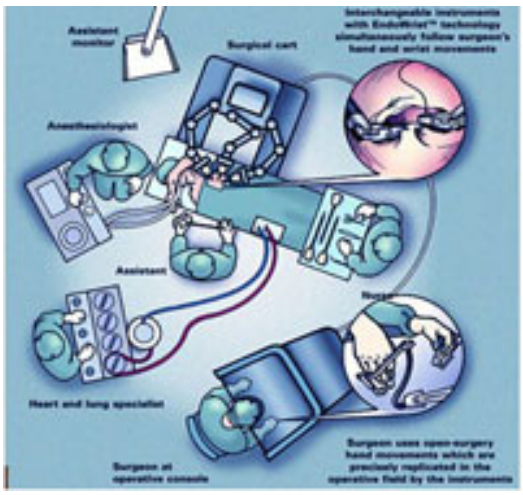
Training Surgeons To Perform Robot-Assisted Laparoscopy

Using the dVSS, the surgeon operates while seated at a console viewing a 3D image of the surgical field.

Laparoscopy is a minimally invasive surgical procedure that uses long instruments inserted through small incisions. Compared with traditional open procedures, laparoscopy has revolutionized the treatment of abdominal pathologies by shortening recovery time with less pain and fewer adhesions, resulting in better postoperative quality of life.

However, manual laparoscopy has also revealed several limitations, including lack of depth perception, poor camera control, limited degrees of freedom for the instrument tips, and inverted hand-instrument movements. These limitations lead to unnatural and painful surgical postures that result in surgeon fatigue.

The advent of robot-assisted surgery using the dVSS from Intuitive Surgical, Inc. has helped surgeons overcome some of the limitations of manual laparoscopy. In robot-assisted laparoscopy, the surgeon sits at a console and remotely controls endoscopic instruments via a surgical robot. The 3D visualization provides depth perception, and the wrist-like articulations of the console instruments improve surgeons’ dexterity by diminishing tremor and scaled motion and increasing range of motion. The coordinated hand-instrument movement reduced laparoscopic surgeon training time using robotic systems in comparison to using manual laparoscopy. The dVSS has been approved by the FDA for gastrointestinal, thoracic, urological, gynecological, and cardiac procedures.



[1] A sketch of what the operating room looks like when performing laparoscopy using the dVSS.

Training Surgeons to use the dvss using LabVIEW

Although the prevalence of robot-assisted surgery has tremendously increased, the development of training protocols is limited. Establishing a training program for robotic assistive surgery will help meet the demand for the technique. We feel learning robotic technology should be part of the medical curriculum. At the Nebraska Biomechanics Core Facility in the HPER Biomechanics Laboratory at the University of Nebraska at Omaha, we worked with the Robotic Surgical Laboratory at the university's medical center to develop a training program for robotic surgery where new surgeons can learn how to use this advanced technology.

Using LabVIEW software, we developed two training platforms. The first is designed for monitoring and recording a surgeon's performance in our training program and ensuring that the surgery is performed using the correct movements. This training platform, based in LabVIEW, also creates visual real-time feedback to show trainees how much force they apply on the training task or animate tissue. This visual feedback helps trainees reduce tissue damage inflicted during the procedure. We also used LabVIEW to create a working environment for training in virtual reality. This second training platform gives us the flexibility to conduct research by collecting data and adjusting our training tasks in the virtual simulator via Ethernet. Virtual robotic surgical training opens a new realm of possibility where multiple surgeons can train simultaneously and provide problem-based training protocols for new surgeons to learn robotic surgery.

We acquire all the information from the robotic surgical system by connecting with the dVSS via TCP/IP. We also use the NI USB-6009 data acquisition board to connect to the electromyography system and electrogoniometers to acquire physiological measurements such as muscle activations and joint angles from the surgeons.

We chose a graphical system design approach using LabVIEW software and NI data acquisition hardware for several reasons. The inherent ease-of-use of the LabVIEW platform was enhanced by the numerous training courses offered by NI, which was a component other solutions could not provide. Although both of the engineers who

developed this platform were already familiar with LabVIEW programming, they were able to further develop their skills and shorten development time by attending training seminars held throughout the Omaha and Lincoln areas. Additionally, we were able to continuously improve our training system because of the modular approach of software-defined hardware.

With this system, researchers and medical personnel can objectively evaluate surgical proficiency before and after the robotic surgical training protocol. The application assists in training doctors on a system that mutually benefits doctors and patients alike by reducing surgeon fatigue and minimizing tissue damage inflicted during laparoscopic procedures.

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