Reinforcement Learning*, International Conference on Intelligent Robots and Systems (IROS), 2022.
- **M. Lee**, H. Admoni, R. Simmons, *Machine Teaching for Human Inverse Reinforcement Learning*, Frontiers in Robotics and AI, 2021.
- **M. Lee**, *Self-Assessing and Communicating Manipulation Proficiency Through Active Uncertainty Characterization*. Pioneers Workshop at ACM/IEEE Conference on Human-Robot Interaction, 2019.

Leadership & Service

Reviewer

- ICRA (2024), ICAPS Explainable Planning Workshop (2023), IROS (2022), RSS Pioneers (2022-23), AAAI Undergrad Consortium (2022), AAAI Fall Symposium (2021), HRI Pioneers Workshop (2020-24)

Undergraduate AI Mentorship, *Mentor* Jan 2019 – May 2023

- Provide guidance on relevant coursework and experiences for graduate school through monthly meetings.

Teaching Assistant (Carnegie Mellon University) Jan – May 2020, 2021

- Created/graded assignments, advised projects for these classes: human-robot interaction, computer vision

Robotics Institute Summer Scholars Admissions Committee, *Reviewer* Feb – Mar 2017, 2019

- Assisted in reviewing over 680 applicants for the Summer Scholars program, an eleven-week research experience for 30 undergraduates hosted by the Robotics Institute at Carnegie Mellon University.

RISS Working Papers Journal Committee, *Managing Editor* Jun – Dec 2015

- Oversaw the journal comprising research papers written by the 2015 Robotics Institute summer scholars.

Princeton Robotics Club, *Quadcopter Control Subteam Leader* Sep 2013 – Jun 2015

- Co-led a team of eight students in building a quadcopter from scratch and implementing controls for flight.

Outdoor Action Orientation Program, *Week-long Backpacking Trip Leader* Jan 2014 – Jun 2015

Honors & Awards

AAAI Doctoral Consortium, *Member* 2024

- One of 30 PhD students selected to present/discuss work with peers and senior scholars in the field of AI.

HRI Pioneers Workshop, *Member* 2019

- One of 19 PhD students selected to present/discuss work with peers and senior scholars in the field of HRI.

National Defense Science and Engineering Graduate (NDSEG) Fellowship, *Finalist* 2018

Sigma Xi, *Associate Member* 2016 – 2017

- Nominated for induction into the honor society by the Mech. & Aero. Eng. Department at Princeton Univ.

Robotics Institute Summer Scholars Program, *Member* Jun – August 2015, 2016

Technical Skills

Languages: Python, MATLAB, C++, HTML5, JS, CSS | **Tools**: Flask, psiTurk, Prolific, ROS, Git