Research team proposes mathematical model that examines multiple walking patterns and movements in adults older than 65

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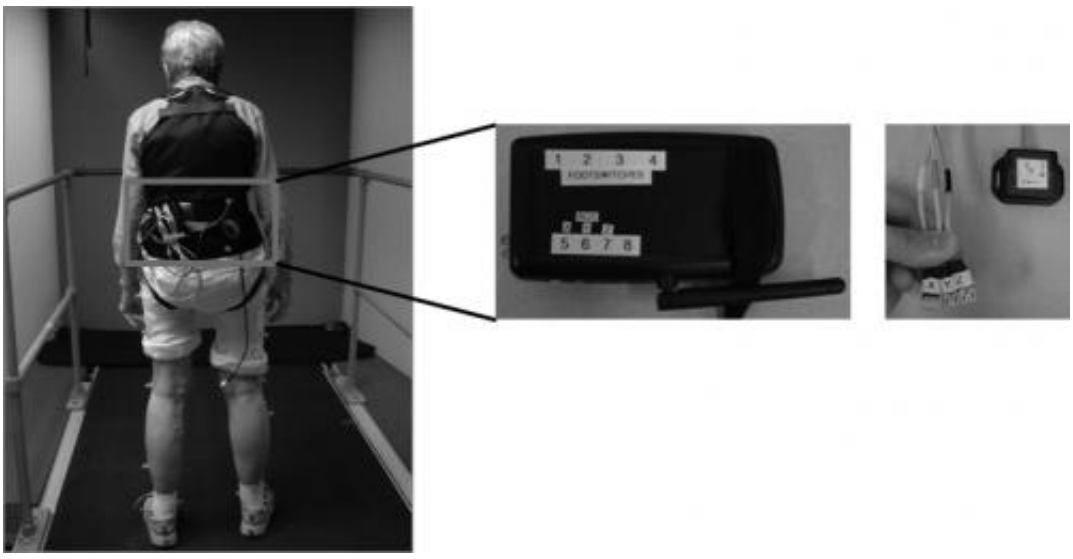

A Pitt research team is working toward building a better tracking device to make earlier predictions regarding diseases like Parkinson's. They tested their approach on older adults using a motion-analysis system that studied 39 joint regions.

Older adults diagnosed with brain disorders such as Parkinson's disease often feel a loss of independence because of their lack of mobility and difficulty walking. To better understand and improve these mobility issues—and detect them sooner—a University of Pittsburgh multidisciplinary research team is working toward building a more

advanced motion test that addresses a wider range of walking patterns and movements.

In a recent issue of *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, researchers from Pitt's Swanson School of Engineering, School of Health and Rehabilitation Sciences, and School of Medicine propose a mathematical model that can examine multiple walking, or gait-related, features in healthy and clinical populations. To date, no study has brought together such a team to examine such a high number of movement features comparing healthy and clinical older adults. Previous studies have typically only measured one or two types of movement features in just one population.

"Right away, you can tell whether an older individual has difficulties walking by conducting a simple gait test," said Ervin Sejdic, lead author of the paper and an assistant professor of engineering in the Swanson School. "But can we quantify these changes and document them earlier? That's the biggest issue here and what we're trying to model."

Thirty-five adults older than 65 were recruited for the study, including 14 healthy participants, 10 individuals with Parkinson's disease, and 11 adults who had impaired feeling in their legs owing to peripheral neuropathy (nerve damage). Walking trials were performed using a computer-controlled treadmill, and participants wore an accelerometer —a small box attached with a belt—and a set of reflective markers on their lower body that allowed for tracking of the participants' movements through a camera-based, motion-analysis system. These two systems allowed the team to examine the torso and lower body movements of patients as they walked. Participants completed three walking trials on the treadmill—one at a usual walking pace, another while walking slowly, and another that included working on a task while walking (i.e. pushing a button in response to a sound).

The accelerometer signals were used to examine three aspects of movement: participants moving forward and backward, side to side, and up and down. The researchers then used advanced mathematical computations to extract data from these signals.

The results—integrated into the mathematical models—showed significant differences between the healthy and clinical populations. These metrics were able to discriminate between the three groups, identifying critical features in how the participants walked.

The Pitt team is now looking to conduct this type of study on a larger scale—evaluating the gait patterns of older adults residing within independent living facilities.

"Our results indicate that we can potentially develop these mathematical models as biomarkers to predict changes in walking due to diseases like Parkinson's disease," said Sejdic. "Now, we want to take it further. We're especially hoping to help those individuals in independent living facilities by predicting the declines in their walking even earlier."

"What also makes this study unique is the multidisciplinary team approach we used," said Jennifer S. Brach (SHRS '94G, '00G) coprincipal investigator of the study and associate professor in Pitt's Department of Physical Therapy. "Here we brought together a research team that included engineers, physical therapists, and experts in geriatrics to work on an important problem in older adults—changes in mobility."

More information: The paper, originally published online June 6, is titled "A Comprehensive Assessment of Gait Accelerometry Signals in Time, Frequency, and Time-Frequency Domains."