Active shot insoles designed to augment the foot’s existing neural function and help restore lost sensation could improve sensitivity, balance, and walking dynamics

A Critical Need
Sudden falls are the leading cause of injury among the elderly. Every year, more than 18,000 older adults die from injuries sustained during such falls, and the worldwide cost of their treatment is expected to exceed $50 billion by 2020. Many of these falls are a result of the diminished sensory capabilities of the foot that typically come with age. Restoring the foot’s lost sensation could help improve balance and prevent these falls from occurring. The sole of the foot plays a critical role in communicating sensory information to the body’s central nervous system. Sensory receptors send messages about foot position, weight distribution, and pressure. This system is essential for maintaining balance, moving effectively and safely, and recognizing injuries and infections before they develop into serious medical conditions. But sensory function can degrade for many reasons, including aging, injury, and disease. For example, people with diabetes may experience such diminished sensory function that they develop foot ulcers, which often result in amputation. Beyond these major conditions, the foot’s sensory capabilities also affect other aspects of daily life such as workplace safety, athletic performance, children’s walking and developmental processes, and stroke victim recovery.

Wyss Institute Active Insoles Technology
The application of a small amount of noise has been shown to improve sensitivity in certain types of systems. Historically, this principle, known as stochastic resonance, has been used to describe planetary dynamics and climate changes that affect weather. More recently, it has been applied to improve the performance of biological systems.

The Wyss Institute active insoles technology incorporates stochastic resonance in the development of a therapeutic medical device that is designed to enhance the sensory functions of the foot. For elderly individuals, this sensory enhancement stimulation could improve their sense of balance with the goal of reducing the risk of falls. For a wearer with diabetes, the active insoles could potentially restore some of the sensation that is lost through the disease, with the goal of potentially lowering the risk of ulceration and thus reducing the need for lower extremity amputation. Additional potential applications include areas in which augmented physical performance is desirable, such as rock climbing and construction work, or to improve workplace safety, accelerate rehabilitation, or improve performance in athletic activities.

Adjustable Active Insoles for Any Type of Footwear
With mechanical actuators embedded into insoles made with traditional insole materials, the Wyss Institute active insoles are designed to be inserted into any type of footwear. Signal generators and battery packs are used to generate the noise signal and provide electrical power. A simple user interface, such as a smart phone, may also be incorporated to help adjust the device and monitor its status. The objective of this continuing research is for the development of a device that will be inexpensive to manufacture, intuitive to control and adjust, safe and effective.
