Foundations for Physical Co-Manipulation with Mixed Teams of Humans and Soft Robots

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http://radlab.byu.edu/nri-co-manipulation

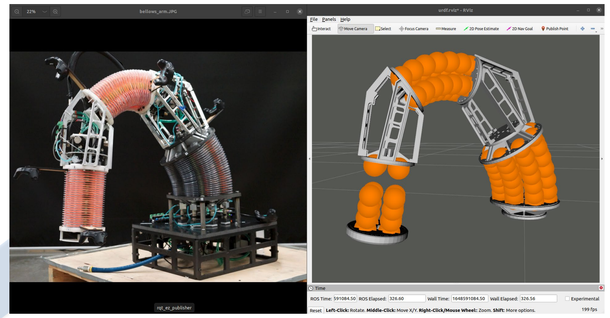
Challenge: Optimal control strategies for uncertain systems (such as soft robots or human-robot teams) can enable improved performance, but often models that are difficult to obtain or do not explicitly model the inherent uncertainty in the problem.

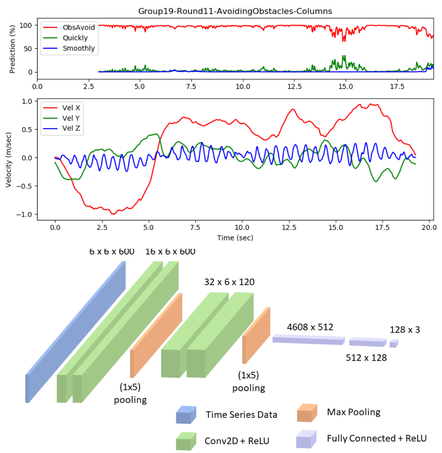
Human-human Study:

Over 60 participants collaboratively navigated through multiple obstacles with an object requiring six DoF motion given a specified behavior (see image of experiment on left).

Future Work

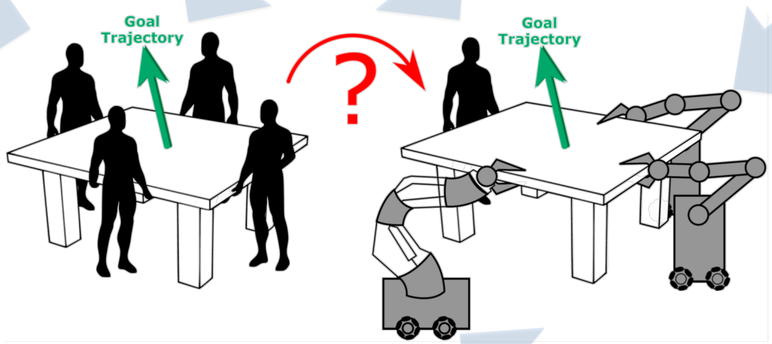
Perform experiments with multi-agent human-robot teams for co-manipulation tasks in virtual reality (see virtual environment on left).





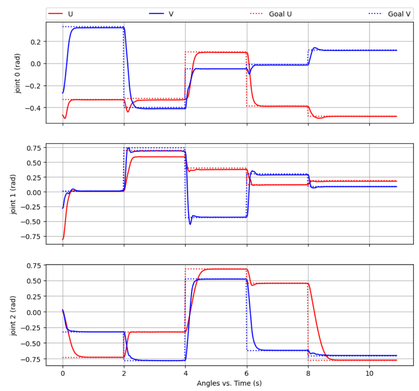
Scientific Impact:

Developed algorithm using force-torque and object motion during co-manipulation to enable future robotic systems to interact intuitively with human partners (see results on left).



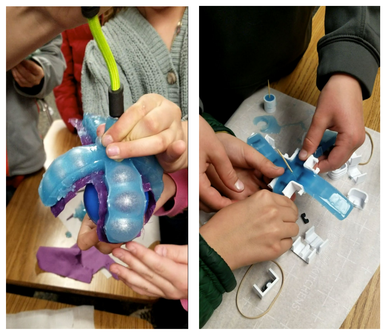
Scientific Impact:

Developed RNE-based soft robot model for simulation and control for co-manipulation. Model runs faster than real-time (see top right).



Educational Outreach:

Underrepresented undergraduate students developed and implemented soft robotics education program in collaboration with Yale and presented to over 100 fifth grade students.



Broader Impact:

Over 20 undergraduate engineering students designed, built, and tested an omnidirectional mobile base to enable co-manipulation tasks (see continuum joint mounted to mobile base on right).

Scientific Impact:

Developed RNN-based dynamic model for use in real-time gain-based model predictive controller for soft robot arm (see simulation results above).

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