

**COMPUTER ASSISTED INTERVENTIONS & MEDICAL ROBOTICS  
RESEARCH AT GEORGETOWN UNIVERSITY MEDICAL CENTER  
(including recent work in respiratory motion compensation)**

Kevin Cleary, PhD  
Filip Banovac, MD  
Elliot Levy, MD  
Vance Watson, MD

Imaging Science and Information Systems (ISIS) Center  
Department of Radiology  
Georgetown University Medical Center  
Washington, DC

A research program in computer assisted interventions and medical robotics at Georgetown University will be presented. This focus of our research is to develop physician-assist systems for precision placement and manipulation of medical instruments during minimally invasive procedures. The characterization of respiratory motion and compensation for respiratory motion are also research thrusts.

Physician-assist systems can incorporate three-dimensional visualization, mechanical systems such as robots, and optical and magnetic localization systems. An overview of two current projects will be given:

1. medical robotics for precision placement of needles in spinal procedures and for lung biopsy
2. electromagnetic field sensor based localization of instruments for internal organ motion in liver interventions

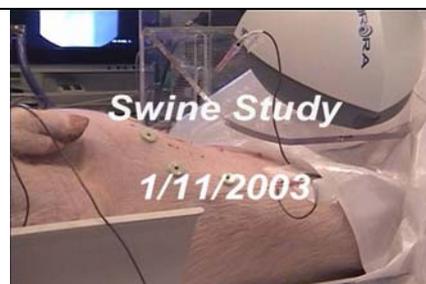
Our work in medical robotics began with a clinical trial incorporating a small “needle driver” robot for placement of a 22-gauge needle for nerve and facet blocks in the spine. The needle driver robot was designed and built at Johns Hopkins Urology Robotics (URobotics) Laboratory. The robot has recently been applied to robotically assisted lung biopsy as shown in Figure 1.

For tracking internal organ motion, we have been developing a novel image-guided surgery system based on electromagnetic field sensor localization. The AURORA® (Northern Digital, Waterloo, Canada) is a magnetic field based positioning sensor system that is capable of tracking tiny sensor coils (0.9 mm in diameter and 8 mm in length). A recent swine animal study using this system is shown in Figure 2.

Finally, I will also present our recent work in respiratory motion compensation including developing a motion simulator platform for the CyberKnife radiosurgery system as shown in Figure 3.



**Figure 1:** Needle driver robot for lung biopsy using phantom and joystick control



**Figure 2:** Electromagnetic tracking system and tracked needles in swine study



**Figure 3:** CyberKnife motion platform for respiratory motion compensation