Abstract:
The number of minimally invasive surgeries has increased by more than 1 million cases per year from 1996 to 2006 according to the Center for Disease Control. With this dramatic and sustained increase in the number of minimally invasive surgeries the surgical workload has subsequently increased. Inadequate rest time following any significant exposure to biomechanical risk factors can lead to serious musculoskeletal disorders such as carpal tunnel syndrome, tendinitis and nerve impingement among others. Numerous research groups have recognized this issue and begun to evaluate laparoscopy from an ergonomics perspective. Surface electromyography is the most common quantitative study method published by ergonomics literature on laparoscopy. After reviewing current ergonomic literature on laparoscopic surgery it becomes clear that a comprehensive approach to quantitatively reporting on the associated biomechanical risk factors has yet to be performed. Surgeon posture has been primarily evaluated using observational methodology, but by utilizing an optoelectronic motion capture system the exact surgeon posture can be recorded in 3D space. Electromyography is used to evaluate muscle recruitment and workload for small forearm muscles used in wrist stabilization. Additional muscles can be studied to observe large muscle recruitment in the upper arm as well as finger flexors and extensors. Point force sensors are used to evaluate hand forces required to actuate and grip various features of medical devices. This is vital for determining subsequent palm forces during grip tasks which may increase pressure on peripheral nerves. The force plate gathers information on center of pressure to follow surgeon position during procedures. Operating forces and moments are also recorded by the force plate and result from push, pull, and twisting motions of hand-held devices. Correlating data between research modalities can result in new information with regards to the biomechanical influences devices have on the surgeons. This new information can then guide the development of the next generation of devices and operating room equipment.