

Studying Human-Robot Interaction in the Lab and in the Wild to Help Patients

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Abstract

Robotic manipulators are widely used in a variety of medical applications, including surgery and rehabilitation. In most cases, these devices are operated by humans (physicians) and act on humans (patients). Robotic devices are also used to study the human sensorimotor system, and their use has led to the development of rigorous computational models and theories of human motor control. However, the design and control of medical robots is rarely informed by these models and theories, thus impeding the realization of medical robots' full potential. For example, even though surgeons rely strongly on their sense of touch during open surgery, state-of-the-art teleoperated robot-assisted surgery systems do not provide them with touch information. This and other current gaps may be closed with human-centered approaches to control and design of medical robots. In robot-assisted minimally-invasive surgery (RAMIS), computational modeling of surgeons' movements combined with theories of motor coordination and learning could lead to the optimization of robot design, the development of novel teleoperation controllers, and the development of improved training curricula; all these will expand the current capabilities of robotic surgery.

In this talk I will address two major research directions in the Biomedical Robotics Lab: surgeon's sensorimotor performance in robot-assisted surgery, and basic sensorimotor control research. I will present our studies of teleoperated and freehand reach movements of experienced robotic surgeons and novices with a clinical RAMIS system, and a study of teleoperated and open needle-driving with a RAMIS research platform. I will also present our studies on the effect of delay in sensory information on perception and action.

These studies are part of a research framework that applies neuroscience to solve challenging problems in medical robotics, studies users interacting with medical robots to advance neuroscience, and employs both to improve the quality of life for patients.