

Biomechanical Indicators of Movement Disorders in Parkinson's Disease

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Motivation

- ◆ Sensor-based technology is needed for implementing personalized therapeutic approaches in PD¹.
- ◆ Continuous sensor-based monitoring of multiple motor symptoms of PD during daily activity is important to track the medication response, but has not yet been achieved.

Objective

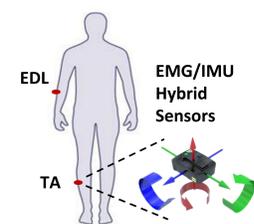
- ◆ To develop wearable sensor-based biomechanical indicators and real-time algorithms for automated detection of multiple PD symptoms during unscripted activities of daily living.

Data Collection

(1) Subject Population

PD Subjects	
Number	n = 29
Age (y)	60.8 ± 11
Male/Female	17/12
PD Duration (y)	6.5 ± 5.4
Total Data	5000 min
Hoehn-Yahr (On)	II-III

(2) Sensor Placement



(3) Data Acquisition Protocol

- ◆ Trigno IM™ wireless sensors (Delsys Inc) recorded sEMG and IMU measurements from upper- and lower-limb (see Fig.)
- ◆ Data were recorded during 3 hours of unscripted activity in a simulated home setting
- ◆ Video recordings were annotated by experts to determine the presence/absence of PD symptoms

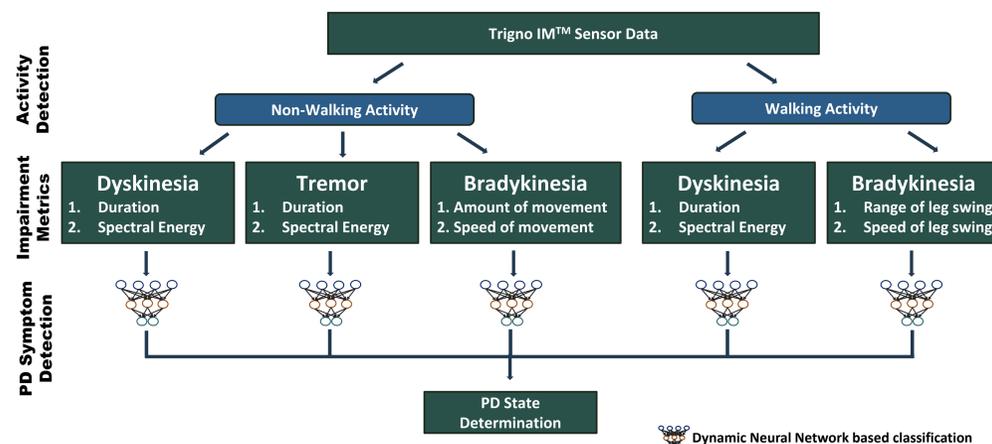
Approach

- ◆ Defined PD symptoms based on motor impairments listed in UPDRS.
- ◆ Selected sensors (Trigno IM™) that can provide both muscle activity (EMG) and inertial movement. Current work focuses on only movement based metrics.
- ◆ Because PD symptoms manifest differently during gait, walking and non-walking segments were automatically classified prior to PD symptom detection.
- ◆ Assessed PD motor impairments by tracking changes in the magnitude of sensor-based metrics.

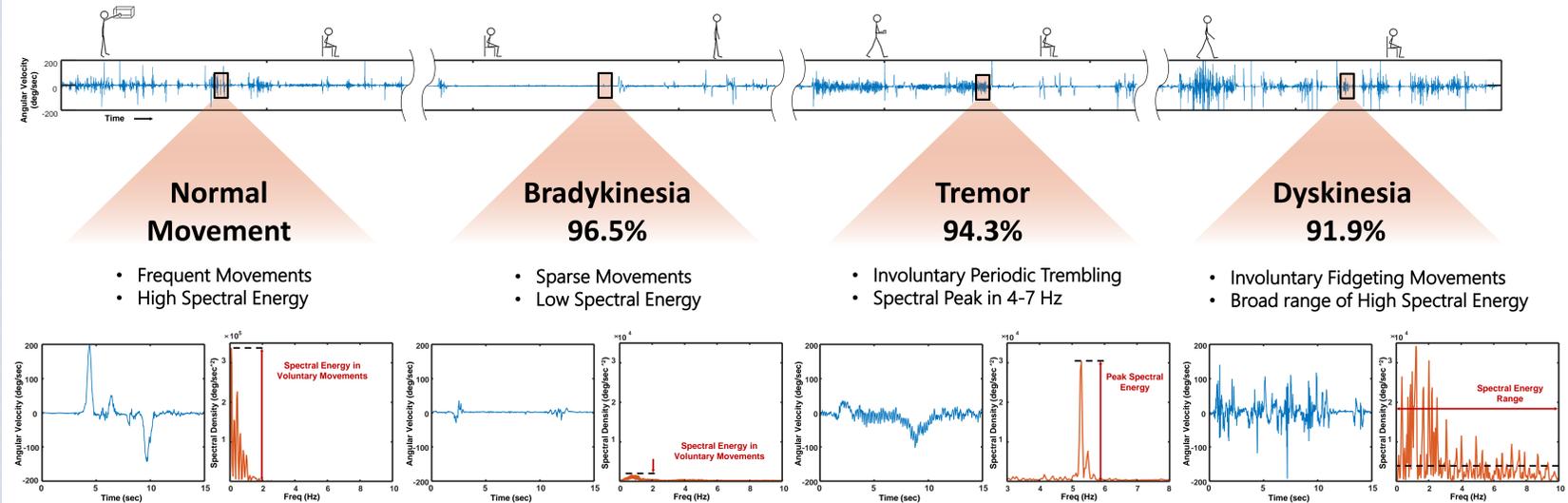
Parkinson's Disease Motor Symptoms



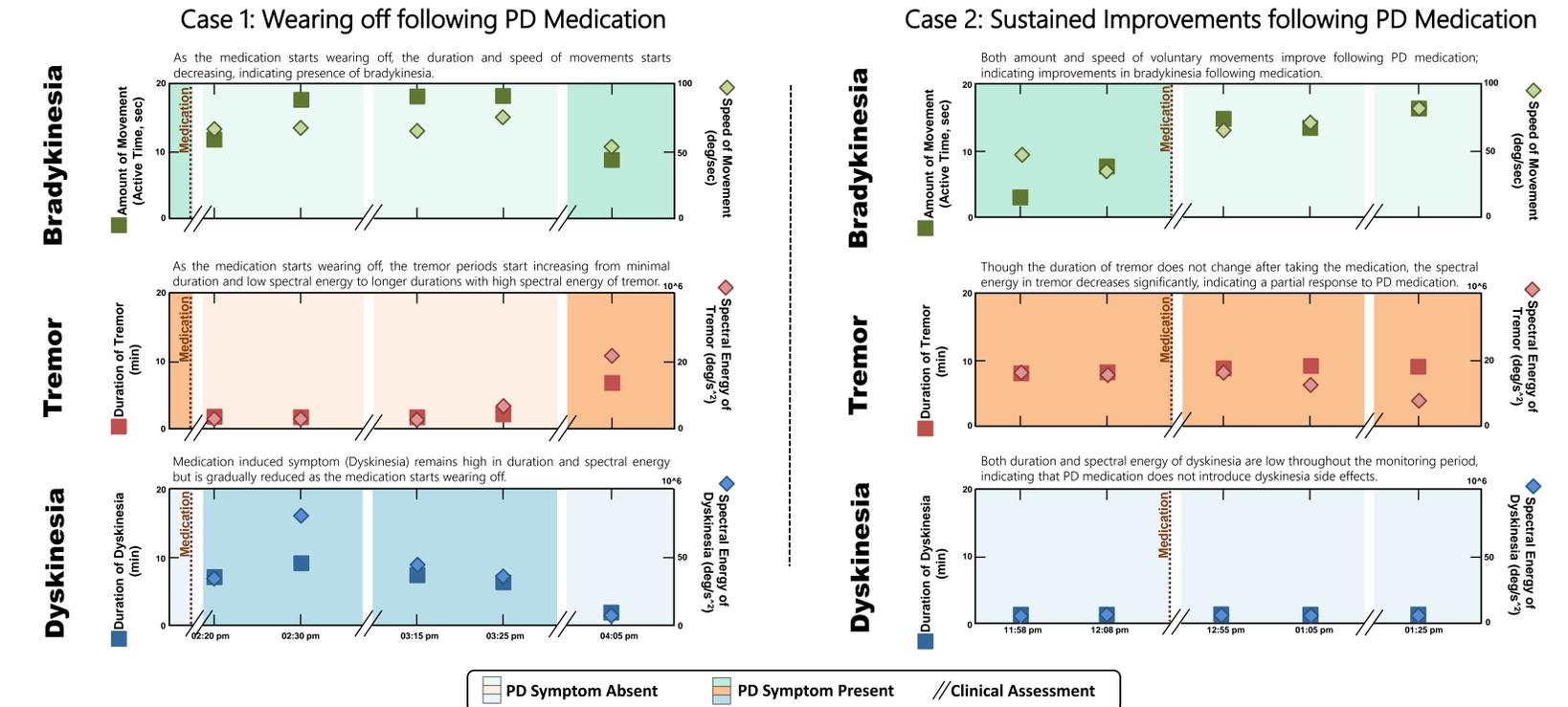
Algorithm Design



Automated Detection of Multiple PD Symptoms based on Biomechanical Sensor Metrics



Automated Tracking of PD (L-Dopa) Medication Response based on Biomechanical Sensor Metrics



Conclusion

First achievement of a wearable system that can be used during normal daily activities to provide:

- Continuous monitoring of unscripted activities
- Simultaneous tracking of a broad spectrum of PD motor symptoms
- Objective biomechanical metrics to quantify motor effects of PD medication

Acknowledgments

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References

¹Movement Disorders, Vol 31, No 9 2016.