INTRODUCTION
Stair descent is difficult for amputees using lower limb prostheses, in part due to the absence of sensation. We are focusing on the lack of sensation of the plantar surface forces that may be used to feel foot placement. The natural motion of lowering the foot during stair descent is obstructed because of insufficient ankle dorsiflexion in prosthetic feet, but this effect can be mitigated by foot placement. Even active dorsiflexion prosthetic feet provide less than the 27 degrees observed for physiological ankles during stair descent [1, 2].

We developed a haptic feedback system for assisting transtibial amputees during stair descent by providing information of toe overhang as stimulations on the thigh. We suggest that haptic feedback information of foot placement based on toe overhang can enable amputees to use a strategy of rolling the plantar surface of the foot about the staircase edge as the pivot point. This could enable the lowering of the intact limb without ankle flexion in the prosthetic limb hence allowing easier stair descent with regular foot prostheses.

RESULTS AND DISCUSSIONS
Results for Experiment 1 are plotted as a confusion matrix and Experiment 2 as a bar plot (Figure 2). It can be seen that in Experiment 1, subjects were able to distinguish and localize the locations of applied force correctly >82%. Most misperceived locations were off by a single location. In Experiment 2, while the mean error is less for the case when feedback is present (0.0639 vs 0.1068), the standard deviation for both cases are large.

CONCLUSION
The haptic feedback system was able to provide distinct and useful feedback information on the location of applied force at the plantar surface of the foot. Effectiveness of the system while worn during stair descent looks promising but more experiments are underway to confirm, and to apply the system to prosthetic limb users instead of the boot.

REFERENCES