Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M20-232P^
Published: 3/29/2021

Inventors

Hyunglae Lee
Carly Thalman
Tiffany Hertzell
Marielle Debeurre

Contact

Shen Yan
shen.yan@skysonginnovations.com

Inflatable Soft Actuator for Ankle-Foot Orthosis Exosuits

Background

Permanent deformation of the tendons surrounding the ankle joint can occur in individuals suffering from chronic ankle instability (CAI), which is a long-term disability that can result from recurrent ankle sprains. Lateral ankle buckling causes sudden instances of ankle inversion-eversion (IE) in the frontal plane, which creates excessive stress in the tendons and results in the ankle sprain. An estimated 85% of reported ankle sprains are a result of such injuries, and repeated occurrences of sprained ankles can lead to CAI. An affected individual is at an increased risk of injury, as the damaged tendons surrounding the ankle joint may lead to an irregular gait pattern.

Individuals suffering from hemiparesis after a stroke, paralysis of pretibial muscles, or fixed plantarflexion will often experience a lack of shock absorption and loss of definitive heel strike in the gait. This can cause a loss of the final rocker action needed to propel the foot forward for toe-off to transition to pre-swing. Hence, the development of practical and effective ankle-foot orthoses can prevent further injury or pain.

Invention Description

Researchers at Arizona State University have developed a Multi-material Actuator for Variable Stiffness (MAVS), which features fabric-based inflatable actuators constrained by thin rigid retainer pieces. These rigid retainers limit the vertical expansion of the fabric layers by physically restricting the volume of the internal pressure chamber. Design emphasis was placed on maximizing stiffness and reducing actuation time. The MAVS is intended for integration with a soft robotic ankle-foot orthosis (SR-AFO) exosuit to aid in supporting the human ankle in the inversion/eversion directions, assisting those with CAI or other ankle joint impairments.

A brief video overview can be viewed here.

Potential Applications

- Soft robotic ankle-foot orthosis (SR-AFO) exosuits
- Gait rehabilitation
- Wearable robots

Benefits and Advantages

- Reduced actuation time and increased ankle stiffness compared to its predecessor
- Achieves flush fit with user's ankle through integration of rigid sections that constrain actuator inflation

Related Publication: The Multi-material Actuator for Variable Stiffness (MAVS): Design, Modeling, and Characterization of a Soft Actuator for Lateral Ankle Support

Research Homepage of Professor Hyunglae Lee