Motivation

- Robots are currently used to extend the reach of humans and to augment their physiological skills during manipulation.
- This research aims to introduce a new paradigm of complementary situational awareness (CSA), which is the simultaneous perception and use of the environment and operational constraints for task execution.
- Using this new paradigm robots can act as our partners, not only in manipulation, but in perception and control.

Illustrative Examples

- A search and rescue telemanipulation robot that uses its own perception to form an understanding of task constraints. For example the robot could use UDAR information to augment the perception of the user who typically sees only the video feed from a forward-looking camera.
- An intelligent excavator that uses sensory information about the ground and potentially hidden pipes to assist the user in safe excavation.
- An intelligent surgical robot that uses in-vivo sensory information to characterize its operational constraints and to assist the surgeon in avoiding sensitive anatomy.

Research Goals

Real-time Sensing during Task Execution: Design algorithms for acquisition of in-vivo sensory information including methods for assessing the interaction with the environment.

Situational Awareness Modeling: extend simultaneous localization and mapping (SLAM) to develop algorithms that synthesize in-vivo, intraoperative and pre-operative data to augment human situational awareness.

Telemanipulation based on CSA: Create a telemanipulation framework that uses CSA to enable the use of assistive virtual fixtures based on the updated understanding of environmental characteristics to semi-automate surgical tasks.

Planned research activity

Telemanipulation based on CSA includes the intelligent high level controller (HLC), the low level controller (LLC) of the master robot, LLC of the slave robot, and SLAM-based modeling block to correct the environment model.