UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

On the Reliability of Wearable Sensors for Assessing Movement Disorder-Related Gait Quality and Imbalance: A Case Study of Multiple Sclerosis

by

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For the Ph.D. degree in Computer Science and Engineering

Approximately 33 million American adults had a movement disorder associated with medication use, ear infections, injury, or neurological disorders in 2008, with over 18 million people affected by neurological disorders worldwide. Current gait assessments used by physical therapists, such as the Multiple Sclerosis (MS) Walking Scale, provide only semi-quantitative data, and cannot assess walking quality in detail or describe how one's walking quality changes over time. This work consists of three key research objectives. First, we investigate performance and step count and segmentation differences between movement-capturing sensors embedded in smartphones and standalone, wearable inertial measurement units (wIMUs) for gait assessment. We, then, propose novel methods to estimate step length and width and for processing raw signals gathered from wIMUs. Finally, we demonstrate the reliability of wIMUs for gait analysis in MS against a gold standard walkway system. Our methodology takes advantage of signal processing and machine learning techniques for analyzing wIMUs' signals and converting these raw signals into practical significance.

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Publications

1) Zaleski, O., Navarro, M., **Díaz, S.**, Redondo, J., Labrador, M. "Clinical gait assessment comparison: Smartphone-based versus inertial measurements units. In SoutheastCon 2018, pages 1-5. IEEE, 2018.
2) **Díaz, S.**, Disdier, S., Labrador, M. "Step length and step width estimation using wearable sensors." In 2018 9th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), pages 997-1001. IEEE, 2018.
3) **Díaz, S.**, Stephenson, J., Labrador, M. "Use of wearable sensor technology in gait, balance, and range of motion analysis." Applied Sciences, 10(1):234, 2020.

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