Design of a tendon-based robotic device for locomotion training

Background:

Most of the research in robot-assisted gait training has focus in designed rigid exoskeletons to guide the legs of patients with neurological injuries in a "correct" gait pattern. Although robotic guidance is often used in locomotor training, there is currently little evidence that robotic guidance is more beneficial for training. In fact, research has emphasized that errors are fundamental signals that drive motor adaptation.

The commercial treadmill h/p/cosmos with the non-actuated h/p/cosmos robowalk® expander

The proposed project aims at designing a novel tendon-based parallel robotic device for locomotion training that can guide or resist the patients' movements during training. Tendon-based robots are actuated through ropes, driven from motor actuated winches located outside of the controllable workspace. The wires are guided from the winches over deflection units fixed on the robot frame into the workspace. Tendon-based systems are especially suitable for dynamic tasks (e.g., walking/running), since each actuator is independent and does not need to support or drive the mass of other actuators, compared to robotic serial links.

The system will consist in a set of motors, pulleys and ropes that will be attached to the patient' leg segments (e.g., ankle), and that will allow the application of different forms of physical guidance (from guiding forces to assist patients in following the "normal" gait pattern, to force disturbances that would challenge patients and increase their effort during gait training).

Aims:

1. Literature research about tendon-based robotic devices.
2. Synthesis of the robot (i.e., finding the optimal robot geometry to produce the forces required at each workspace point to perform the desired task).
3. CAD design and prototyping.

Materials and Methods:

H/p/cosmos Venus: High performance treadmill for athletic running.

Requirements:

Good mechanical design skills are strongly required. Knowledge about motion control and robotics is recommended.

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