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Influence of Prosthetic ankle-angle and walking speed on pylon moments in the Two Axis aDaptable Ankle

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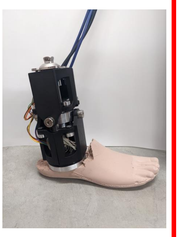
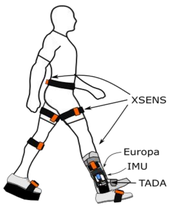
Introduction

Two Axis aDaptable Ankle (TADA)

- Prosthetic Ankle[1]
- 2D ankle control
  - Low Power
  - Semi-active
  - Move in swing
- Non-backdrivable



Frontal

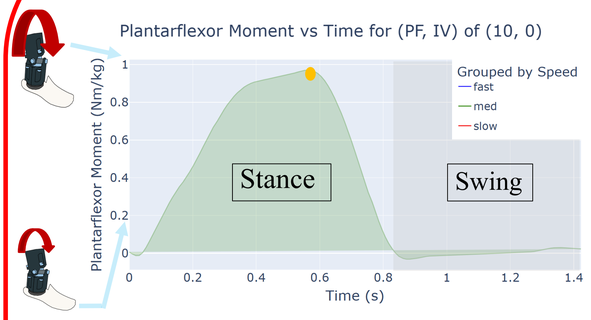


Sagittal

Research Aims:

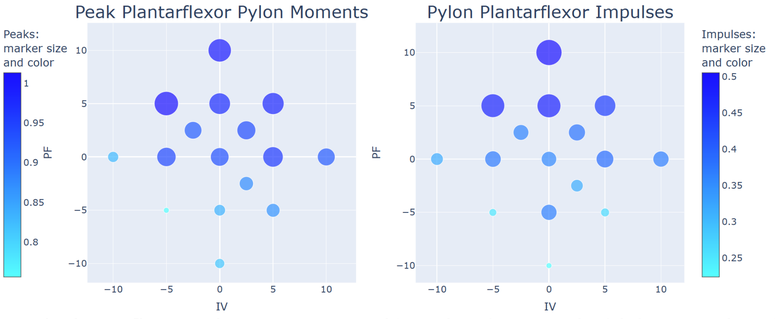
- To demonstrate synchronous collection of all wearable sensors
- To pilot test the influence of ankle angle and walking speed on pylon moment for the TADA

Representative Results



How does the person interact with the TADA while walking?

- We investigated Peak pylon moments and Impulses[3] for sagittal and frontal planes
- Pylon data was normalized by dividing by body mass
- Units for the peaks are Nm/kg and impulses are Nm/kg*s

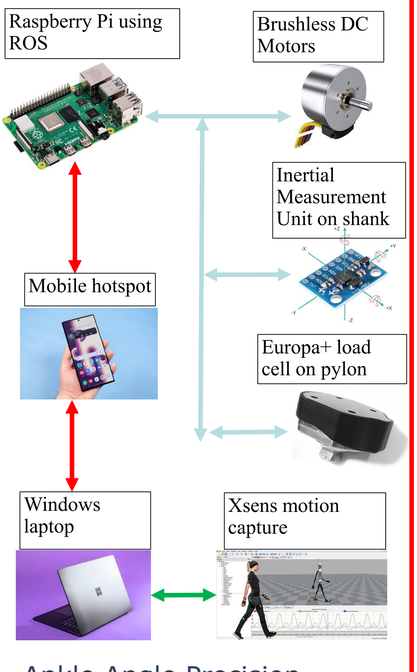


Peak Plantarflexor Pylon Moments and Impulses increased with increased PF

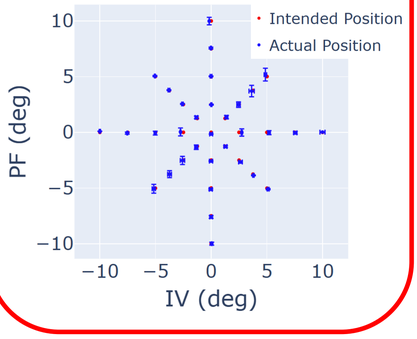
Method

- One able-bodied walker
- Different combinations of plantarflexion (PF), dorsiflexion (DF), inversion (IV), and eversion (EV)
- 3 self-selected walking speeds

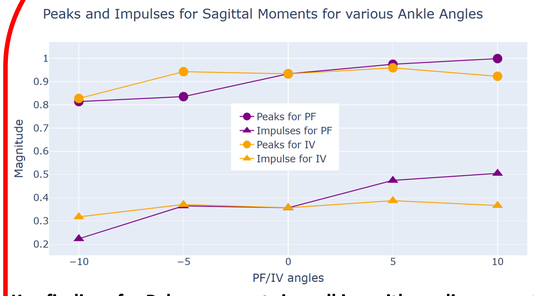
Fully Wearable Instrumentation System



Ankle Angle Precision

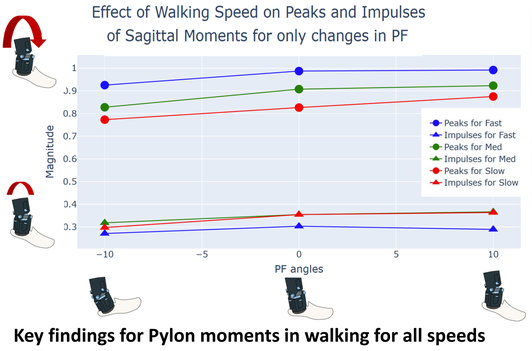


Summative Results



Key findings for Pylon moments in walking with medium speed

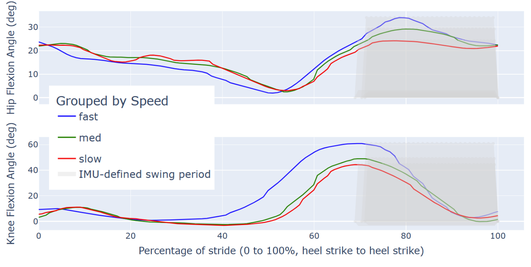
- Peak Plantarflexor and Invertor (not shown) Pylon Moments and Impulses increased with increased PF and IV, respectively



Key findings for Pylon moments in walking for all speeds

- General trends of increased sagittal and frontal pylon peak moments with PF and IV respectively
- More trials and participants are needed to draw statistical conclusions

Example Kinematic Results

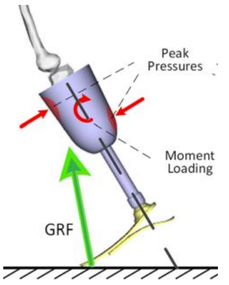


Example findings for hip and knee angles for increased walking speed

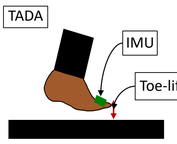
- General trends of upward shift of hip and knee angles from 40 – 60 % of stride

Discussion

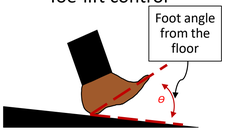
- The TADA can control 2D ankle angle in a reliable and precise way
- The TADA is ready for out-of-the-lab experiments
- Lower pylon moments could help reduce socket discomfort (see below[4])



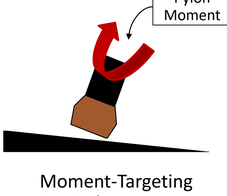
Future Directions



Toe-lift control



Slope-Matching Control



Moment-Targeting Control

UW BADGER Lab
Biomechatronics, Assistive Devices, Gait Engineering, & Rehabilitation

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[1] Adamczyk. Powered Prostheses, 2020.
[2] Hashimoto et. al, Gait and Posture, 2021.
[3] Kobayahi et. al, Journal of Biomechanics, 2014.
[4] LaPre et al, Journal of Medical Devices, 2016.

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