AbstractID: 2588 Title: Image-Guided Minimally Invasive Robotic Surgery

Image-guided surgery allows surgeons to specifically target diseased tissue while sparing healthy tissue, reducing morbidity and improving patient outcomes. Minimally invasive surgical techniques deliver specific intervention without the morbidity associated with large open incisions. Image-guidance technology has the potential to provide significant benefits for minimally invasive surgery, where surgeons must usually cope with difficult access and reduced visualization. A new generation of minimally invasive surgery has emerged that uses a robot to hold surgical tools during laparoscopy or thoracoscopy, under direct control by the surgeon. Surgical robots offer an excellent platform upon which to fuse the benefits of image-guided and minimally invasive surgery. The da Vinci surgical robot system has a high-fidelity video display, a stereo endoscope, and sensors to track the position of each surgical instrument and the endoscope, offering a potentially ready-made stream of data for registration and tracking.

The proposed project involved an academic/industry collaboration to give da Vinci the fundamentally new capability of steering to a specific point in the patient's frame of reference. Using the traditional da Vinci control paradigm, the robot simply follows the surgeon's relative motions and has no concept of the patient's frame of reference. With the new ability to navigate through the patient's frame of reference as described by preoperative imagery data sets registered to the patient during surgery, da Vinci will enable surgeons to more accurately perform targeted tasks such as biopsy, tumor ablation, resection planning, and gene therapy in a minimally invasive manner. The project used liver surgery as a motivating application. This work addressed three feasibility milestones: Establishing communication between the surgical robot and existing image-guidance software, establishing robot tracking error under 2 mm, and establishing surface registration errors under 5 mm.