Cable-driven exoskeleton for effective physical rehabilitation

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Technology description

Summary

This technology is a simple, lightweight cable-driven exoskeleton that can be used for physical rehabilitation and gait training.

Unmet Need: Lightweight robotics for guided gait rehabilitation

Gait training for patients with neural impairments or other movement disorders typically requires long hours with a trained therapist. While robotics have emerged as a promising alternative, current models suffer from bulky designs that can lead to misalignment with the patient’s joints and a restricted range of motion.

The Technology: Simple, cable-driven exoskeleton for gait training in adult and pediatric patients

This technology is a cable-driven exoskeleton that offers a lightweight, robotic alternative without limiting the patient’s range of motion and reduces the risk of injury due to improper alignment. The device is composed of lightweight adapters that attach to the patient’s legs. Externally supported cables are routed through these adapters and work to support the patient while driving the leg’s range of motion. Strategically placed sensors enable data to be collected from the tension, angle of movement, and the patient’s overall performance during use to better assist in improving gait rehabilitation. This simplified system reduces unnecessary stress on the joints and the risk of injury due to incorrect alignment with the exoskeleton, and can be adapted for patients of different ages, weights, and states of mobility.

This exoskeleton design has been tested with human subjects using a treadmill to demonstrate the ability to accurately track a prescribed ankle path.

Publications

Banala SK, Kim SH, Agrawal SK, Scholz JP. “Robot assisted gait training with active leg exoskeleton (ALEX)” IEEE Trans Neural Syst Rehabil Eng. 2009 Feb 17;(1):2-8.
Jin X, Cui X and Agrawal SK. "Design of a cable-driven active leg exoskeleton (C-ALEX) and gait training experiments with human subjects." IEEE international conference on robotics and automation (ICRA). May 2015.

Application area

Gait rehabilitation device for stroke or spinal cord injury

Gait rehabilitation device for cerebral palsy patients

Gait re-training technology for healthy individuals with non-ideal gaits due to habit or surgery (e.g. ACL reconstruction, etc.)

Physical rehabilitation device for patients with various neural impairments

Prevention of osteoarthritis

Research tool to investigate differences in gaits between individuals

Pediatric rehabilitation

Advantages

Eliminates need to align the exoskeleton with the patient, eliminating the risk of injury due to misalignment

Does not restrict range of motion by including rigid links or mechanical joints

Incorporates lightweight cuffs on the limbs to reduce mass and inertia on the patient

Sensors and externally supported cables and to assess movement parameters

Allows for natural degrees-of-freedom of human motion

Institution

Columbia University

Inventors

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