Robotic Walker for Gait Rehabilitation

Robots can potentially relieve therapists from the strenuous work and improve functional outcome. However, the potential of the robot assisted therapy has not been realized due to poor design and control methodologies of current gait rehabilitation robots.

Constraining the patients the sagittal plane and restricted pelvic motion on the treadmill are the key limitations of most current gait rehabilitation systems. It is believed that most effective gait training can only be achieved in trainings resembling the most natural over-ground walking, which will best facilitate brain plasticity and motor learning and motor skill retention. Patient self-motivation is another important factor to promote brain restructure and virtual reality games simulating the natural gait tasks is the most effective way to allow patients to initiate the gait movements and get real-time feedback during training.

We developed a novel robotic platform that enables patients post stroke to perform over-ground gait training at home or community rehab centers. The system consists of an omni-directional mobility platform, an active body weight support (BWS) unit, and a pelvic and trunk support and assist module (fig. 1). The omni-directional motion coupled with the pelvic support allows unrestricted natural trunk posture and pelvic motion. The user interacts with the system through a six DOF force/torque sensor. An admittance controller enables a natural and intuitive interface. The adaptive shared controller enables several control modes depending on the patient condition. The system can provide stability, balance, and gait training. It can also provide perturbation, resistance, and error augmentation training methods to enhance training efficacy. A set of IMU sensors is used to measure the gait kinematics and provide quantitative measures of gait recovery. Surface EMG sensors are used to monitor muscle condition and activation pattern. A functional electrical stimulation module can also be implemented on the system to provide simulations for patients with severe drop foot to enhance gait recovery.

Figure 1. Overall System Concept
Figure 2. Prototype of Robotic Walker
Figure 3. Walker under Testing

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