Domestic robot assistants are essentially autonomous mobile manipulators capable of exerting human-scale precision grasps. To maximize utility and economy, non-technical end-users would need to be nearly as efficient as trained roboticists in the control and collaboration of manipulation task behaviors. However, this remains a significant challenge given that for many WIMP-style tools, superficial proficiency in robotics, 3-D graphics, and computer science is still needed for rapid task modeling and recovery.

Intelligent agents have shown to be effective assistants to their human counterparts in many real-world Human-Robot Team (HRT) scenarios under human-centric collaboration, such as teleoperation. Human agents are adept at tasks requiring abstract perception and reasoning, providing opportunities for reactive and compute-intensive agents to refine human input to the teleoperative task. In complement, research on robot-centric collaboration has garnered momentum in recent years; robots are now planning in partially observable environments that maintain geometries and semantic maps, presenting an opportunity for non-experts to cooperatively control task behavior with autonomous-planning that exploit the knowledge. However, as autonomous systems are not immune to errors under perceptual difficulty, a human-in-the-loop is needed to bias autonomous-planning towards recovery conditions that resume the task and avoid similar errors.

In this thesis, we explore interaction techniques that allow non-technical users to model task behaviors and perceive cooperatively with robots under robot-centric collaboration. We evaluate the use of stylus and touch modalities that users can intuitively and effectively convey natural abstractions of high-level tasks, semantic revisions, and geometries about the world. Experiments are conducted with pick-and-place tasks under an ideal `Blocks World' environment using a Kinova Jaco 6-dof manipulator. Possibilities for the architecture and interface are demonstrated with the following features in our prototype:

1. Semantic `Object' and `Location' grounding that describe function and ambiguous geometries
2. Task specification by coalescing an un-ordered list of predicates representing a goal
3. Guiding task recovery by implied scene geometries and manipulation via symmetry cues and configuration space abstraction.

Empirical results from four user studies show our interface was much preferred than the control condition, demonstrating high learn-ability and ease of use that enable our non-technical participants to model complex tasks and provide effective recovery assistance.

Major: Modeling and Simulation

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2000, National University of Singapore
Master's of Modeling & Simulation, MS, 2011, University of Central Florida

Committee in Charge:
Joseph J. LaViola Jr., Chair, Department of Computer Science
Shaojie Zhang, Department of Computer Science
Hassan Foroosh, Department of Computer Science
Si Jung Kim, Howard R. Hughes College of Engineering, University of Nevada Las Vegas

Approved for distribution by Joseph J. LaViola Jr., Committee Chair, on June 17, 2018.
The public is welcome to attend.