INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Multi-Path Cam-Follower Transmission for Wearable Robotics

TECHNOLOGY NUMBER: 2018-435

OVERVIEW

A cam-based transmission and stiffness modulation unit to improve existing knee-ankle orthoses

- Provides a novel means by which to more closely match human biomechanics during gait
- Allows variations in energy return to optimize overall energy storage and return (ESR)

BACKGROUND

Commercially available prosthetic ankle-foot orthoses commonly behave like springs that store and return energy to the wearer as they ambulate. However, these devices do not conform to the appropriate torque-angle relationship which occurs during able-bodied walking. The mechanics of normal gait follow what is known as the "quasi-stiffness" curve, and the choice of prosthetic stiffness cannot vary during different phases of walking to match the normal state. The inability to design devices with nonlinear stiffness characteristics causes hindrances at specific points of the gait cycle, depending upon which stiffness is chosen for the orthosis. Energy and storage return (ESR) is also difficult to optimize in prosthetic feet across phases of standing and walking, especially when traversing stairways. The resulting compensatory gait abnormalities created by patient efforts to correct for these imperfections can result in socket pain, back pain, and joint diseases. A need therefore exists to develop an ankle-foot prosthesis which exhibits appropriate biomechanics during the different phases of gait, such as those which exist while walking, moving up and down stairs, or standing quietly.

INNOVATION

Researchers have invented a cam-based transmission and stiffness modulation unit to more closely match human biomechanics during gait. The system is comprised of a cam profile and a cam follower, the latter of which may be positioned within the concave portion when the assistive device in located in an equilibrium position. The cam profile is positioned to rotate about a joint of the device in response to a force applied during a stance phase of gait, while the cam follower can be coupled to a leaf spring and roll along the curved outer edge of the cam profile from dorsiflexion to plantarflexion. A sliding element is positioned on a motor-powered

Technology ID

2018-435

Category

Medical Devices
Life Sciences

Inventor

Elliott Rouse
Hashim Quraishi
Leo McManus
Maxwell Shepherd

Further information

Aparna Bubna
abubna@umich.edu

View online page

screw that adjusts the position of the sliding element on the surface of the leaf spring, and the position of this sliding element can be manually adjusted. The invention also allows for the use of multiple cam profiles to allow variations in energy return and optimize energy storage and return (ESR). Overall, the invention provides a cam-based transmission and stiffness modulation unit that can be varied continuously to improve the biomechanics of prosthetic ankle-foot orthoses.