A Turn Detection Algorithm in a Wearable Gait Rehabilitation Application for Lower-Limb Prosthetic Users

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Background

Lower-limb prosthetic users (LLPUs) undergo **gait rehabilitation** to increase symmetry between limbs during gait

Wearable sensors can be used to monitor walking and supplement gait rehabilitation

Gait detection **algorithms** are needed so the system is usable **outside of the clinic**

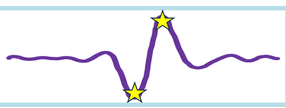
Real-time recognition of activities like **turns** would allow for an accurate measure of gait in **unpredictable community settings**

Objective

Create a **robust algorithm** that correctly detects the **start and end points of turns** during gait

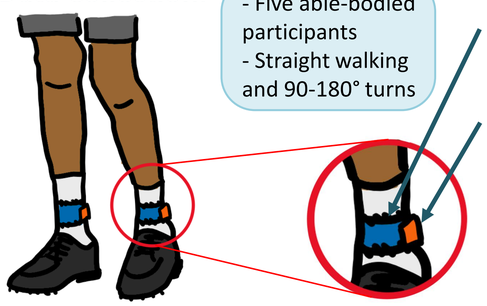
Methods

Python Algorithm: detects turns from angular velocity extrema



Data Collection:

- Five able-bodied participants
- Straight walking and 90-180° turns



Elastic ankle strap
Secures sensor to ankle via Velcro

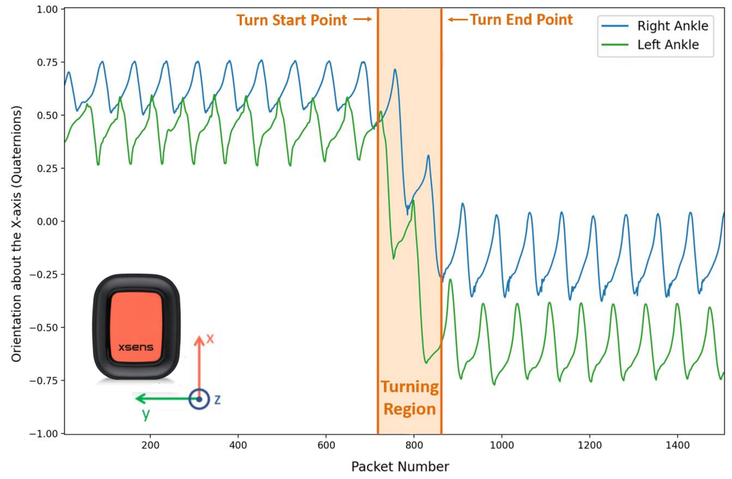
Inertial measurement unit (IMU) sensor
Measures and records tri-axial acceleration and angular velocity data

A wearable rehabilitation system that identifies turns allows for lower-limb prosthetic users to monitor and improve their gait outside of clinical settings

Scan for a project demo video

Results

Graph of Turn Detection for a Walking Trial with a 180° Left Turn



OVERALL SENSITIVITY: 98%

98% of turns were **correctly detected** by the algorithm

% OF FALSE NEGATIVES: 2%

2% of turns were **not detected** by the algorithm

% OF FALSE POSITIVES: 10%

10% of the trials had a **false turn detection**

Conclusion & Next Steps

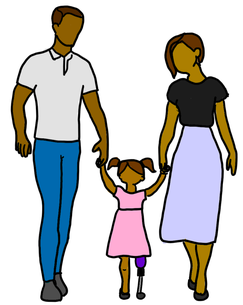
☑ Turn detection algorithm successfully and accurately detects **90°, 120°, 150°, and 180° right and left turns** in able-bodied individuals

- ❑ Collect turning gait data from LLPUs
- ❑ Validate the algorithm and its applicability

Impact

A wearable rehabilitation system would be valuable for **children and youth with lower-limb prosthetics**

This system could improve their:
a) mobility
b) independence
c) musculoskeletal health



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*This research study was approved by the Research Ethics Board at Holland Bloorview Kids Rehabilitation Hospital (REB-0448)