Biorobotics Laboratory

Department of Electrical Engineering

The UW Biorobotics Laboratory is currently working on three interrelated thrusts:

1) haptic interfaces
2) surgical robotics and simulation, and
3) biologically inspired robot design.

Current projects include: devices and experiments to characterize the biomechanics of surgery, methods for achieving stable high performance control of haptic devices, artificial muscle spindles, and powered prosthetic and orthotic devices.

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One of the focus areas of the BRL is in haptics. Haptic devices provide tactile information to the user to improve realism of simulators, for example. Haptics research in the BRL focuses on the development of devices and stable controllers, as well as using them in experiments to determine human perception thresholds.

The BRL is also interested in understanding the underlying biomechanical interactions involved in minimally invasive surgery (MIS). We measure the interactions the surgeon has with the surgical instruments in order to quantify their skill level. Statistical (Markov) models have been developed which can estimate a surgeon's skill level based on the forces and torques they apply to the tool during a typical procedure. A device has also been built to track the motion of the surgical tools during the surgery. Other research has also taken place in analyzing the mechanical characteristics of organs within the abdomen, using custom-made instruments.

The biologically inspired robotics group at the Biorobotics Lab develops robotic hardware that functionally replicates elements of the human musculoskeletal system and its neural control. One current project in this area is the development of a biologically accurate mechanical model of the muscle spindle that is being used to study the transduction properties of populations of muscle spindles. Another topic is the study of implementing pneumatic artificial muscles to power orthoses for rehabilitative training applications with spinal cord injured patients.

Selected Publications

Rosen J., Solazzo, M., Hannaford, B., Sinanan, M., 2001, "Objective Laparoscopic Skills Assessments of Surgical Residents Using Hidden Markov Models Based on Haptic Information and Tool/Tissue Interactions," Stud. Health Tech. Inform. 81:417-23.

Klute, G.K., Hannaford, B., 2000, "Accounting for Elastic Energy Storage in McKibben Artificial Muscle Actuators," ASME Journal of Dynamic Systems, Measurements, and Control, 122:386-8.

Venema, S.C., Hannaford, B., 2000, "Experiments in Fingertip Perception of Surface Discontinuities," Intl. Journal of Robotics Research, 19:684-96.

See <http://rcs.ee.washington.edu/BRL/reports> for PDF files.