HEATlab
human experience & agent teamwork laboratory @ harvey mudd

2017 Summer Research Projects

Temporal plans exist to guide robots to accomplish their goals, while also coordinating when these activities should occur. In general, we want temporal plans that are adaptable to events that are beyond the direct control of agents; e.g., a robot may experience slippage or sensor failures. To do this, we must answer questions such as how and when do new or unexpected events arise in practice? And how "good" is a temporal plan at adapting to these unexpected events?

Further, Trust and cooperation are fundamental to human interactions. How much we trust other people directly influences the decisions we make and our willingness to cooperate. It thus seems natural that trust be equally important in successful human-robot interaction, since how much a human trusts a robot affects how they might interact with it.

In previous summers, we explored the usefulness of a new metric called robustness, which assesses the likelihood that a multi-robot plan succeeds. We showed that robustness is a better measure of multi-robot plan quality and that we can generate plans that optimize for robustness. We also explored whether humans behave differently in terms of their levels of trust and cooperation depending on if they are interacting with a robot or another human.

This summer take on the following three projects that explore the following questions:

Project 1 – Robot Brunch: How do we best disentangle interacting robots' schedules?
In this project, we will:

- Construct new representations that better capture the uncertainty that interactions with others imposes on a robot's plans;
- Design new algorithms for optimally decoupling multiple robots' schedules; and
- Evaluate our approaches using mutli-robot navigation tasks on the mock factory floor in our lab.

Project 2 – Human-robot teamwork: How do we schedule reliable interactions with human teammates?
In this project, we will:

- Create and implement new human-robot teamwork tasks that utilize our lab's NAO and possibly other, new robots;
- Evaluate our approaches for measuring and generating robust multi-robot temporal plans on tasks requiring human-robot coordination; and
- Design new representations and techniques for capturing the types of uncertainty that humans introduce to team activities.

Project 3 – Poly-bots!: How many scheduling possibilities actually exist?
When robots team up with humans, we want to give human teammates as many possibilities as we can for completing their activities. However, counting how many possibilities exist, is actually very difficult! In this project, we will:

- Develop new approximate techniques for computing the number of schedules afforded by a temporal plan;
- Explore the connections between temporal plans and the geometrical construct called a (n-dimensional) polytope to leverage existing methods for computing the volume of n-dimensional polytopes;
- Design new tools for visualizing and measuring temporal plans.

Skills: artificial intelligence, algorithm design, interaction design, ROS development, python, behavioral economics, social psychology, probability, information visualization, geometry

Apply at: https://www.cs.hmc.edu/research/