Dual Stewart-Platform Gait Rehabilitation System for Individuals Post-Stroke

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Introduction

Rehabilitation of walking for individuals post-stroke presents specific challenges. These include realistically reproducing the demands and environments for waking while maintaining safety. A Virtual reality (VR) walking simulator has been developed to allow individuals post-stroke to practice ambulation in a variety of virtual environments (VE). The system is an extension of the Rutgers Ankle Rehabilitation System (RARS) in sitting which has been used in the rehabilitation of gait of individuals post-stroke.[1, 2] Physical therapists can use the system to design and implement examinations and interventions either locally or remotely

Hardware and software Setup

The Stewart-platforms developed for this system are based on the original design of the Rutgers Ankle[3] 6DOF pneumatic robot. The new devices are larger and can sustain heavier loads making them suitable for gait training. The user, strapped in an unweighing frame stands on two such devices placed side-by-side (Fig. 1(a)). The devices can apply 6DOF forces and torques to the feet making it possible to simulate varied support surface conditions.

Figure 1. (a) Dual Stewart-platform system; (b) VR exercise - Street Crossing; (c) VR exercise - Park Walk

The platforms are integrated with two VE simulations, a street crossing and park path. The street crossing simulation (Fig. 1(b)) places the user on a sidewalk facing a street crossing. The user's task is to reach the other sidewalk while the light is still green. The complexity of the task is manipulated by changing several elements of the environment such as lighting, noise and the support surface conditions. The park-path simulation allows the user to walk along a winding path though a park. In this VE the complexity of the simulation is manipulated by changing the seasons, type and dimension of obstacles, elevations, support surface conditions and noises. Haptic effects have been developed to simulate contact with obstacles or road surfaces such as ice, water, gravel or mud. User progress is monitored using several outcome measures, including gait speed and walking distance.

FUTURE WORK

The system is currently in a development phase, which will be followed by validation and pilot trials on patients. It is anticipated that users' training on this system will transfer improvements from the VE to over-ground walking in different environments.

References

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