a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

Supervisor Contact: Prof. Elizabeth Croft, Ph.D., P. Eng.
Department of Mechanical Engineering
office: Room x015 ICICS Bldg.
mail: 2054-6250 Applied Science Lane
The University of British Columbia,
Vancouver, B.C. V6T 1Z4, Canada
email: ecroft@mech.ubc.ca, phone 604-822-3147

MECH 493 project: Investigation of Human Balance and Galvanic Vestibular Stimulation

Background and research goal

The Sensorimotor Physiology Laboratory (Kinesiology) and the CARIS Lab (Mechanical Engineering) are studying the sensorimotor control systems that underlie the human balance system. This research is performed by combining vestibular (inner ear) stimulation with real-world motions on a 6 degree of freedom robot motion platform, Figure 1.

Figure 1. Robot Balance Platform in the CARIS Laboratory

It has been shown that by applying a small electrical current across the vestibular nerves (Galvanic Vestibular Stimulation or GVS), it is possible to produce a whole-body balance response. Volunteers subjected to electrical vestibular stimuli perceive an irresistible pull and consequently lean in the direction of the positive electrode. The response to, and perception of, this stimulation changes with body and head position, providing a unique investigative tool to understand how the central nervous system processes vestibular signals and relates these signals to physical motions (linear and rotational accelerations).

In recent work by Masters student Eric Pospisil, we identified several experiments that would help to explain the function of the vestibular system for motion perception and standing balance. In particular, we found that the effect of the GVS could be effectively "cancelled" by physically accelerating the subject while they balance on the robot. As well, we identified that vibrations present during operation of the robot platform presented limitations to vestibular studies already performed. These vibrations have now been eliminated through a re-design of the robot's control system.

This project would comprise learning about the vestibular system and GVS, recreating some of Pospisil's experiments under vibration-free conditions, and selecting and implementing several of the recommended experiments from the last chapter of Pospisil's thesis.

Tasks to be performed by the student

1) Literature review on human balance system and careful review of Pospisil's thesis.
2) Training on the robot system, and on GVS, and assisting with other human subject experiments to learn experimental methods.
3) Revise/amend (as necessarily) experimental protocol.
4) Recruit subjects and run selected experiments
5) Analyze data following Pospisil's methods
6) Report findings and prepare a research paper

Above tasks require the student to have the following skills/background:

- Ability to program in Labview and Matlab
- Strong interest in human biomechanics and physiology
- Understanding of system modeling, and 3-D rigid body kinematics and dynamics
- Data analysis and statistics
- Interest in working on human subject testing

Facilities and team:

Location of work: CARIS Lab, ICICS x015
Supervisors – E Croft (Mechanical Engineering), JS Blouin (Kinesiology)