Executive Summary

Postural stability is the ability to maintain an upright posture and to keep the center of gravity (COG) within the limits of the body’s base of support. It is maintained through the dynamic integration of muscle activity and joint position, both of which are influenced by sensory information from visual, vestibular, and somatosensory inputs. The foot, and therefore footwear, also plays a critical role in postural stability. The plantar surface of the foot contains cutaneous mechanoreceptors that detect tactile stimuli and relay this information to the central nervous system. Stimulation of cutaneous mechanoreceptors is believed to improve postural stability and proprioception (an awareness of where one’s limbs are oriented in space). While traditional walking footwear is designed to provide stability and support to the foot, one of the hottest trends in the footwear industry is “toning” shoes which have an intentionally unstable sole design. This unstable sole design forces the wearer’s body to constantly work to find equilibrium or balance points. The manufacturers claim that this instability helps the wearer burn more calories, tone muscles, improve posture, and improve overall health.

The goal of this study is to determine the effects of footwear on the postural stability of college-age women. Each subject’s postural stability will be evaluated wearing toning shoes, standard athletic shoes, and in a barefoot condition. A standard balance protocol will be conducted that will test each subject’s bilateral and unilateral stance in both an eyes-open/eyes-closed condition. The displacement of the participants’ COG will be the primary balance parameter used to describe the subject’s postural stability.

To complete this postural stability study, $1000 is requested for supplies and equipment to be used during the 2011-2012 Spring Quarter. Audrey Niverson will be doing this project for academic credit. The study will require lab space, and we have arranged for space in M203, an ABBE biomechanics/bioinstrumentation lab, where the equipment will be stored and the data collection will take place. The research will be arranged around laboratory activities scheduled in the room.

*An institute IRB application for human subjects participation has been submitted.
Detailed Project Description

The findings of the proposed project will be important to the field of biomechanics. While there have been several studies that investigate the effect of “toning” shoes on dynamic, long-term physiologic performance, there is an absence of well-controlled studies that look at the short-term, postural stability claims of the “toning” shoe manufacturers. The proposed study will provide Audrey with a unique opportunity to answer an important biomechanical question while developing skills that are critical in the field of biomedical engineering. Audrey and I will work together to develop an IRB-approved research plan, recruit subjects, gather informed consent from all the participants (which requires excellent communication skills to make sure that the participants understand their rights as subjects), set up and calibrate equipment, collect the data, develop a data analysis plan, analyze the data, perform a statistical analysis of the data, and generate final conclusions. She will be involved in every aspect of the project and learn practical applications of the knowledge she has gathered in her first two years of coursework at Rose-Hulman. This project will also have an impact on the research participants. It is very likely that all the participants will be RHIT students. Participants will be encouraged to ask questions and interact with the hardware and software during the informed consent portion of the experiments. Participants can also request to receive the study findings at the conclusion of the research.

20 - 25 female participants will be recruited to participate in the study. Subjects will be tested barefoot, in a pair of “toning” shoes, and in a pair of normal walking shoes. Shoes will be provided; therefore shoe size will be one of the selection criteria for subjects since only 3 sizes of shoes will be available. Subjects will stand in a comfortable upright position with their eyes open/closed for bilateral/unilateral standing experiments on a Matscan pressure mat (Tekscan, Boston, MA). Subjects will be given the opportunity to practice the stability trials and a rest period between trials will avoid fatigue. The location of the COG during the data collection will be tracked and recorded for future analysis.

Budget Justification

The Matscan pressure mat will be borrowed from the Orthopaedic Biomechanics Lab (OBL), but the OBL does not currently have the Sway Analysis Module (SAM) which is required to evaluate the direction and amount of COG displacement. This software has been assessed for accuracy and validity and is the state-of-the-art for balance studies.

**Equipment**

| Sway Analysis Module (Tekscan, Inc.) | $1000 |

**Supplies/Consumables**

| 3 pairs of New Balance Women’s Toning Shoes | $225 (~$75/pair) |
| 3 pairs of New Balance Walking Shoes | $180 (~$60/pair) |
| Socks (for health and safety due to shoe sharing) | ~$50 |

**Total Request**

$1455