Self-Motion Control Exoskeleton for Upper Limb Rehabilitation with Perceptron Neuron Motion Capture

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Abstract

Upper limb rehabilitation robot can facilitate patients to regain their original impaired arm function and reduce therapist' workload. However, the patient does not have a direct control over his/ her arm movement, which may lead to discomfort or even injury. This paper focuses on the development of a self-motion rehabilitation robot using Perception Neuron motion capture, where the movement of the impaired arm imitates the motion of the healthy limb. The Axis Neuron software receives the healthy upper limb's motion data from Perception Neuron. Unity serves as the simulation engine

software that provides a 3-dimensional animation. ARDUnity acts as the communication platform between Unity software with Arduino. Arduino code is generated using Wire Editor, which avoids the need of the programming to be written in C++ or C#. Finally, Arduino instructs the exoskeleton motors that are connected to the impaired arm to move, following the healthy joint's motion. The forward kinematics analysis for the robotic exoskeleton has been carried out to identify its workspace. Hardware experimental tests on the elbow and wrist flexion/ extension have shown the root-mean-square errors (RMSE) between the healthy and impaired arms movement to be 1.5809° and 12.1955° respectively. The average time delay between the healthy and impaired elbow movement is 0.1 seconds. For the wrist motion, the time delay is 1 second. The experimental results verified the feasibility and effectiveness of the Perception Neuron in realizing the self-motion control robot for upper limb rehabilitation. The proposed system enables the patients to conduct the rehabilitation therapy in a safer and more comfortable way as they can directly adjust the speed or stop the movement of the affected limb whenever they feel pain or discomfort.

Author keywords

ARDUnity; Axis Neuron; Master-Slave; Perception Neuron; Self-Motion Control; Unity; Upper Limb Rehabilitation Robot

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