Balance retraining is a critical part of rehabilitation for many individuals following neurotrauma such as stroke. This work focuses on implementation of visual feedback in balance therapy with the ultimate goal of improving the efficacy of clinical balance rehabilitation. Using the custom-built WeHab balance rehabilitation software tool, this work examines strategies for implementing visual feedback in terms of how balance information is transformed and displayed, as well as interpretation of balance information based on mediolateral weight shifting. By focusing on gaming peripherals such as the Nintendo® Wii Balance Board, which are inexpensive and widely available, this work has the potential to enable visual feedback for balance therapy in both clinical and home settings.

One-hundred nineteen young, healthy subjects between the ages of 17 and 22 participated in two studies of visual feedback design strategy. The first study examined the effects of feedback arrangement (direct CoP vs. mediolateral weight distribution), numeric feedback, and dimensionality, while the second study investigated implementation of feedback
based on CoP, CoG, and filtered CoP information. Together, these studies demonstrated that feedback design has a significant impact on subject performance in both quiet standing and mediolateral weight-shifting balance tasks.

Using mediolateral weight-shifting data from the young, healthy subjects in the first study, balance control parameters were obtained by matching experimental balance performance to simulated results using an inverted pendulum model. The close matching obtained across all subjects indicated the usefulness of this novel application of the simple model in examining mediolateral weight shifting. Additionally, this modeling study incorporated a novel non-minimum phase behavior metric in classifying subject weight-shifting performance.

In addition to instrumentation of young, healthy studies in a research setting, the WeHab system has been deployed to five local balance therapy facilities. At these locations, 89 patients have gone through their normal balance therapy using the WeHab system over the course of 172 therapy sessions. Preliminary examination of the data from these sessions indicates that instrumentation of clinical balance therapy could provide a method for quicker balance assessment and quantitative insight into patient balance performance. Additionally, comparison of clinical data with data from the young, healthy subjects and 13 age-matched subjects demonstrates differences between the subject populations that should be explored further in future work.