



ASSESSING ACTIVITY LEVELS AND COMMUNITY INTEGRATION OF PEOPLE WITH LOWER LIMB AMPUTATION

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INTRODUCTION

- Advent of complex prostheses has led to increased demand of these newer devices
- Patient classification is needed for prescription justification of these expensive prostheses
- K-level system often used to classify patients based on mobility and community ambulation¹
- Assigned K-level is a large factor in determining device access, medical compensation², and potential function³
- Not based on empirical data with vague guidelines¹
- Self-report measures often used for classification – inaccurate compared to objective measures⁴

Purpose: Determine the ability of K-levels to successfully predict patients' degree of mobility and community ambulation.

Study 1: Determine accuracy of ActiGraph Link in detecting step count and cadence at different placements

Methods

- 3 healthy participants (22 ± 1.73 years, 85.4 ± 19.3 kg)
- Accelerometers (Fig. 1) placed at dominant hip, non-dominant (NDA) and dominant ankles (DA)
- Worn for three full days for at least 10 hours, and for 3 minutes of level ground walking while steps were filmed



Figure 1. ActiGraph Link tri-axial accelerometer (left) and an example of monitor being worn at the hip (right).
www.actigraph.com

Data Processing and Analysis

- Inter-instrumental comparison of daily activity data with multivariate ANOVA and post-hoc analysis
- Actual step count compared to measured step count on each monitor using a one-way ANOVA and post-hoc analysis

Results

- Vector magnitude: Hip < ankles ($p < 0.01$); DA = NDA ($p > 0.80$)
- Steps per minute: Hip = DA = NDA
- No significant difference between monitors and true step count ($p = 0.364$)

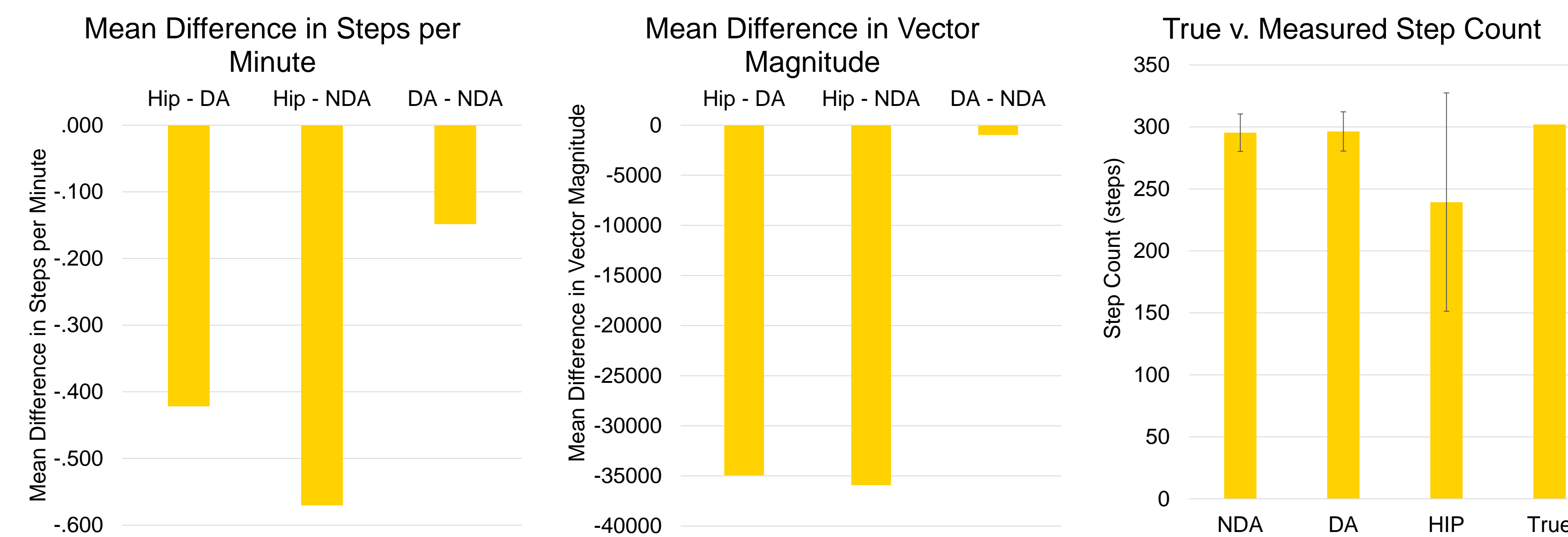


Figure 2. Mean difference in measured vector magnitude (left) and steps per minute (middle) for 3 days of daily activity. Right: Comparison between true steps per minute and accelerometer measures at 3 locations for 3 minutes of over-ground walking.

Conclusions

- Activity monitors placed at the ankle are able to accurately measure step count during ambulation
- Prosthesis placement would be suitable to measure daily activity

Study 2: Establish protocol to collect and combine IMU, accelerometer, and GPS data to monitor activity in daily life

Methods

- One bilateral amputee wore an accelerometer for 7 days
- Activity, IMU, and GPS data collected via accelerometer placed on the prosthesis (Fig. 3), IMU-enabled ActiGraph on top of the foot, and a Smartphone GPS app

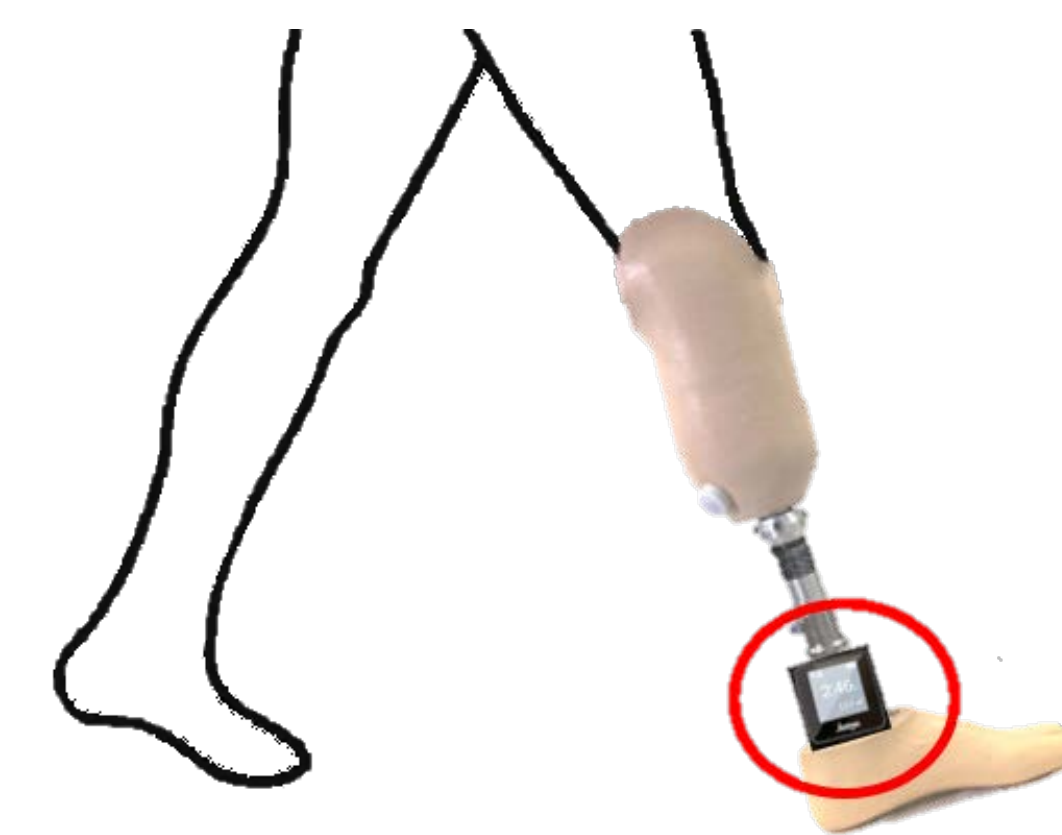


Figure 3. Example of activity monitor placement on the prosthesis ankle.

Data Processing and Analysis

- GPS and activity data linked with ActiLife software
- Exclude non-wear time⁵ to determine activity bouts⁶

Results

- Infrequent, short bouts of activity predominantly occurring at work or at home (Fig. 4)
- Generally more active on weekdays (Fig. 4)
- GPS and activity data successfully linked (Fig. 5)

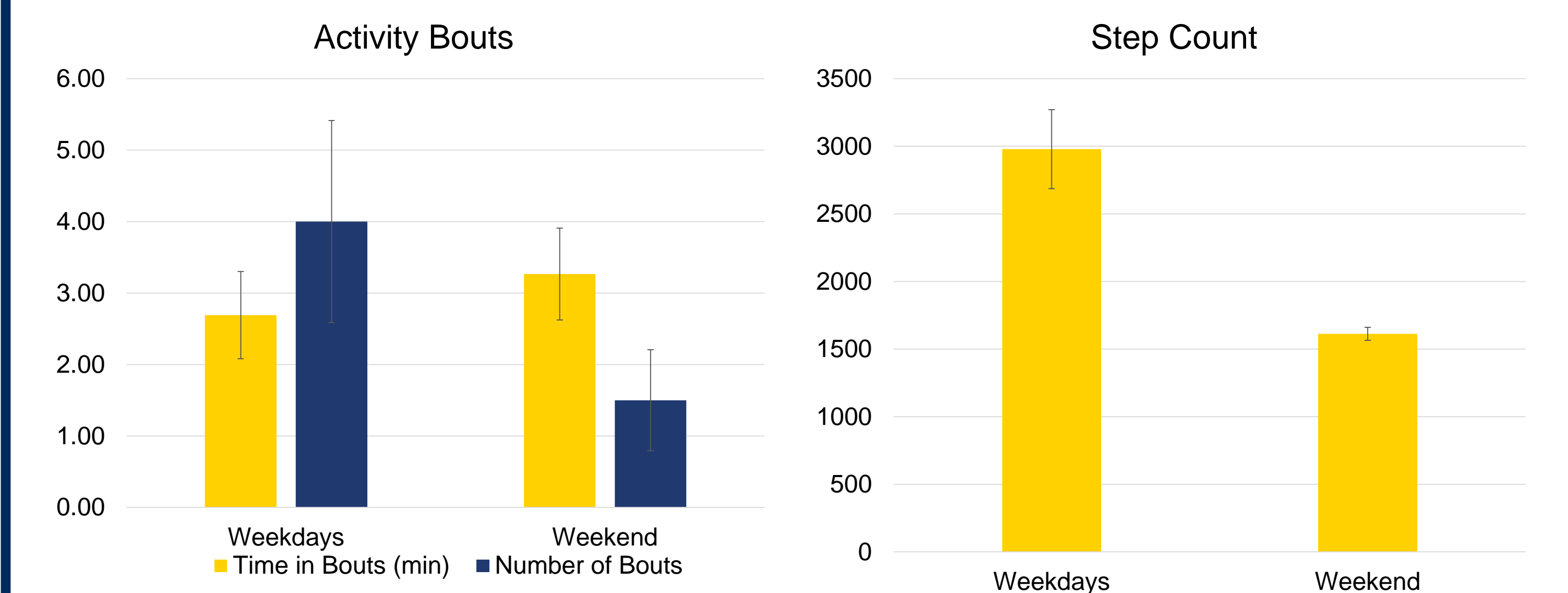


Figure 4. Depiction of activity bouts (left) and step count (right) on weekends v. weekdays.

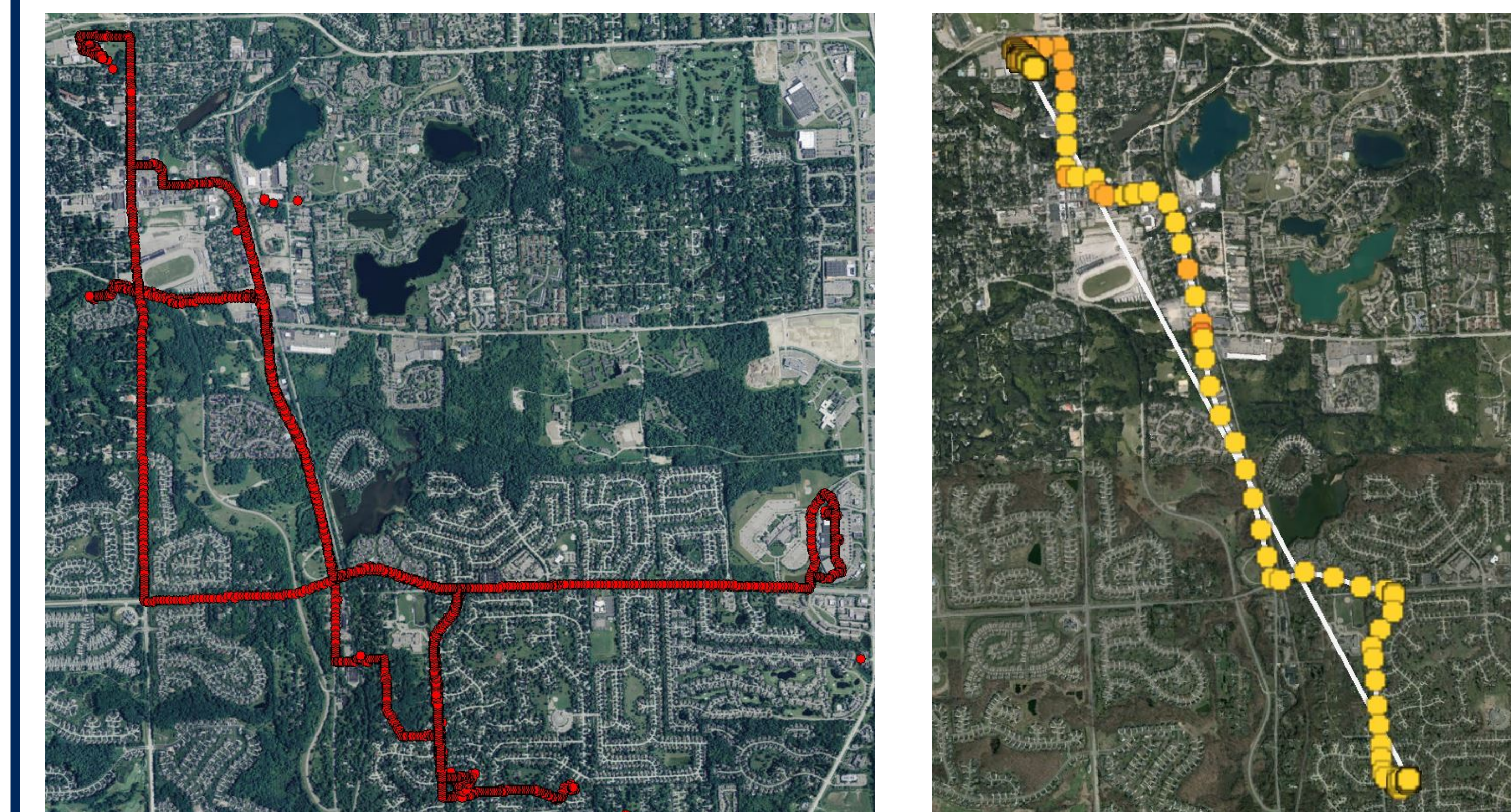


Figure 5. Right: 7 days of GPS data. Left: GPS and activity data correlated for 1 day (more red = more intense activity)

Conclusions

- Patient activity trends are in agreement with previous studies⁷
- Collecting GPS data via Smartphone and linking it with accelerometry data is feasible
- More processing is needed to classify activities using IMU data

FUTURE DIRECTIONS

- Use methodology to gather more data on subjects of patients of all ambulatory K-levels
- Determine efficacy of K-level system in predicting daily function of lower extremity amputees
- Eventual improvement of prosthetic prescription

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