Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Robotic Ankle System for Gait Disorders

There are many factors that can contribute to gait disorders including aging, injury, and neurological conditions. When considering gait rehabilitation, the ankle push-off phase is vital in a patient's ability to walk and propel themselves forward. During this push-off phase, the planar flexor muscles provide a large amount of force to push the heel off the ground. For those with compromised strength in these muscles, walking and gait can be affected. Assistive ankle-foot orthoses (AFO) can provide support to a user's ankle and assist with the force needed for heel off, however they tend to be heavy, work only on flat surfaces, and require an external power source that needs to be replenished after a few actuations, making them impractical in real use.

Researchers at Arizona State University have developed a robotic ankle system (semi-active AFO) to assist patients with gait issues. This wearable ankle robotic device attaches to the user's shoe, and provides continuous force during the entire heel up phase, helping with gait regulation. Utilizing a constant force spring and a ratcheting mechanism, this shoe stores energy supplied by the user and releases it upon heel off. Instead of only providing force in the initial phase, the constant force springs allow for the force to be applied throughout the entirety of the heel up phase of the step. Further, a variety of shoe sizes can be accommodated with the design of the robotic shoe system without requiring any change to the frame structure.

This lightweight semi-active AFO system provides a continuous assistive force that could help in real world situations for the thousands of patients who suffer from gait disorders.

Potential Applications

- Rehabilitation
- Permanent assistance
- Assistive AFO alternative

Benefits and Advantages

- Continuous assistive force is provided during the entire heel-up phase

- Eliminates the constraints of only being able to operate on a flat surface

- Lightweight design – adds less than 1kg to the user's foot, but can support a user of 90kg

- Active release mechanism that provides greater controllability over devices with linear springs

- Easily adjustable to shoe size without requiring changes to the frame structure

- A locking mechanism evenly distributes the force throughout the frame to prevent twisting

- Reduced power consumption – the actuator only needs to be powered while the device is unlocking

- Using a 1300mAh LiPo batter provides 5.4 hours at a walking speed of 1m/s

- Monitors a user's ground reaction forces to determine actuation timing

For more information about this opportunity, please see

Schaller et al - ASME Conference Proceedings - 2020

For more information about the inventor(s) and their research, please see

Dr. Zhang's laboratory webpage

Dr. Zhang's departmental webpage