Autonomous Tracking of Body Bradykinesia during Unconstrained Activities in Parkinson’s Disease

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Motivation
- Sensor-based technology is needed for implementing personalized therapeutic approaches in Parkinson’s disease (PD)1.
- Current approaches measure bradykinesia using intermittently standardized UPDRS motor tasks, such as finger tapping (Item 23).
- Continuous sensor-based monitoring of whole-body bradykinesia during daily activity is important, yet remains to be achieved.

Objective
- To develop a software platform of wearable sensors and real-time algorithms for automated detection of body bradykinesia during unscripted activities of daily living.

Approach
- Defined presence and absence of body bradykinesia based on impairments listed in Item 31 of UPDRS.
- Selected sensors that can provide limb muscle activity (EMG) and inertial movement (Gyro and Accelerometer) to characterize motor impairments of body bradykinesia.
- Because body bradykinesia manifests differently during gait, walking and non-walking segments were automatically classified prior to body-bradykinesia detection.
- Assessed body bradykinesia motor impairments by tracking changes in the magnitude of sensor-based metrics (e.g., reduced limb velocity, reduced limb amplitude and poverty of movement).

Data Collection
- Subjects
  - PD Subjects
  - Walking Data
  - Non-Walking Data
- Participant Details
  - Number: 19 + 19 = 38
  - Age: 57.5 ± 12.5
  - Male/Female: 32:6
  - PO Duration: 8.6 ± 5.4
  - Total Data: 100 min
- Prevalence (%) of Total Data
  - PD
  - Male/Female

Algorithm Design
- Sensor-based Metrics
  - Inertial (IMU)
  - EMG
- Non-Walking Data
  - Speed of Movement
  - Angular Velocity
- Walking Data
  - Speed of Leg Swing
  - Amplitude of Leg Swing
- Bradykinesia Detection
  - Non-Walking
  - Walking

Conclusion
- First achievement of a wearable system that is used during normal daily activities to provide:
  - Body bradykinesia classification with <5% error
  - Objective metrics to quantify motor impairments associated with body bradykinesia.
This proof-of-concept tool provides assessments and metrics that are responsive to PD medication.

Acknowledgments
Research supported in part by the De Luca Foundation and by the National Institute of Neurological Disorders and Stroke of the National Institutes of Health under award R44NS083098.

References
1Movement Disorders, Vol 33, No 9 2016.