



# Human Activity Recognition

Predictive Modelling via Wearable Sensors & Motion Tracking Cameras



## Casey Olson

- Mechanical & Biomedical Engineer
- Medical Device Research

### Interests:

- Sensors & Imaging
- Automation tools

### Hobbies

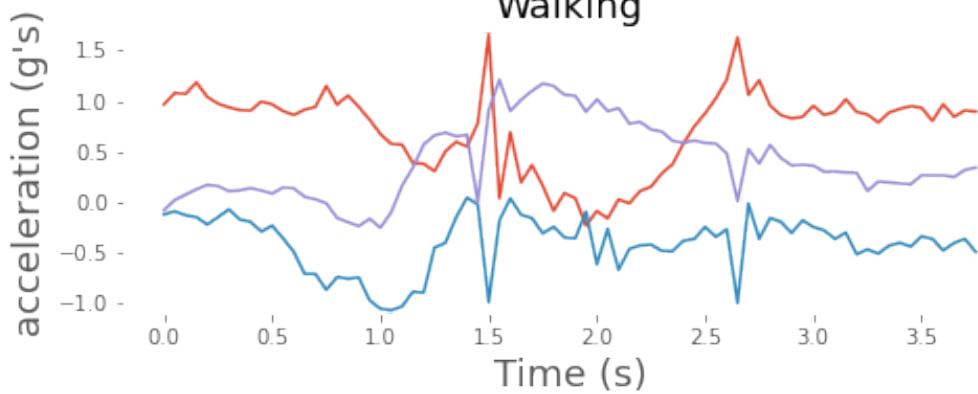
- Mountain Sports



# SPHERE

Sensor Platform for Healthcare in a Residential Environment

Wrist Accelerometer



Motion Tracking Camera



Living Room Camera



# Goal

Predictive modeling

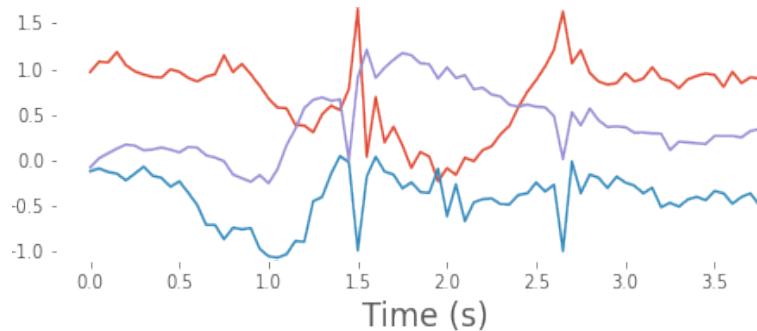
Raw Signals



Machine Learning  
Pipeline



Predictions



Time-Series Windowing

Featurization

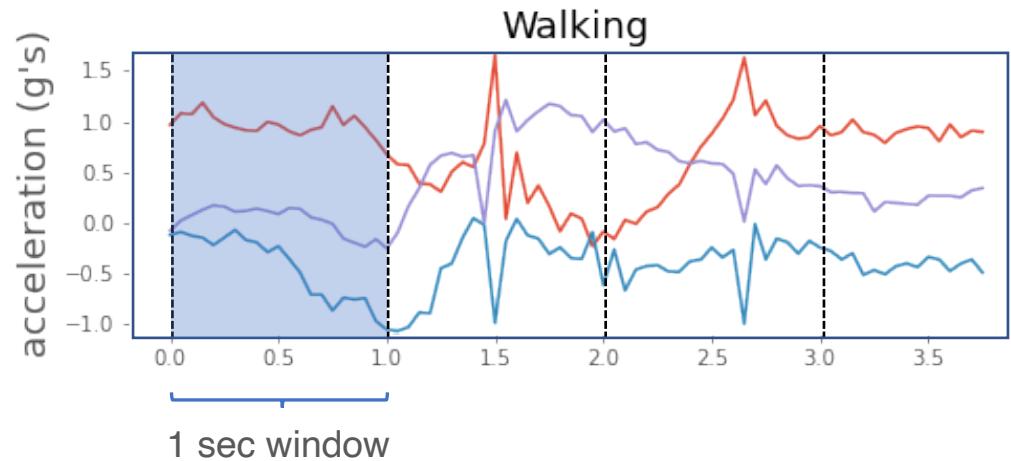
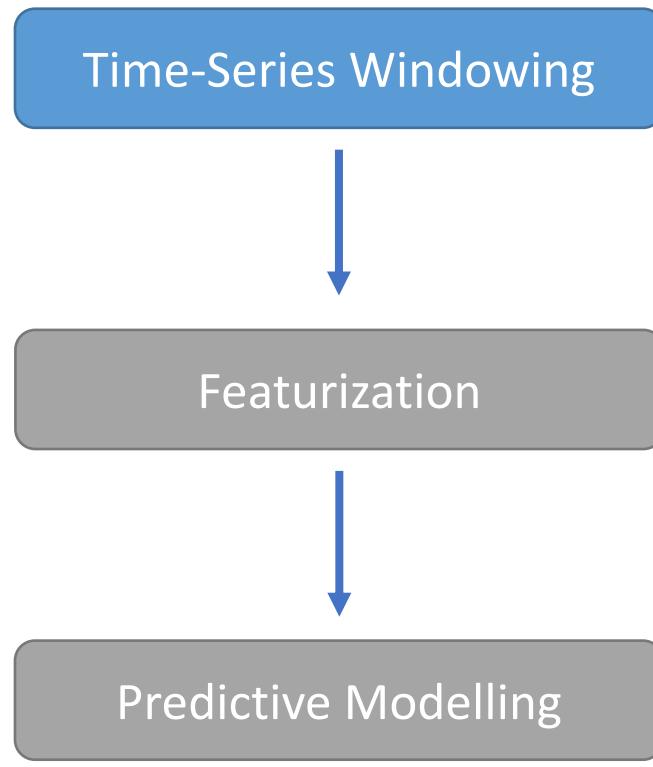
Predictive Modelling

Stand  
Sit  
Lie  
Bent  
Kneel  
Walk  
Loaded walk  
Ascend  
Descend  
Turn

# Pipeline

Raw data -> Window

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- Window width vs. Model Accuracy?
  - 0.5 - > 2.5 sec windows

# Pipeline

Window -> Features (Accelerometer)

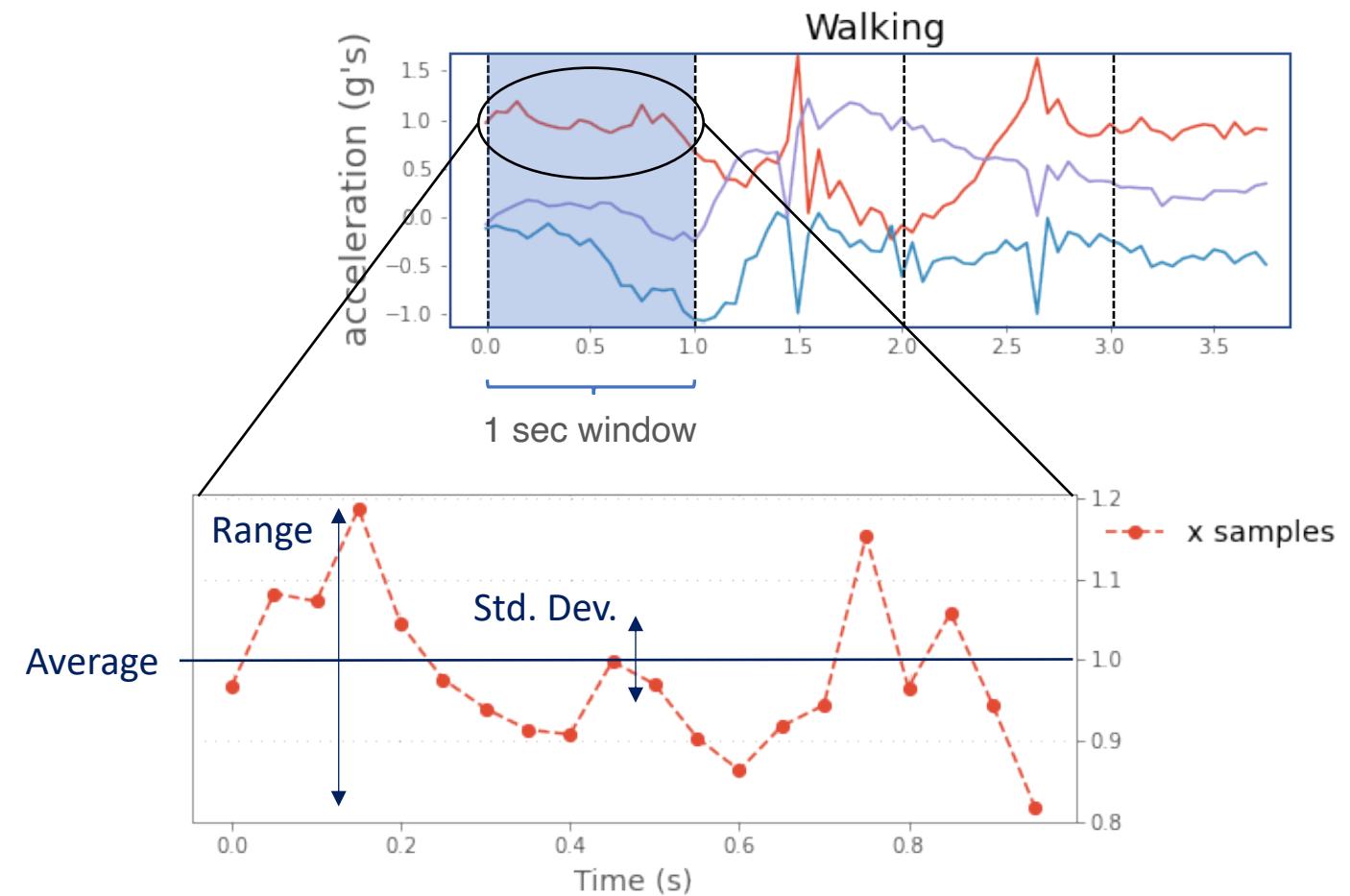
Time-Series Windowing



Featurization



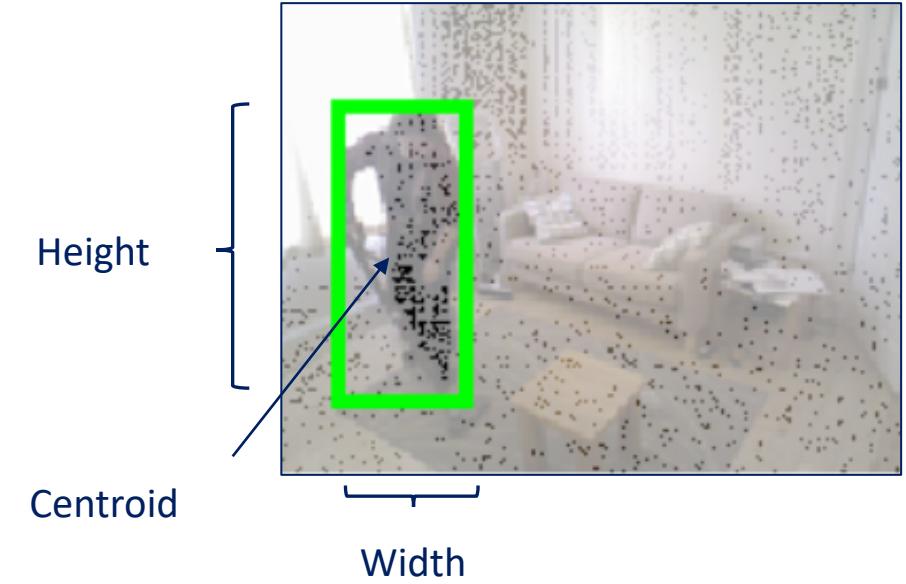
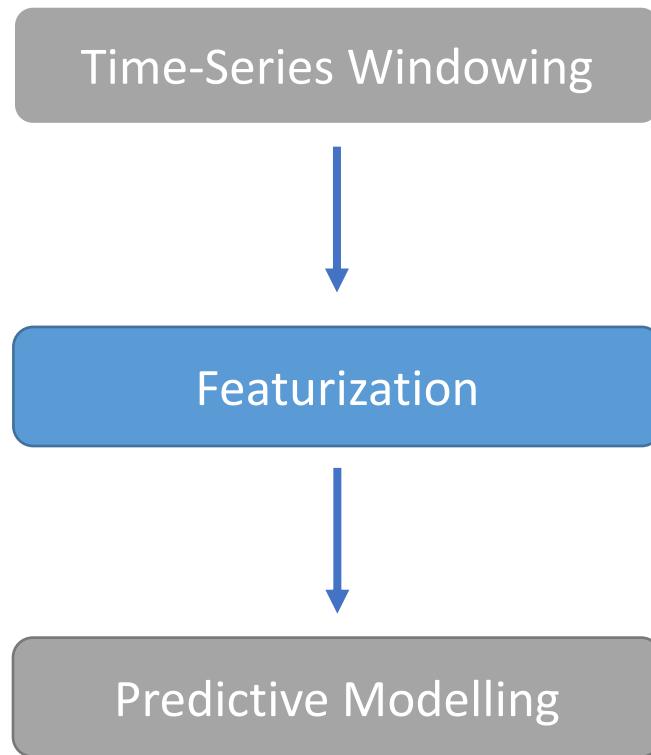
Predictive Modelling



# Pipeline

Window -> Features (Video)

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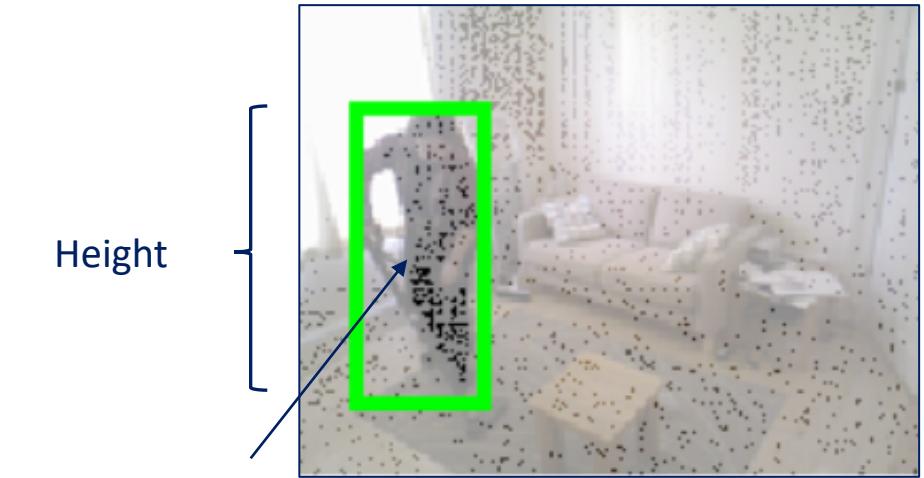


# Pipeline

Window -> Features

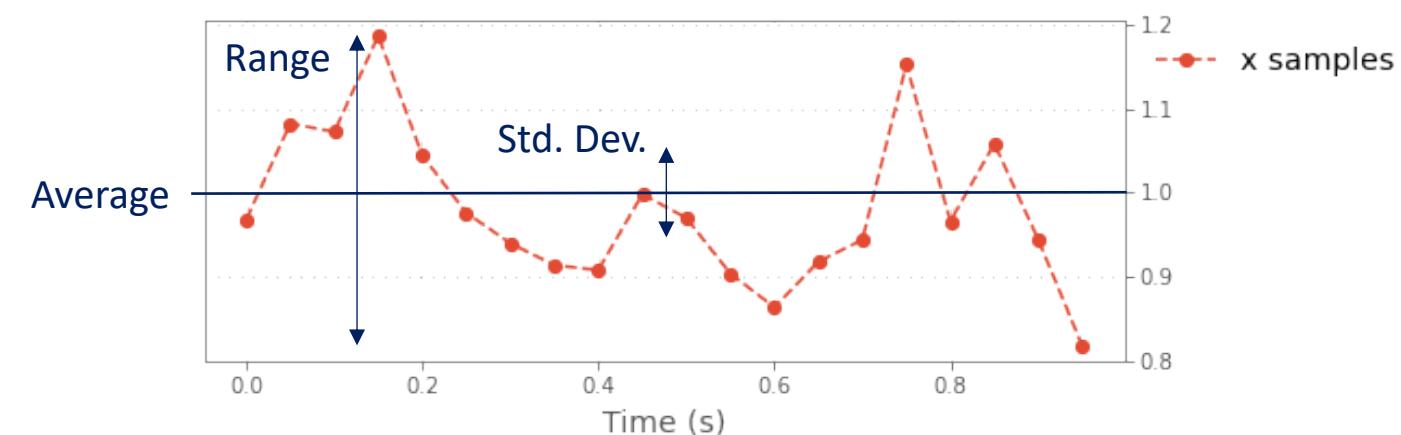
Time-Series Windowing

Features  
32 Video  
24 Accelerometer



Featurization

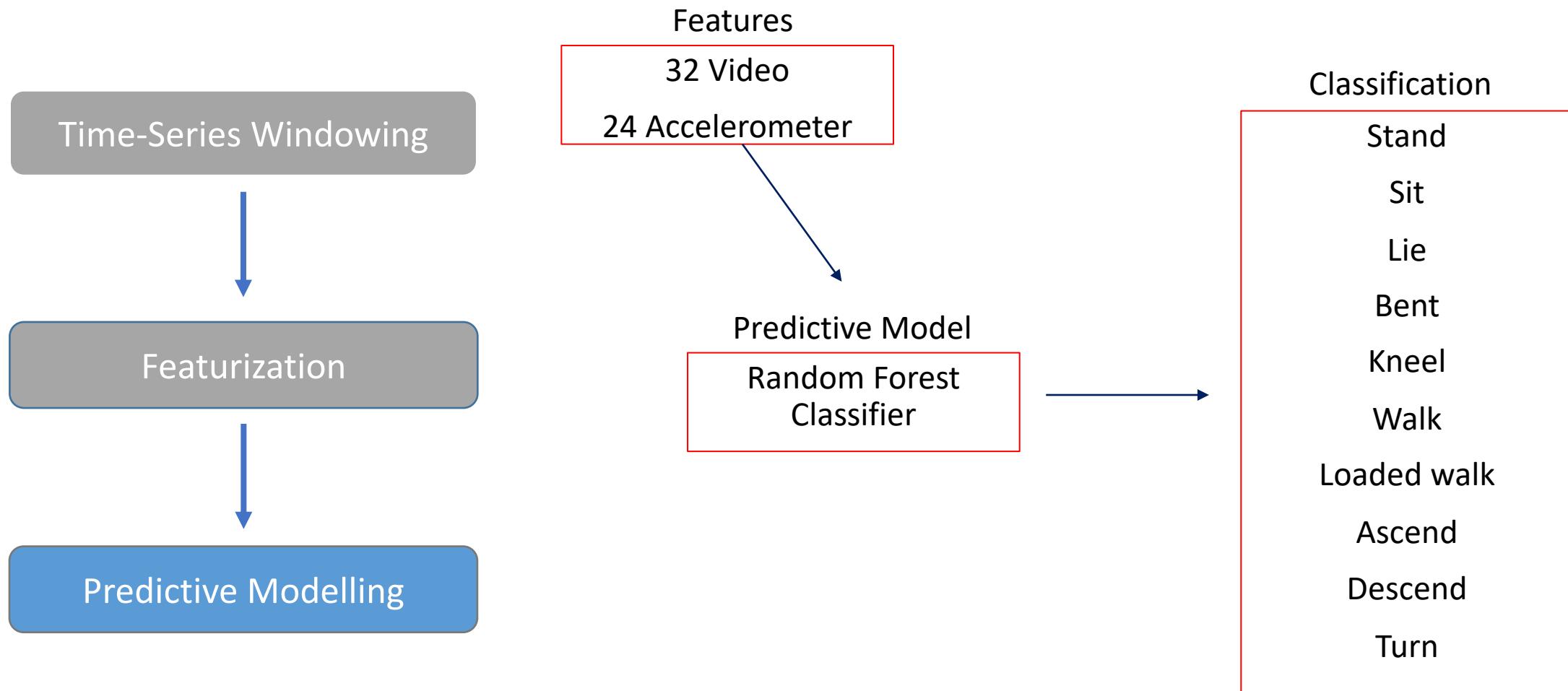
Predictive Modelling



# Pipeline

Features -> Prediction

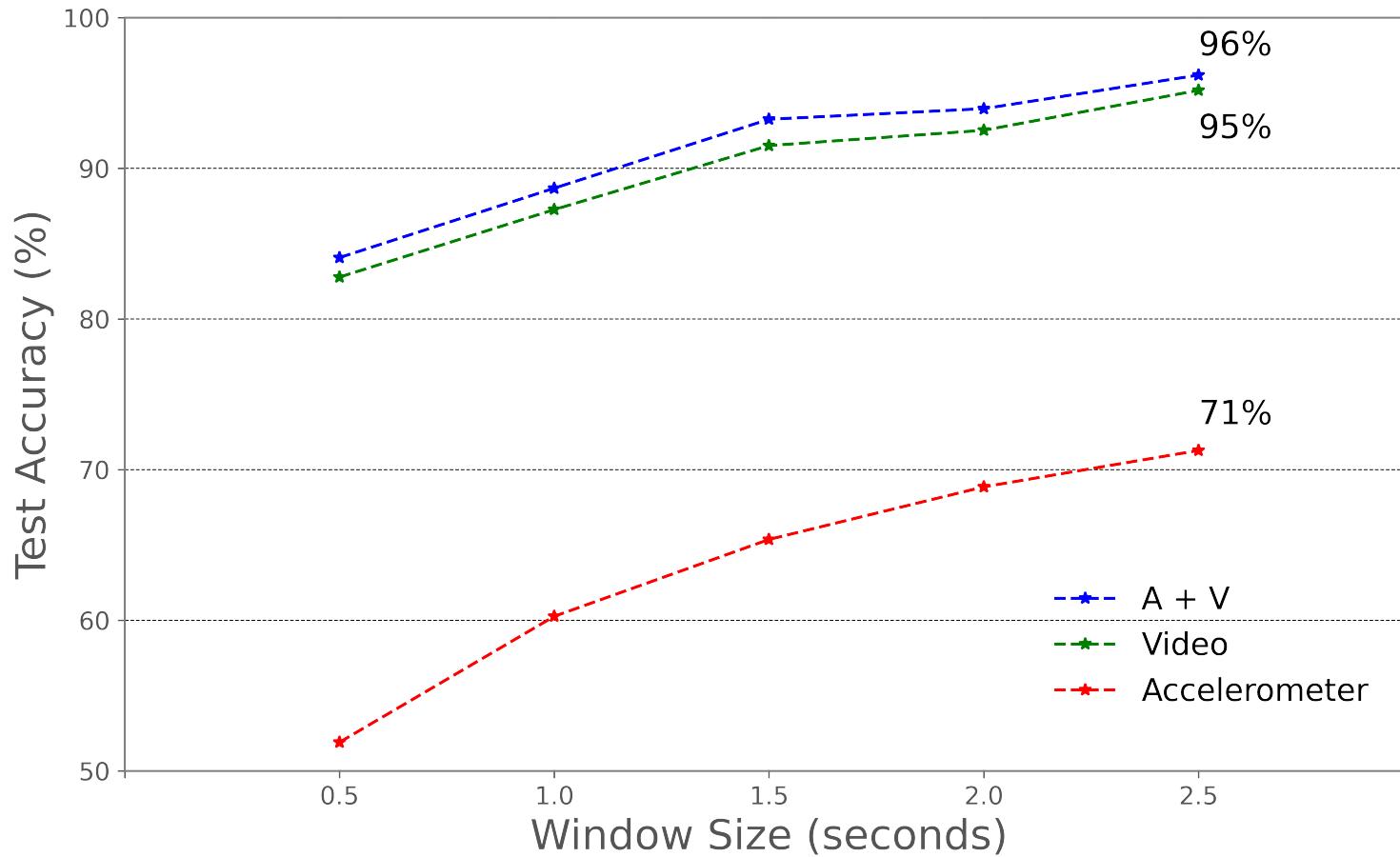
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# Results: Model Accuracy

vs. Window Size and Feature Source

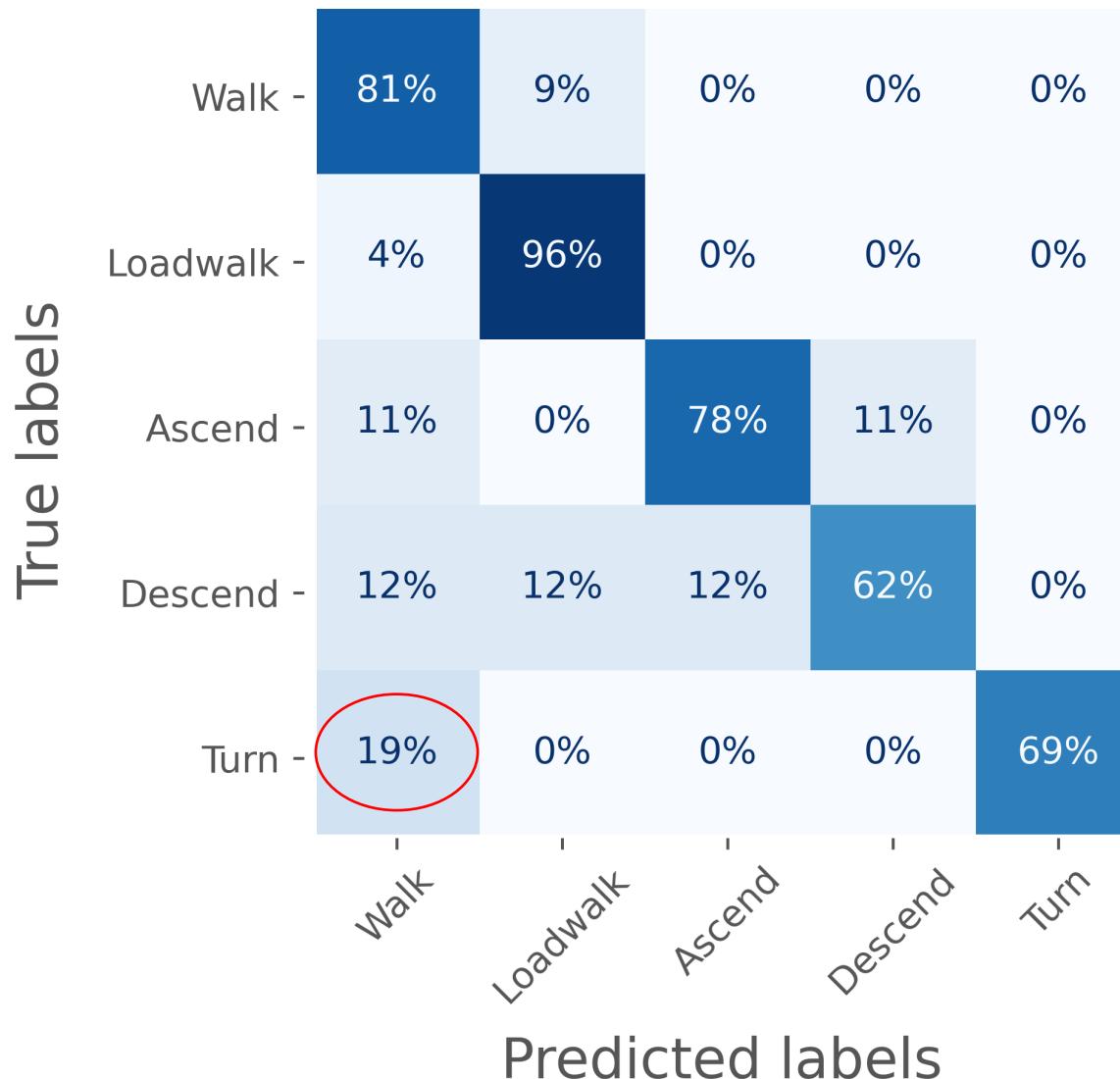
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# Results: Confusion Matrix

## Mis-classifications

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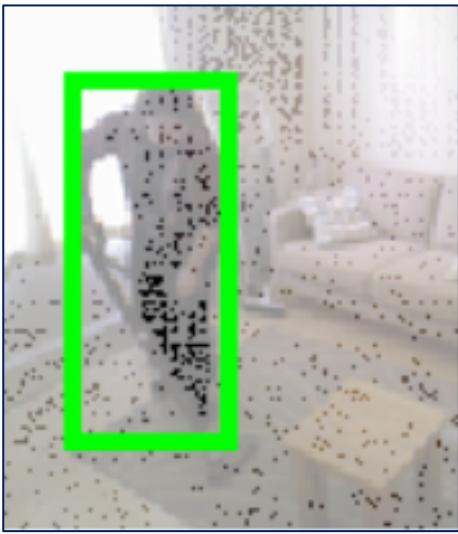


# Results: Confusion Matrix

How much can we improve this model?

Turn or Walk?

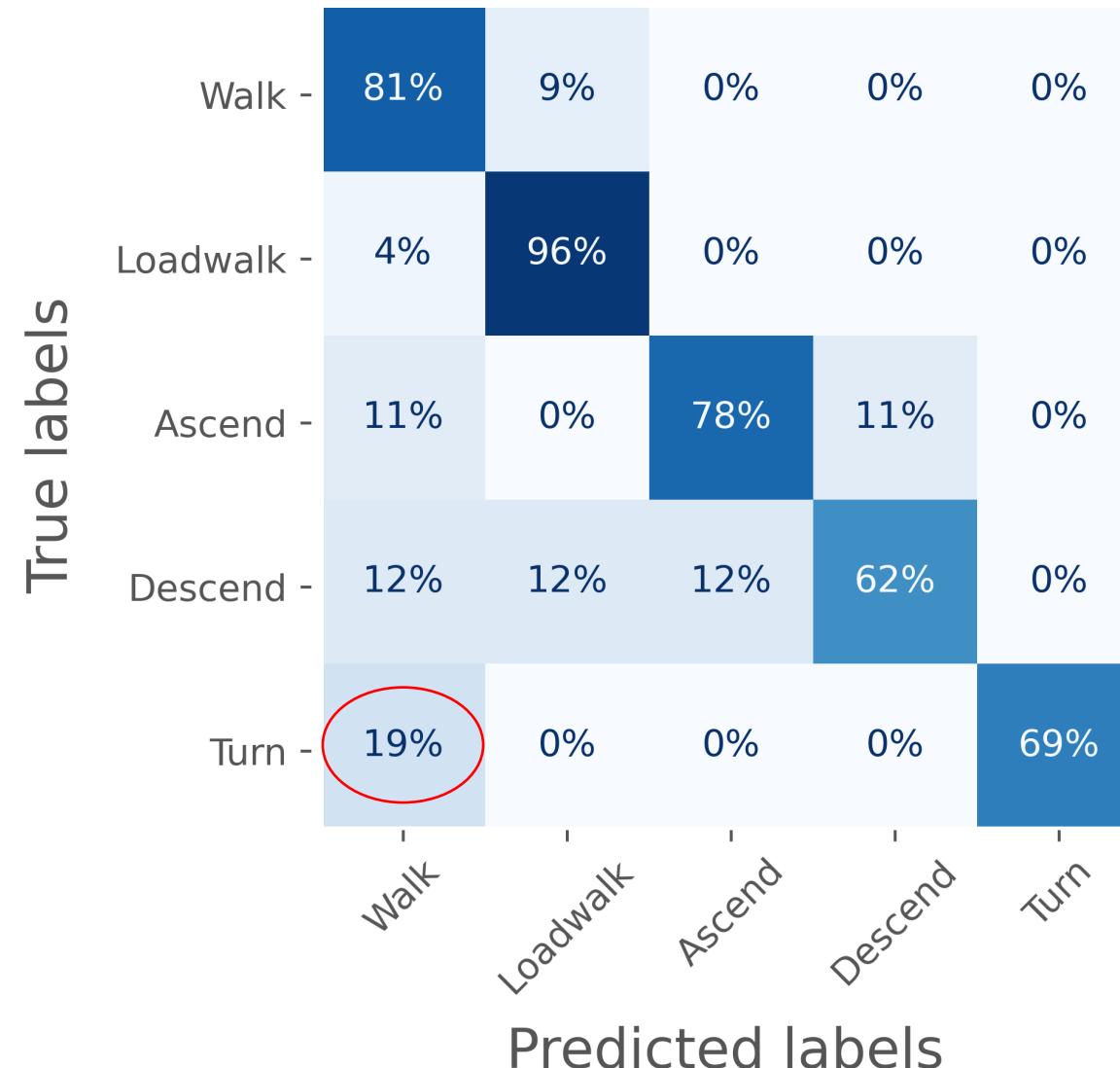
Most Important Features:



Width

Can we make improved features?

Limited by human created labels?



# Conclusions

- ❖ 96% prediction accuracy with random forest classifier
- ❖ Video data more valuable than accelerometers
- ❖ Could be a useful tool for non-invasive patient monitoring

# Thank You!



## CONTACT ME

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