SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

DETECTING AND TRACKING OF FREEZING OF GAIT IN PARKINSON'S DISEASE PATIENTS USING INERTIAL SENSORS

PhD Preliminary Research Examination

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Abstract: Recent study suggests an increase in the incidence rates of parkinsonism and Parkinson's disease (PD) over the last 30 years. Early symptoms in PD are mostly movement related, including tremor, rigidity, slowness of movement, and postural instability. These asymmetrical and uncoordinated episodes of gait patterns are commonly referred to as freezing of gait (FOG). The episodic behavior of the FOG patterns is sudden, generally lasting for few seconds, tending to increase in frequency and duration as the disease progresses. Hence, understanding the FOG patterns can help in developing effective methods of diagnosis and treatment. Currently, clinicians use patient questionnaires with highly subjective scales to validate FOG. These scales do not accurately determine the onset and duration of FOG. Existing wearable sensor-based methods to detect FOG patterns: (i) require sophisticated gear; (ii) lack a signal model that incorporates the FOG patterns; (iii) use long window lengths to perform spectrum analysis; and (iv) demonstrate low sensitivity for the detection of the FOG patterns.

To overcome these problems, we develop new methods to automatically detect the onset and duration of FOG in PD patients in real-time with high accuracy, using inertial sensors. We first build a physical model that describes the tremor motion during the FOG events. Then, we design a statistically-based generalized likelihood ratio test framework to develop a two-stage detector for determining the zero-velocity and tremor events in the gait motion. Thereafter, to filter falsely detected FOG events, we develop a point-process filter, that combines the output of the detectors with the information about the speed of the foot, provided by a foot-mounted inertial navigation system. We calculate the probability of FOG calculated by the point-process filter to determine the onset and duration of the FOG period. Finally, we validate the performance of the proposed system design using real data obtained from Parkinson's disease patients who were asked to undergo a set of balance assessment tests that were likely to trigger FOG. We compare our FOG detection results with an existing method that uses the accelerometer data. Our results indicate that our method yields an improved performance in detecting FOG events and a three-fold decrease in the false alarm rate.

DATE: Tuesday, May 2, 2017
TIME: 10:00 a.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Arye Nehorai

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SCHOOL OF ENGINEERING & APPLIED SCIENCE