Evaluation of Gait Parameters using Wearable Sensors in Simulated Freezing of Gait Episodes

Halie Szilagyi[1] and Amol P. Yadav[1,2]
[1]Indiana University School of Medicine; [2]Indiana University School of Medicine, Department of Neurological Surgery

Background and Hypothesis: Freezing of gait (FoG), the failure to initiate or maintain locomotion, is a common symptom in Parkinsonism that severely impacts patients' quality of life. Wearable technology such as inertial measurement units (IMU) are being widely investigated as a method of detecting these episodes with increasing sensitivity and specificity. The aim of this initial study is to collect objective gait data using IMU sensors via Perception Neuron software and to develop an analysis pipeline for quick in-clinic calculation of gait parameters.

Experimental Design: 16 IMU's were attached to the feet, legs, arms, waist, back, and head in individuals without any gait abnormalities. Subjects were instructed to walk 10 meters normally, followed by 10 meters with interspersed, simulated FoG episodes. This data was processed and analyzed through Axis Studio and MATLAB to identify kinematic markers associated with gait. The correlation between the right and left foot gyroscopic data in the z-axis was determined and plotted against time, with any correlation less than 0.5 being considered a FoG episode. Further, parameters of gait including stride duration, stance duration, swing duration, and stride length were calculated from input of the raw data to establish a control comparison for future studies with Parkinson's patients.

Results: Data analysis demonstrated increased stride duration, stance duration and swing duration with shorter stride length in the stimulated FoG episodes as compared to normal gait. The developed MATLAB code was further able to accurately distinguish the simulated FoG episodes from normal gait given the correlation parameter difference of <0.5.

Conclusion: Our findings showed that data obtained from Perception Neuron IMU can be processed to succinctly detect FoG episodes and calculate gait parameters. Ultimately, this data will be used as the baseline for a future study investigating the use of spinal cord stimulation as treatment for FoG in individuals with Parkinson's Disease.