CAREX: A lightweight exoskeleton for stroke rehabilitation of the arm

Each year, more than 795,000 people in the U.S. alone suffer from stroke, which can lead to loss of motor skills, long-term disability, or death. Rehabilitation following a stroke is an important step in the recovery of physical functionality and often involves the use of strengthening, mobility, and range-of-motion exercises. In recent years, technology-assisted rehabilitation has become increasingly popular, including robotic devices which guide impaired limbs through repetitive motions to regain strength and flexibility. However, the weight of these robotic devices can be severely prohibitive in patients with highly compromised muscles, limiting the effectiveness of the rehabilitation. This technology is CAREX (Cable-driven ARm EXoskeleton), a lightweight robotic arm exoskeleton that assists patients and clinicians in arm motion training for stroke rehabilitation. The CAREX exoskeleton guides arm movements through rehabilitation exercises while being supported by cables that reduce the weight of the device, allowing patients with varying muscular compositions the ability to perform long-term rehabilitation training.

Weight-assisted device allows for post-stroke arm training even in patients with severely compromised muscles

CAREX combines robotics with advanced sensing technology into a wearable device that can be used by a wide range of stroke patients. Weight-bearing support is provided by cables attached to an external device, which can be controlled by a computer to simulate a number of motions with varying levels of support. Sensors embedded into the exoskeleton provide patient-specific feedback to the controller, allowing the device to regulate the motion and assistance provided to the patient. Thus, CAREX is sensitive to patient-specific motion deficiencies and can be used to provide personalized feedback to increase the effectiveness of the rehabilitation. The feedback data obtained using CAREX can also be used to track the longitudinal development of a patient.

A prototype of this technology has been constructed and tested in human subjects including stroke patients. Initial results have shown that patients were able to better follow a prescribed range of motion using the support provided by CAREX compared to an unsupported device.
Lead Inventor:
Sunil Agrawal, Ph.D.

Applications:
• Arm strength and locomotion training
• Physical rehabilitation following stroke
• Arm motion assistance for patients with neurodegenerative disease
• Characterization of arm strength and range-of-motion

Advantages:
• Wearable device
• Lightweight design that offers varying amounts of assistance
• Provides patient-specific feedback to device
• Collects crucial information for longitudinal evaluation

Patent Information:
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Related Publications:

Inventors
Sunil K. Agrawal