An adaptive step detection algorithm for waist-worn wearable devices: A feasibility study in older adults

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Objectives

The large amount of data recorded in wearable studies prohibits the use of manual labelling, calling for reliable algorithms that automate or semi-automate the labelling process. In this investigation, we propose a step detection algorithm based on adaptive thresholds and tested its performance with accelerometry data acquired from an older-adult group.

Methods

We reanalysed a publicly available database recorded from an orthogeriatric population diagnosed with osteoporosis (N=17, mean age = 75.5) [1]. Participants in the study performed four types of parcours: Hallway and lobby walks (back and forth).
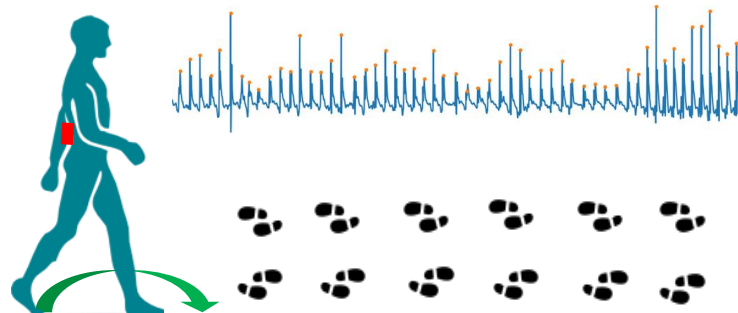

Figure 1.

Our proposed algorithm detects peaks from a processed accelerometry signal and adapts the step-detection threshold according to the amplitude to account for participant differences.

Algorithm's initial parameters were tuned using accelerometry data from one healthy participant (age=38) and the performance independently tested with the orthogeriatric accelerometry database.
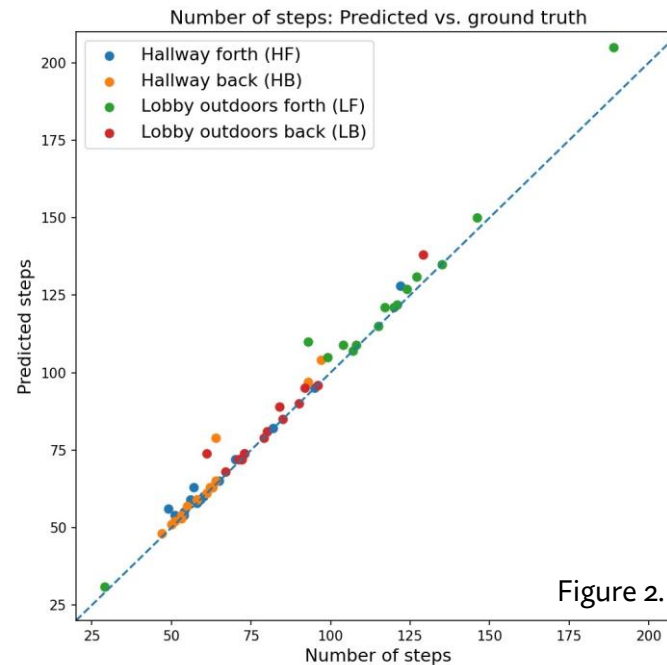

Figure 2.

Results

The total number of steps detected showed a high agreement with the ground truth (mean absolute error = 0.030, SD=0.043, Figure 2). Step detection precision was >0.976 and sensitivity was >0.964 for the four parcours (Figure 3).
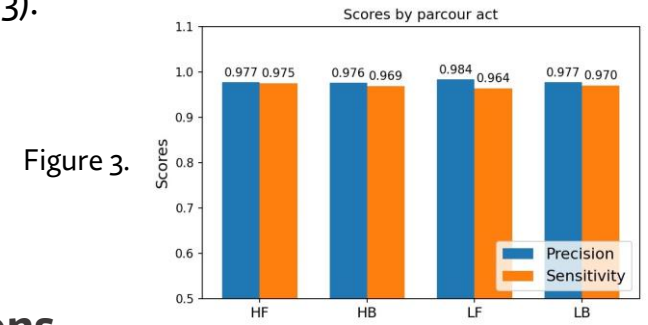

Figure 3.

Conclusions

Our proposed step detection algorithm showed to be highly accurate detecting steps from older adults. Gait analysis in older adults is particularly challenging due to the possible presence of movement disorders such as gait shuffling. More research work will be necessary to test our algorithm in patients diagnosed with gait disorders.

[1] Keppler AM, et al. Validity of accelerometry in step detection and gait speed measurement in orthogeriatric patients. PLoS ONE, 2019.