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A Multi-Axis Robotic Platform to Study Neuromechanics of the Ankle Joint

Multi-Axis Robotic Platform for Studying Neuromechanics of an Ankle Joint

SI Case No. M17-209P

Background

The human ankle provides a variety of functions during both walking and standing. The ankle generates propulsion, supports body weight, absorbs impact, contributes to balance, and aids in stability among a number of other functions through a mechanical impedance. Mechanical impedance relates an input motion to its respective output forces, making it a vital parameter in characterizing biomechanical behavior for a wide range of applications including medical assistive devices, prosthetics, physical therapy, and robotics.

Biological joints are inherently nonlinear systems, making them difficult to model due to the disproportional relationship between varying inputs and outputs. Current methods simplify to single-joint, single degree of freedom (DOF) systems to reduce complexity at the cost of accuracy. A better understanding of the neuromuscular interactions of the ankle would be invaluable to healthcare and sports industries in developing more effective rehabilitation procedures and assistive devices, as well as in optimizing performance of robotic joints.

Invention Description

Researchers at Arizona State University have tackled these issues through the invention of a novel multi-axis robotic platform capable of modeling multi-joint, multi-DOF ankle joint impedance and reflex characteristics for both sitting and walking movements. This system drastically improves the accuracy and precision of ankle joint neuromuscular interactions through its ability to include muscular stretch reflexes. It's modular, lightweight design permits accurate measurements to be taken in a variety of both moving and resting positions.

Potential Applications

- Human-centered robotics

- Physical therapy care
- Prosthetics
- Medical devices
- Sports performance

Benefits and Advantages

- Improves Accuracy – Ability to model nonlinear neuromuscular biomechanics in a variety of situations such as standing, walking, and running.
- Portable – Modular design allows device to be transported to any facility with ease.
- Versatile – Lightweight design allows the device to be utilized in a number of moving and resting positions.

Original Document

Professor Lee's Webpage