Designing an effective human-robot interaction paradigm is particularly important for complex tasks, such as multi-robot manipulation, which require the human and robot to work in a tightly coupled fashion. Although increasing the number of robots can expand the area that the robots can cover within a bounded period of time, a poor human-robot interface will ultimately compromise the performance of the team of robots. However, introducing a human operator to the team of robots, does not automatically improve performance due to the difficulty of teleoperating mobile robots with manipulators. The human operator’s concentration is divided not only among multiple robots but also between controlling each robot’s base and arm. This complexity substantially increases the potential neglect time, since the operator’s inability to effectively attend to each robot during a critical phase of the task leads to a significant degradation in task performance.

There are several proven paradigms for increasing the efficacy of human-robot interaction: 1) multimodal interfaces in which the user controls the robots using voice and gesture; 2) configurable interfaces which allow the user to create new commands by demonstrating them; 3) adaptive interfaces which reduce the operator’s workload as necessary through increasing robot autonomy. This dissertation presents an evaluation of the relative benefits of different types of user interfaces for multi-robot systems, composed of robots with wheeled bases and 3 DOF arms.

User expertise was measured along three axes (navigation, manipulation, and coordination), and users who performed above threshold on two out of three dimensions on a calibration task were rated as expert. Our experiments reveal that the relative expertise of the user was the key determinant of the best performing interface paradigm for that user, indicating that good user modeling is essential for designing a human-robot interaction system that is meant to be used for an extended period of time.

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The public is welcome to attend.