Simulating a Physical Therapy Balancing Test in a Virtual Environment

Maya Martinez[1], Aenah Ramones[2],Genevieve Kelleher[2], Kyle Mazza[2], Praveen Shankar[3], Panadda Marayong[3], Vennila Krishnan[4]

[1]Department of Biomedical Engineering, [2]Department of Computer Engineering & Computer Science, [3]Department of Mechanical & Aerospace Engineering, [4]Department of Physical Therapy

California State University, Long Beach

Virtual Reality (VR) systems are finding uses in multiples applications such as gaming, art, sport and rehabilitation through its added benefits of allowing the developer to manipulate the system parameters easily for various simulation scenarios. In this project, a Cave Automatic Virtual Environment (CAVE) system is used to simulate test balancing while standing in a clinical settings. The primary goal of the study is to determine if the virtual environment can be reliably used instead of the actual clinical environment in the physical therapy (PT) lab. The setup in the CAVE environment includes simulation of a PT lab at CSULB with a balancing apparatus consisting of a pendulum that swings and slightly perturbs the subject's upper torso at the shoulder level. Consequently, the subject's reaction time, ground forces, and muscular activation are measured. The balancing apparatus is recreated in the immersive CAVE VR environment. The contact force from the swing pendulum will be created through a vest that provides tactile feedback at the approximate location the pendulum would hit in a real setup. The development of this project began by designing an electronic package to measure the force exerted by the balancing apparatus when perturbing the subject. Using this data, a vest will be created with tactors to generate the same force resulting in similar biomechanical response of being perturbed. Currently, the VR physical therapy lab is developed in Unity 3D and Blender software and displayed in the CAVE system using Middle VR software. We are currently developing the haptic vest. The validity of the VR system will be tested in a user study to assess its effectiveness against the real set-up. Simulating the standing balance test in VR can offer an effective alternate method for performing a real perturbation due to its ease of use, availability of personnel, and provides an opportunity to develop a future balance training system for individualized care.