

# Balance-Restoring Insoles

Brandee Taylor Clayton, *Biomedical Engineering, University of Rhode Island*  
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**Abstract—Balance-Restoring Insoles are addressing the substantial health hazard of the elderly falling due to balance related problems. These insoles create the future to improve balance among the elderly and also can apply to improve impediments in a range of other health areas, such as victims of cerebral palsy and diabetes.**

## I. INTRODUCTION

One of many leading health concerns for people over the age of 60 is falling, which is often related to balance problems. Every year, 20%-40% of adults over 65 years of age who live at home fall. Good balance entails reliable sensory input from the individual's vision, proprioceptors (sensors of position and movement in the feet and legs), and vestibular system (balance system of the inner ear). The elderly are prone to diseases that affect these systems. Diseases like cataracts and glaucoma affect vision; degeneration of vestibular system occurs the more one ages; and diabetic peripheral neuropathy affects position sense in the feet and legs. With this in mind, important scientific efforts are being made to reduce this substantial health hazard.

## II. METHODS

Mechanical actuators that function by converting rotary motion into linear motion to execute movement (designed to be inserted into any type of footwear) are embedded into the insoles. Signal generator and small battery are also integrated within the insole to provide sensory enhancement stimulation to the user's feet. Smart phone app controls the stimulation level and can inform the user of device status (stimulation and battery levels). Sensory enhancement insole: For elderly persons, potentially improve their walking stability and sense of balance. For diabetics who have peripheral neuropathy, this may increase the sensitivity of their feet and eventually decrease the risk of ulceration

## III. RESULTS

Eighteen elderly recurrent fallers and 18 elderly non-fallers were recruited from the MOBILIZE Boston Study (MBS), a population-based cohort study investigating novel risk factors for falls. Twelve young participants were included as controls. Participants performed three 6-min walking trials while wearing a pair of insoles containing vibrating actuators. During each trial, the noise stimulus was applied for 3 of the 6min, and differences in stride, stance, and swing time variability were analyzed between noise and no-noise conditions. The use of vibrating insoles significantly reduced stride, stance, and swing time variability measures for elderly recurrent fallers. Elderly non-fallers also demonstrated significant reductions in stride and stance time variability. Although young participants showed decreases in all variability measures, the results did not achieve statistical

significance. Gait variability reductions with noise were similar between the elderly recurrent fallers and elderly non-fallers. This study supports the hypothesis that subsensory vibratory noise applied to the soles of the feet can reduce gait variability in elderly participants. *Gait Posture*. 2009 Oct; 30(3):383-7

## IV. DISCUSSION

Although the Balance-Restoring Insoles are not in commercial use scientists are trying to get the final product approved by the U.S. Food and Drug Administration and on the market within the next two years. There are design challenges in converting the prototype to commercial use. Ideally would be a thin insole (including motors, control electronics, and batteries) that would fit most shoes. Scientists must find the most appropriate combination of low profile actuators and gel (that insole is made out of). Thin batteries may not have the energy intensity to deliver hours of vibration so that is another aspect that must be fixed for the final product. These soles only alleviate symptoms but does not cure the cause, which results in people wearing the device for most of the day, at least 8 hours or more. Although there are some limitations now, the future for these soles are bright. It has the potential to improve balance in the elderly which results in fewer falls, lower cost of care, and a more active lifestyle with greater independence; an overall improved quality of life. They can diminish the creation of foot ulcers in diabetic patients, improve the mobility of stroke sufferers, accelerate rehabilitation, assist children with cerebral palsy, improve performance of athletes (runners) and workplace safety (steel workers working on tall structures).

## REFERENCES

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