Modeling and Simulation in Robotics Workshop

Breakout Summary Slides

Team 6

Breakout 3

Slide 1: Consensus Thinking

- Single Framework >> Single simulator
  - Context-based/state-driven/fidelity configurable options may be part of the framework
- What can you learn from ensemble-based methods in simulations/parameters? If your robot is in the within the distribution, perhaps you have the correct model.
- Observation: All the interesting problems are where simulators break down

Slide 2: “Somewhat contentious” Ideas

- Model what you can, and have a simulator that is so fast that you can converge; let the simulator be wrong, but must faster than real-time
- Limit your tasks/behaviors until you have something that your simulator supports
  - Alternative: explore your desired behaviors and converge on simulation that supports it
- There is significant evidence of prediction happening in human brains. In our brains are we really doing simulation, or are we just using cached data?

Slide 3: Odds and ends, out there thoughts, fun stuff

- The purpose of simulation might be to develop a better robot.
- Choose the "right" simulator Every single abstraction has one thing it's trying to address—without this understanding, it just won't be useful.
- Maybe interpreted that there is a methodology by which we can each choose the methodology that is right for them (not a single methodology for everyone)
- Even within a task, there may not be a right simulator. E.g. don't treat a full glass like you do an empty glass, it needs a different model for the same task. Same task, same robot, different level of abstraction.
- Why was ROS successful? Ease of composition through using common interfaces. Why can't we do the same things with a simulator?
- e.g., when I pick up a can w/ liquid, I don't always want to have the physics engine calculating fluid dynamics when the can isn't moving. It's OK to replan but the question is, do I need a different simulator at different times.
- A single modular framework in which we work, but not a universal simulator.
- What's the goal of what we're trying to do? What's important about our state? Putting something in a container (and moving that container) will change perhaps the perception of how something should behave.
- How does composition and distribution get to the multiple levels of abstraction. You have the high-fidelity that you trust. You run this simulation on different scenarios and then see what happens. You run the other models on the same scenario and then you see what happens. You see how closely they agree, and if they're close enough, then this model is sufficient for that task. But if you are now doing this in outer space, you might need to do it differently.
- You have a great solution that is really slow—that's the real world. However, there are safety issues, and there are reproducibility issues.
- There are problems with using real data to train, you need to generate synthetic data to prevent doing dangerous things.
- Phantom robots- 3dof robots that are like a big finger. They are so fast that if you try to use them at their limits, they stop being rigid because they start to bend. If you slow them down, they are rigid again. By changing the task/boundaries of the task, you change the resolution of what's required.
- I have a really hard problem, but if I can solve things fast enough I can just use linearization all over the place.
- Pragmatically speaking, how do you capture what are the limits of the system (or discover what appropriate limits of the system) are, so that they can be used the right way.
- Using MPC/adaptive control allows incorrect models to work over time: note, also true for any kind of feedback control, key is to get the updates.
- There is significant evidence of prediction happening in human brains. In our brains are we really doing simulation, or are we just using cached data?
- What if instead of 1 copy of a simulation, you have 10,000 copies of a simulation. What would you learn from this?
- Do you want a policy that is robust to many different kinds of worlds?

Cheat Sheet Slide

- Breakout Themes, “M&S in Robotics” workshop:
  - Breakout 1: Panoramic view of opportunities
    [a time to dream]
  - Breakout 2: What’s stopping us from getting there
    [the reality check]
  - Breakout 3: Pragmatic suggestions for moving forward
    [what funding organizations, the robotics community, or other vested parties can/should do]

- Breakout session, things to keep in mind
  - You have 25 mins to generate your three slides
  - Select a scribe to generate your three slides
  - Decide who will present your slides in plenary
  - Do not argue within team for more than 2 mins about an idea. Move it to “Slide 2” and proceed
  - Generate diverse/original/out-there ideas

- Plenary session, things to keep in mind
  - Each team has 5 mins to present its slides
  - We seek to collect as many original ideas/points of view/opinions as possible
    - Settling contentious issues not a priority
  - Use open-floor discussion to add to what the teams have presented
  - Limit your remarks to one to two minutes. Give others an opportunity to speak. Keep it fun, keep it friendly