Enhanced Multiple Sclerosis Gait Assessment using Inertial Sensors

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Abstract

Walking performance is an important outcome in Multiple Sclerosis (MS) to assess severity of disease, disease progression, and therapeutic efficacy. Current clinical assessment of walking lacks 1) high precision to capture various and subtle gait features that may be clinically meaningful, 2) real-world application to provide continuous monitoring in a patient’s natural environment.

To better assess gait performance in MS, we adopt a tool that provides higher precision measurements and a remote monitoring capability - wireless, body-worn inertial sensors - and collect gait data on MS patients and healthy controls during 6-minute walk tests. High precision gait features are extracted and demonstrate higher effect size than gait speed, the current clinically-used gait feature.

Research Platform

TEMPO 3 Inertial Body Sensor Network (BSN) Platform

Data Collection

• 30 subjects (9 mild MS, 10 moderate MS, and 11 healthy control) wearing TEMPO 3 inertial body sensors on the lower limbs were asked to undergo an in-clinic 6-minute walk.
• With a measurement wheel, the distance walked was recorded in 1-minute epochs. Subjects were asked to walk as far and as fast as possible (without running) up and down a 75-foot hallway.
• The inertial sensor data was wirelessly transmitted to a laptop for post-processing.

Gait Feature Extraction

Temporal Features

• Double Stance Time (DST)
• Single Support Time (SST)
• Swing Time (SWT)
• Gait Cycle Time (GCT)
• Gait Rate (GRR)

Other Features

• Gait Complexity
• Measured by Lyapunov Exponent
• Gait Stability
• Measured by Time Domain Properties

Research

• Both the gait speed and temporal gait features display differences between the MS group and the control group.
• Features extracted cannot separate the MS group and control group completely.
• Statistical analysis is needed to further examine the significance of the features extracted.

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