# Stepping outside the clinic: gait detection using wrist-worn sensors for remote arm swing analysis in Parkinson's disease

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## Introduction

- Reduced arm swing as a proxy for hypokinetic gait is a candidate digital biomarker for PD progression, particularly due to the unobtrusive nature of wrist-worn sensors.

- However, arm swing studies thus far have been conducted in highly standardized environments, while arm swing varies substantially in free-living conditions[1] and other arm movements can be present during gait (e.g., carrying an object or having hands in the pocket).

## Objectives

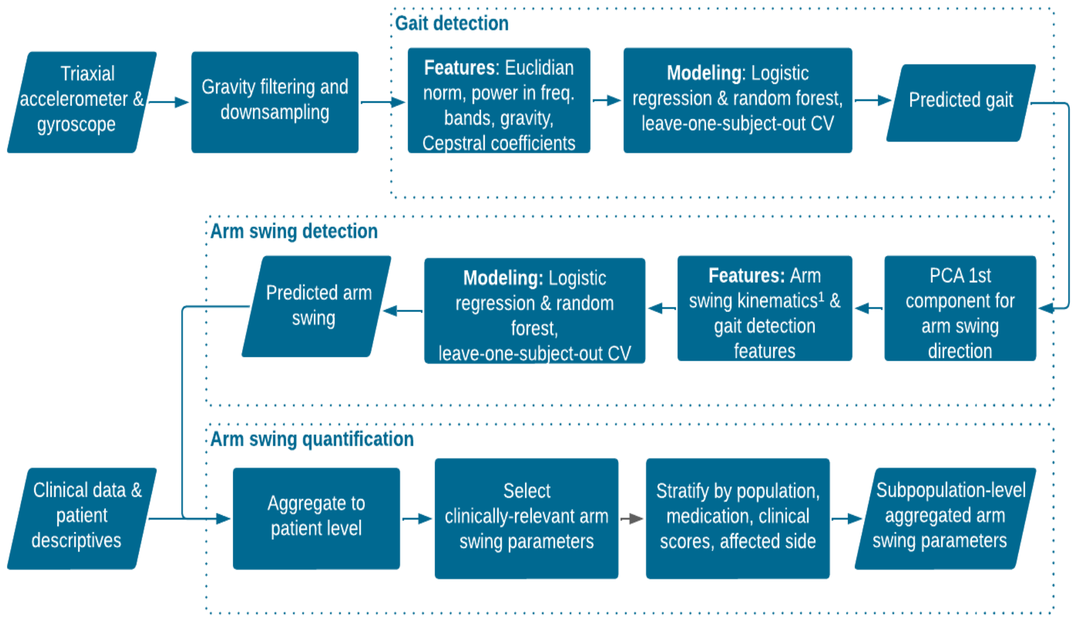
1. To reliably identify gait segments suitable for arm swing analysis in free-living
2. To extract clinically-relevant and sensitive arm swing parameters from predicted free-living arm swing gait segments.

## Study design

- **Sample size**: 25 PD patients (with motor fluctuations and gait impairments) and 25 age-matched controls.

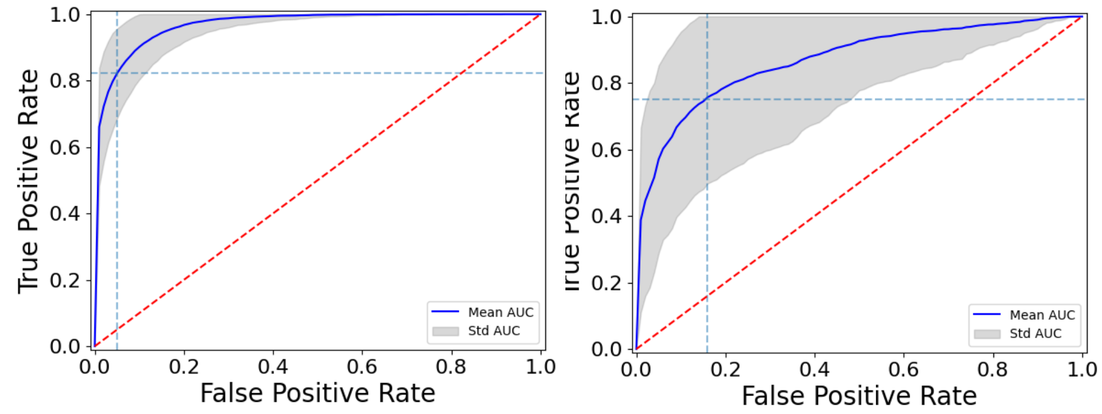
- **Design**: Unscripted free living in and around the house (≥ 1 hour per patient pre- and post-medication); wrist-worn IMU; manually annotated activities and arm movements during gait from videos.

## Methods

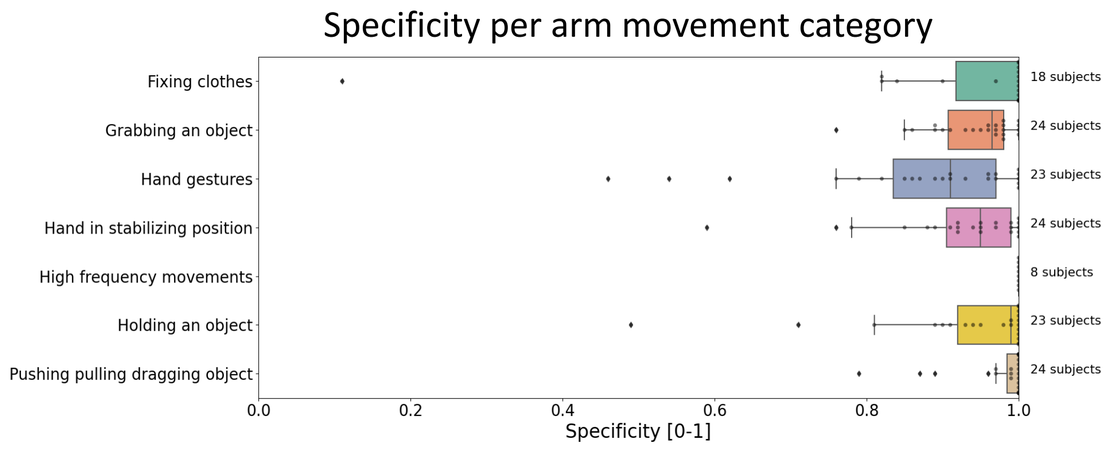



## Results

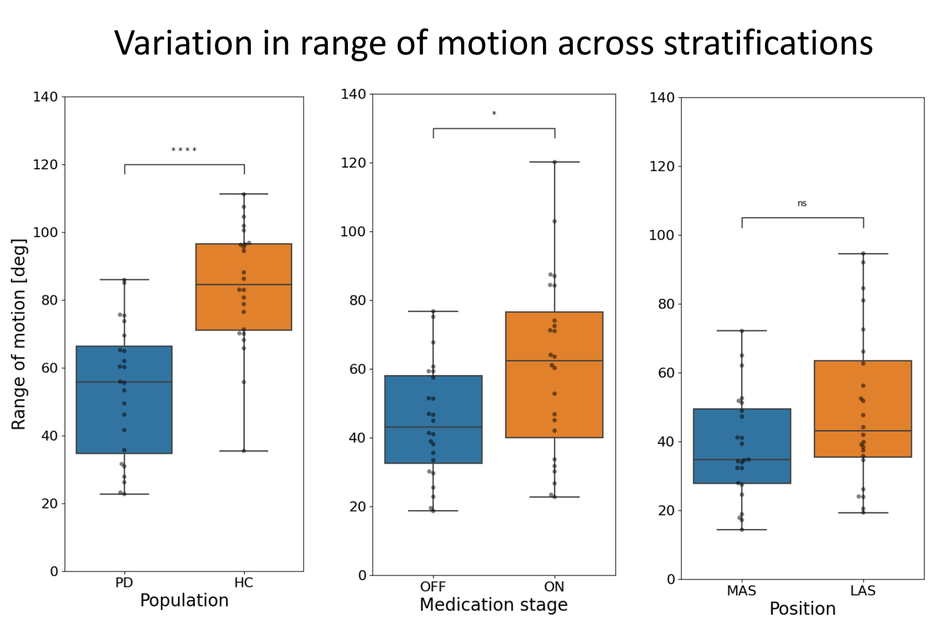
### Discriminative ability – PD OFF MAS




### Arm movements are diverse during gait




### Arm swing quantification




## Conclusions

- Free-living gait can reliably be detected using wrist-worn sensors, while variety in arm movements during gait can affect the ability to detect arm swing unfavorably.

- Clinically-relevant arm swing parameters of predicted arm swing segments are statistically different between PD and controls, as well as between medication stages.

**References**

1. Warmerdam et al., Arm swing responsiveness to dopaminergic medication in Parkinson's disease depends on tasks complexity. NPJ Parkinsons Dis. 2021 Oct 5;7(1):89.

2 Warmerdam et al., Quantification of arm swing during walking in healthy adults and Parkinson's disease patients: Wearable sensor-based algorithm development and validation. Sensors (Basel). 2020 Oct 21;20(20):5963.

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