Monitoring Upright Posture in Individuals with Parkinson's Disease: Foundations for a System to Provide Real-Time Feedback

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Background

Stooped posture is a characteristic feature in Parkinson's Disease (PD) and while this varies from person to person, it often leads to falls. This project aims to develop a real-time feedback system to provide auditory cues to individuals with PD to straighten their posture. In this project, we are investigating options for placing wearable sensors and processing sensor signals to obtain a reliable measure of back angle.

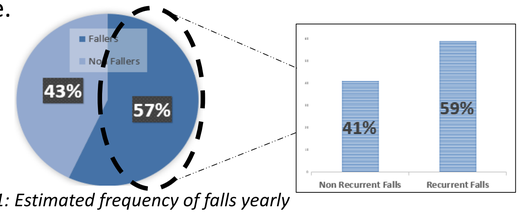


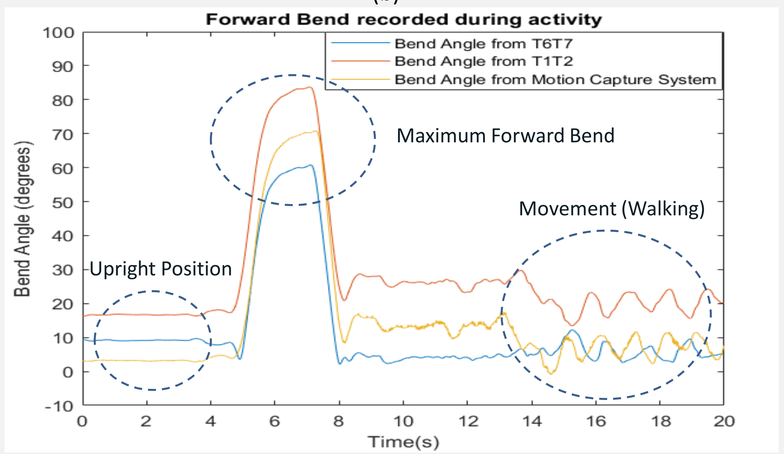
Figure 1: Estimated frequency of falls yearly

Methods

- Two locations on the upper back; namely, thoracic vertebrae 1 and 2 (T1-T2) and thoracic vertebrae 6 and 7 (T6-T7) were investigated as potential positions to record stooped posture.
- Inertial measurement unit (IMU) sensors were used to measure and record stooped posture (back angle) during walking trials.
- T1-T2 and T6-T7 locations were instrumented with reflective markers to validate results with camera system.
- Signals from sensors were analyzed using signal processing algorithms in MATLAB.
- By fusing data from the accelerometer and gyroscope from the IMU sensors, orientation of the body in space as well as the degree of stooped posture was calculated.
- Further processing was implemented to filter out noise from signals.

Results

(a) (b)



(c)

Figure 2:

(a) Sensors and reflective markers arrangement at T1-T2 and T6-T7 locations on the upper back. During activity, motion capture system and IMU sensor measure and record changes in back angle.

(b) Image showing how stooped posture is measured by motion capture system and IMU sensor.

(c) Forward bend estimate from IMU sensor and camera system. During the walking trial, the participant assumed an erect posture for a few seconds and then proceeded with bending/stooping. The participant began to walk shortly after bending and then assumed an erect posture towards the end of the trial. Graph shown was obtained from signal processing analyses.

Discussion

- Data from the wearable sensors reflect the general pattern of movement of the back, as recorded by the laboratory-based system
- During walking, movement of the back at the upper and lower locations measured are out of phase
- More extensive data collection on individuals with PD with stooped posture will be required to determine suitable locations to assess standing posture and posture during gait.

Future Work

- Research is ongoing to establish which location provides good estimates of stooped posture.
- Experimental setup will be tested on severe cases of stooped posture.
- Automated real-time feedback system is yet to be built and implemented as a means of correcting posture.

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