

# Pothole Detection with Cell Phone Data

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## Introduction

- **Problem:** Every year potholes cause damage to cars and, in some cases, accidents. One way to begin addressing this problem is to create an up-to-date, accurate map of the locations of potholes.
- **Current detection methods and issues:**
  1. *Visual inspection*— labor intensive
  2. *Citizen complaints* – miss small potholes
  3. *Specialized vehicles* -- expensive
- **Data used:**
  - GPS and accelerometer
  - Videos from each drive
- **Goal:** Test if the algorithm from “The Pothole Patrol” [1] can be applied to this project’s data.

## Objectives

- Identify potholes through the use of cell phone accelerometer data
- Associate found potholes with images taken from a video shot during the drive
- Evaluate the algorithm’s performance

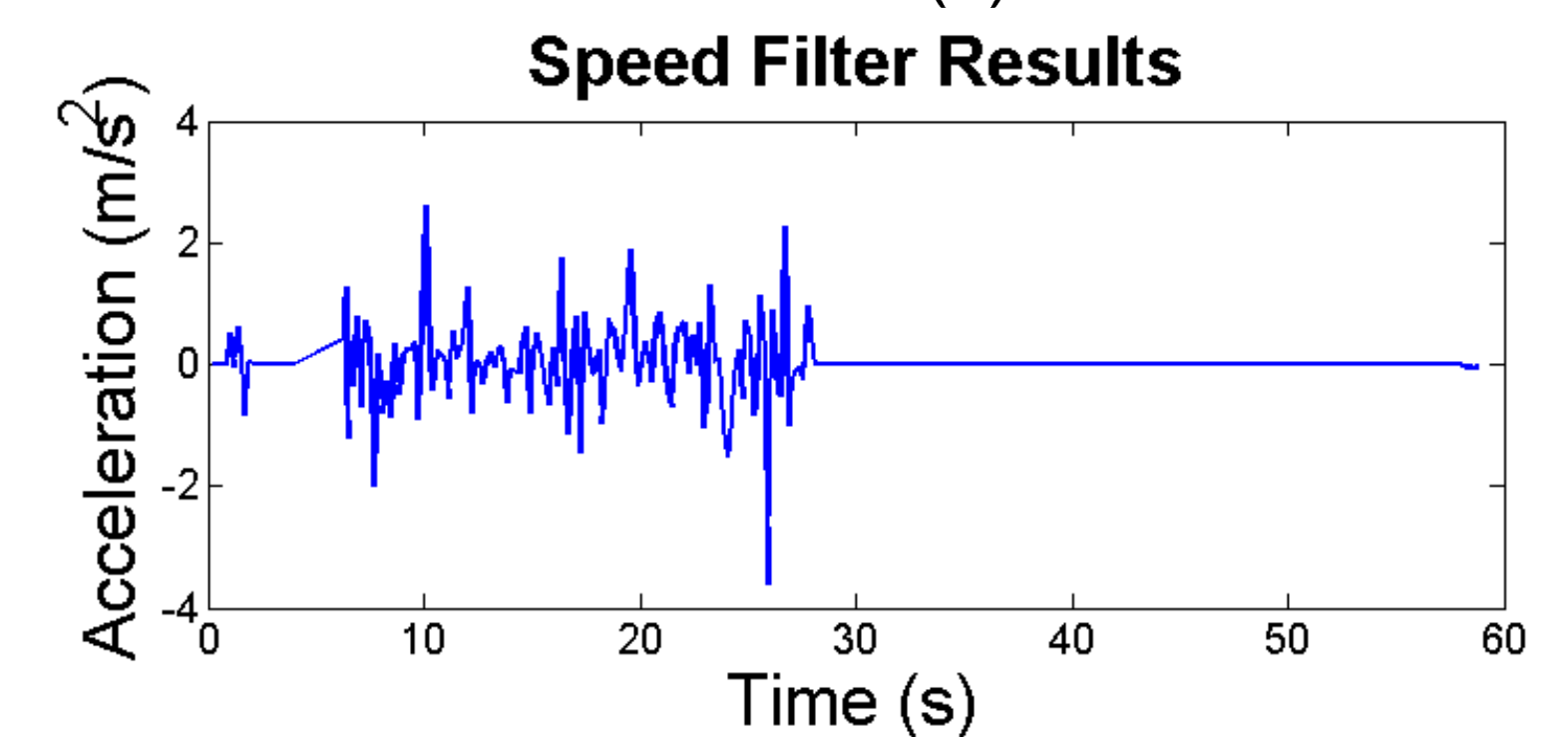
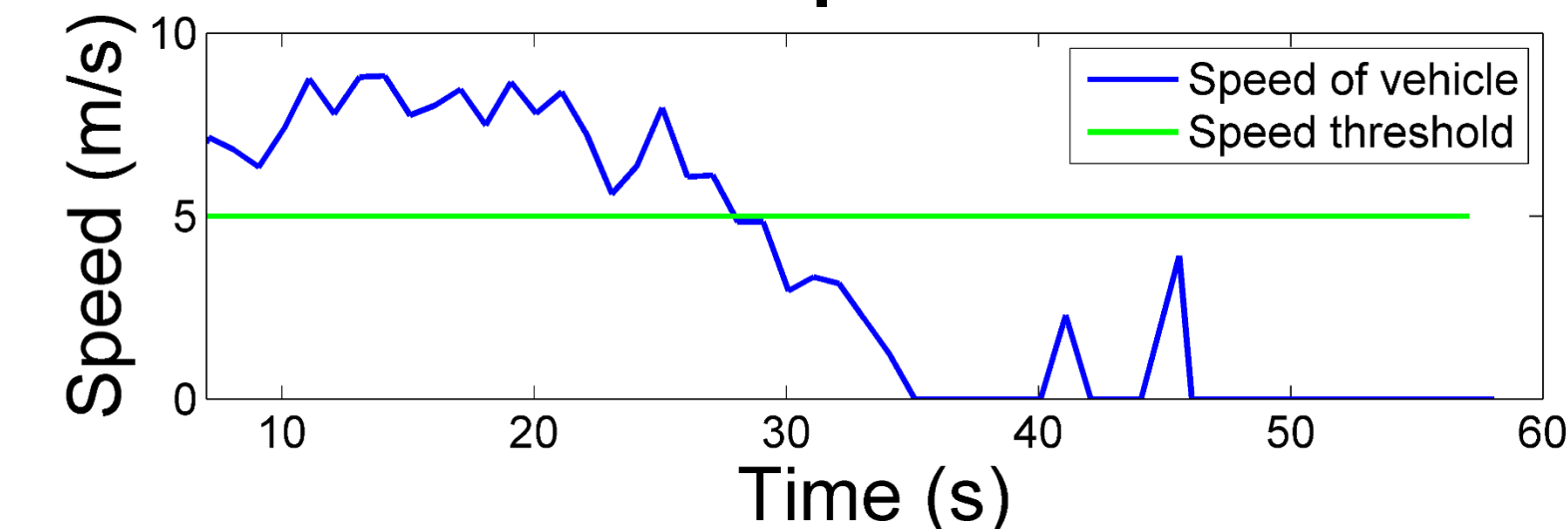
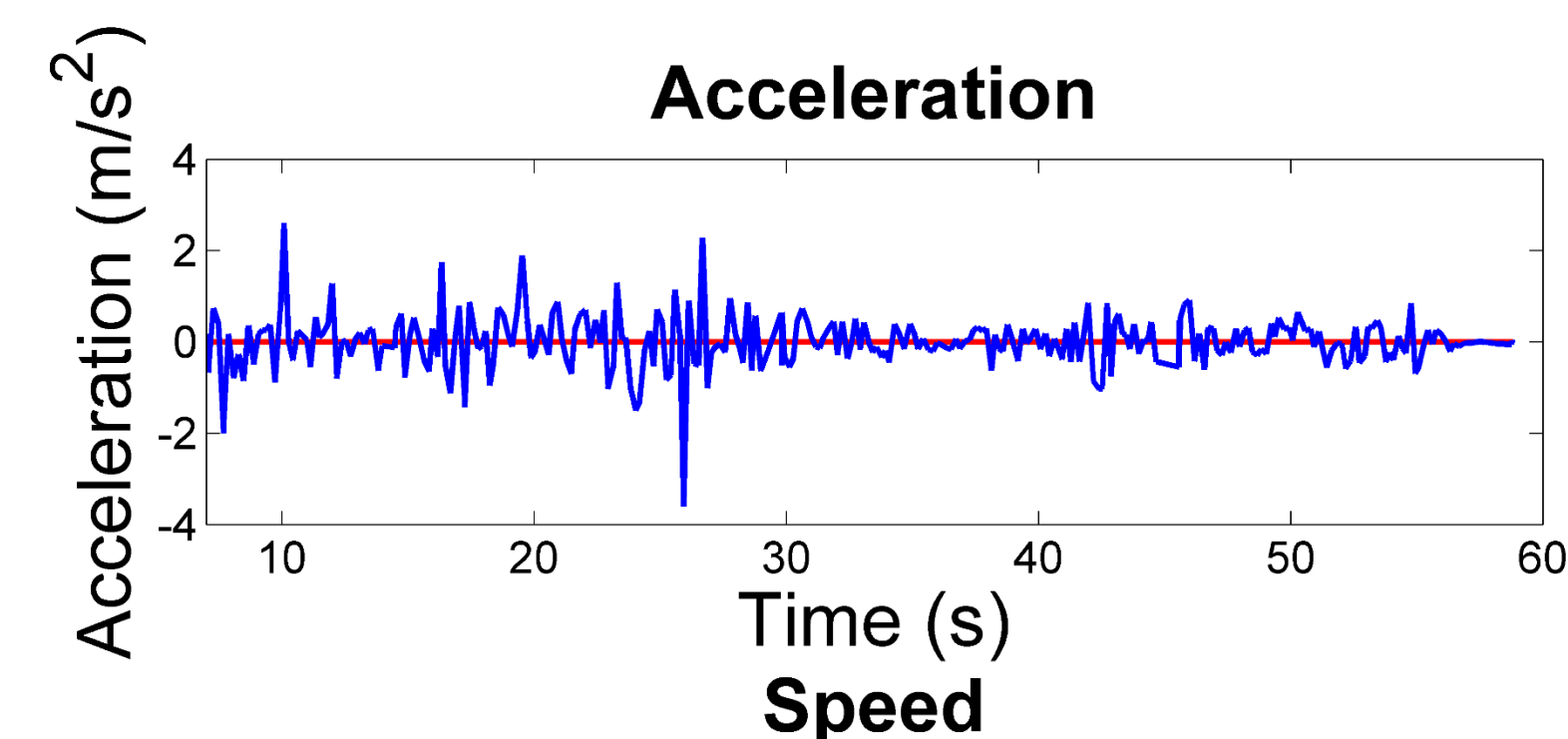
## Methods

- Data
  - Raw: GPS, accelerometer, time, video
  - Derived: speed
- Look at the acceleration data since potholes cause vertical acceleration spikes
- Other causes of acceleration spikes are: engine vibrations, driving around curves, railroad crossings, and speed bumps
- Use a precision recall curve to evaluate the algorithm’s effectiveness

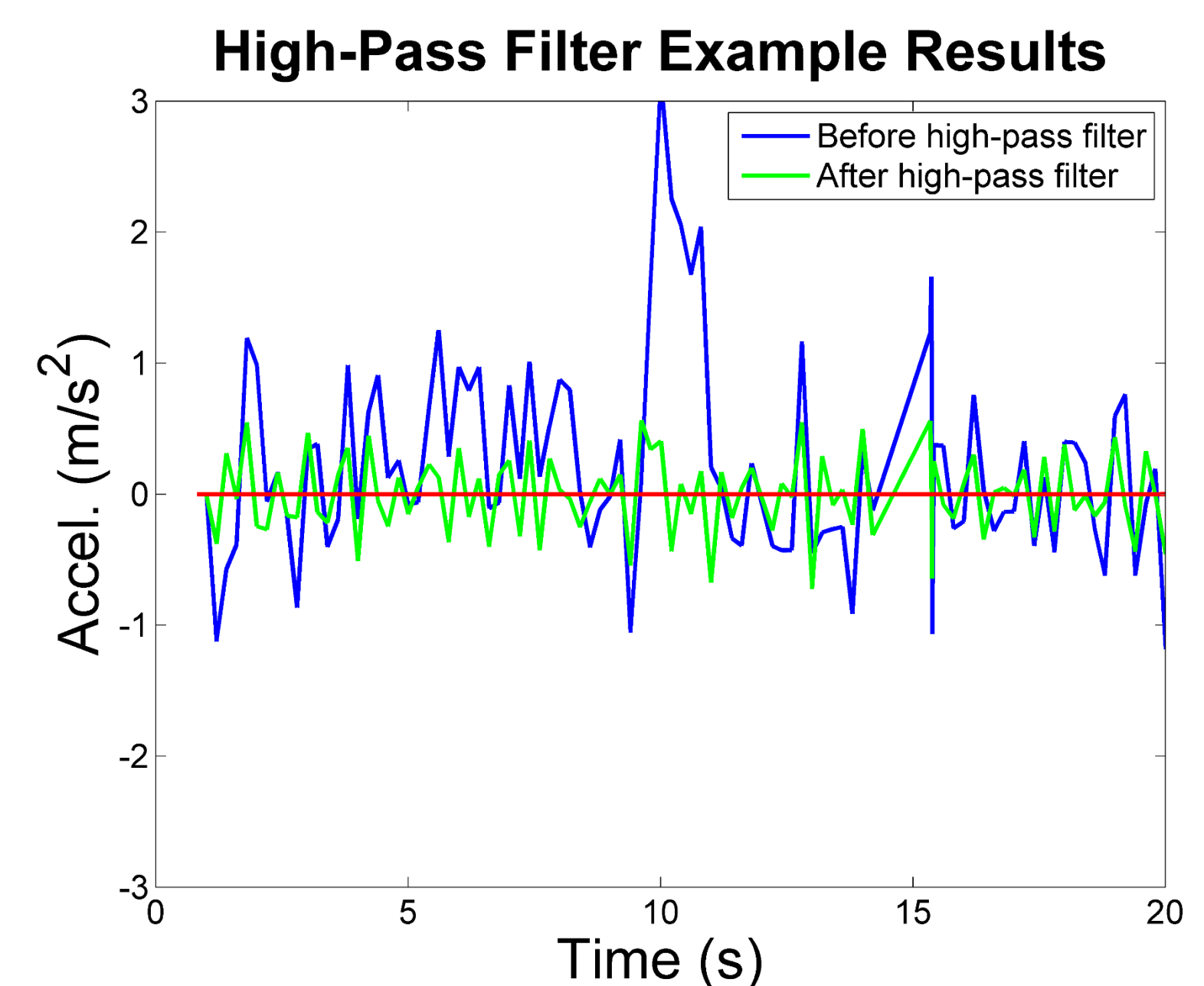
## Pothole Detection

### Acceleration Filters:

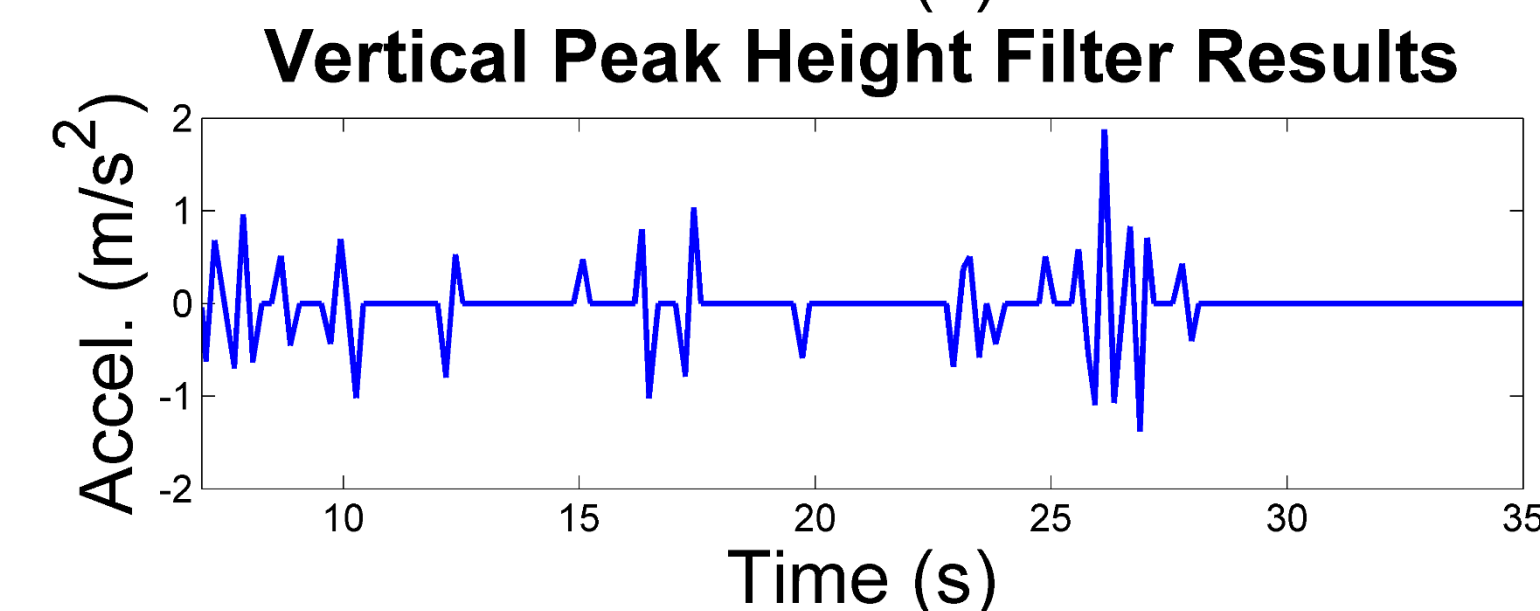
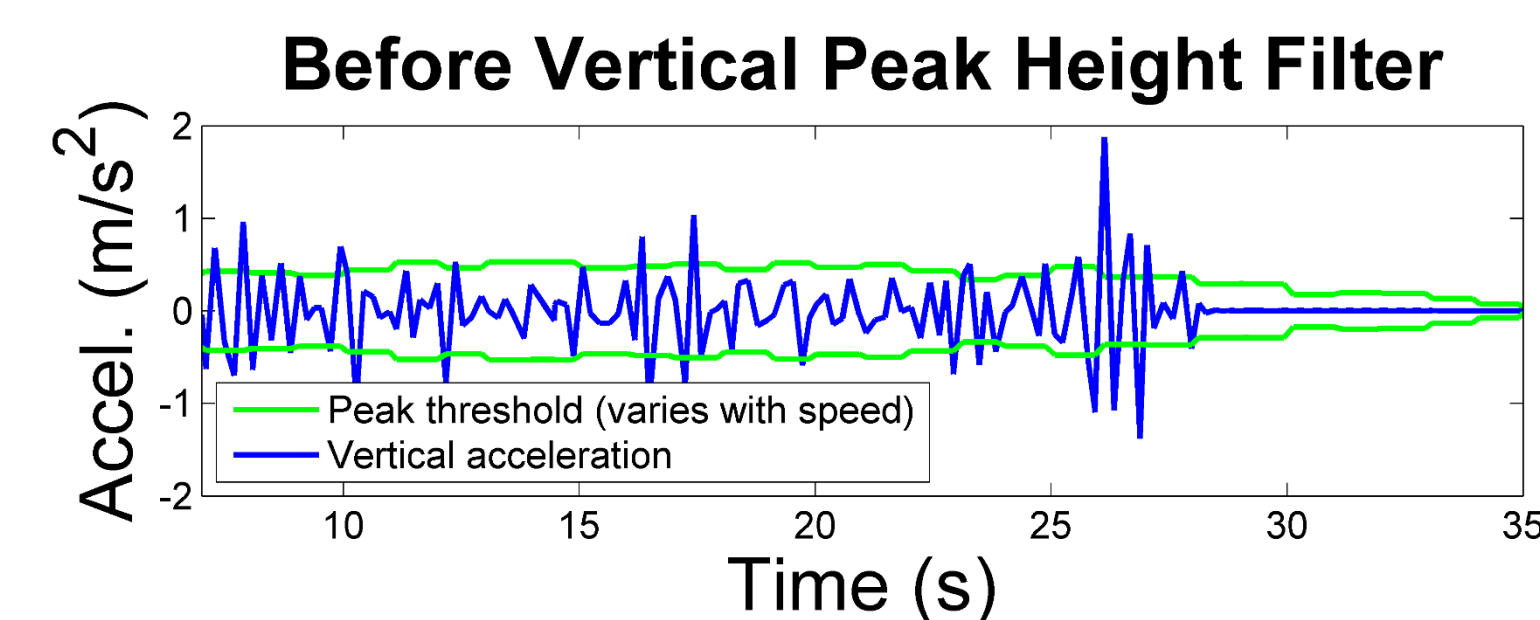
- **Speed:** filters the acceleration data based on the speed of the vehicle at the time
  - Removes events such as stopped vehicle, slow moving vehicles, and door slams



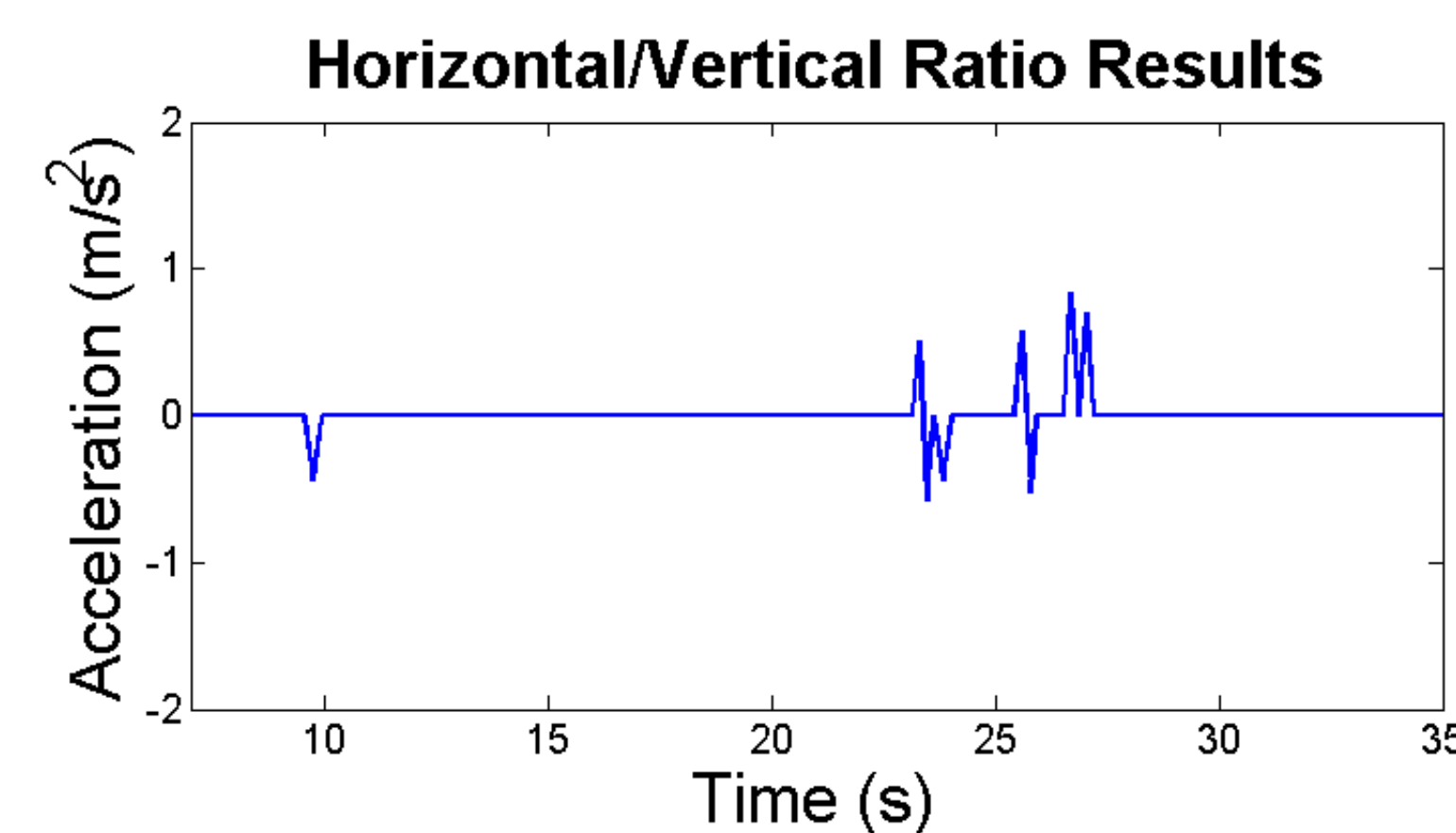
- **High-Pass:** filters out the low frequency accelerometer data
  - Removes events such as turning, acceleration, and braking



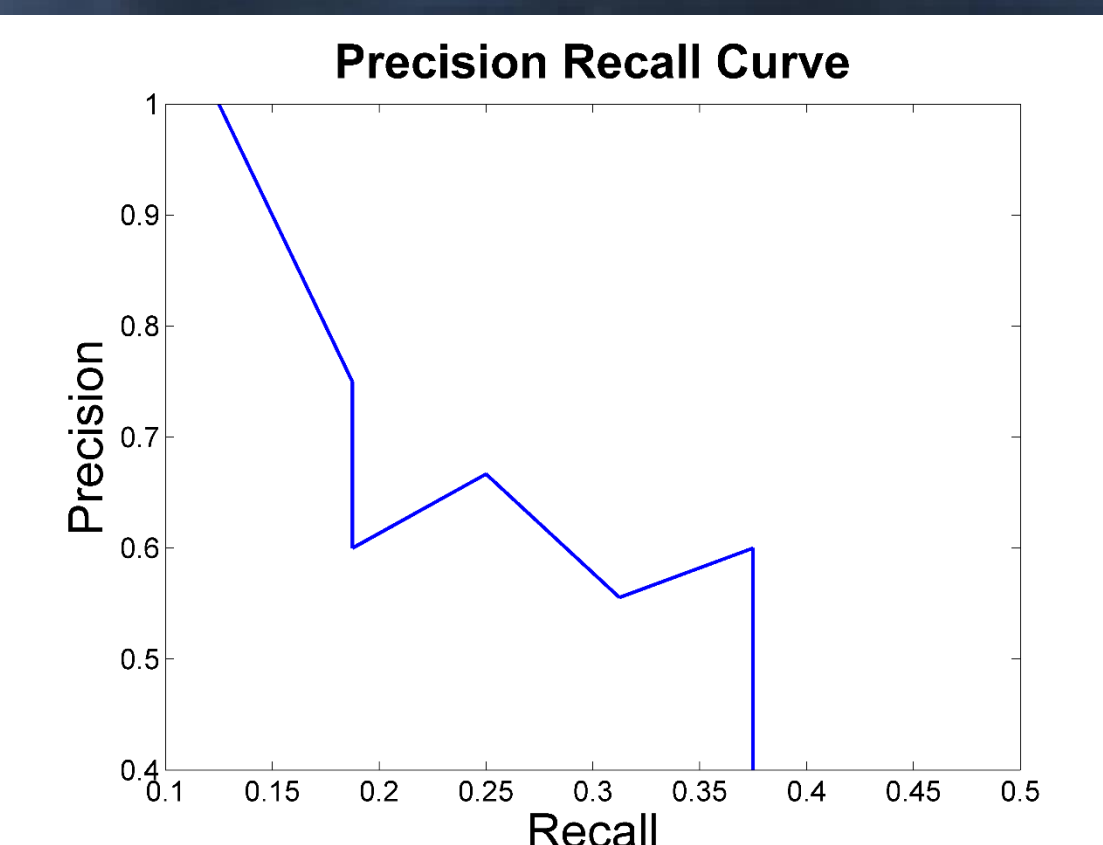
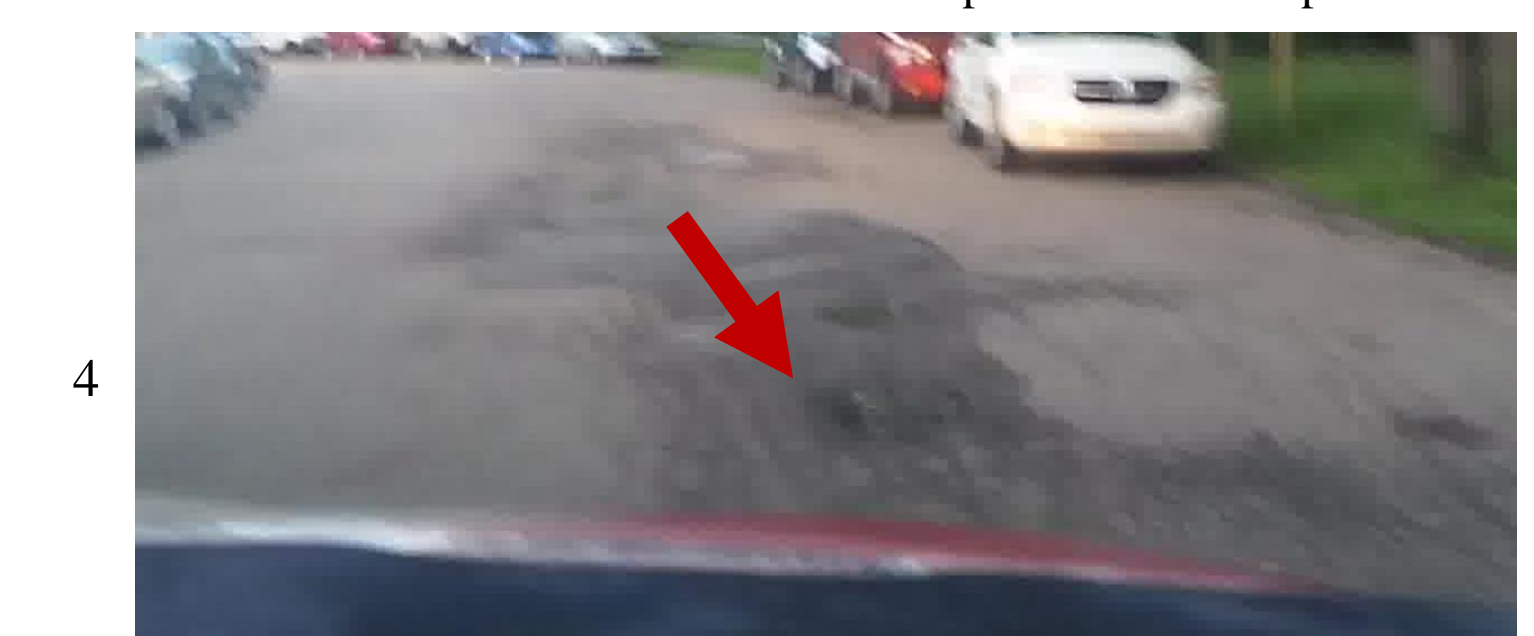
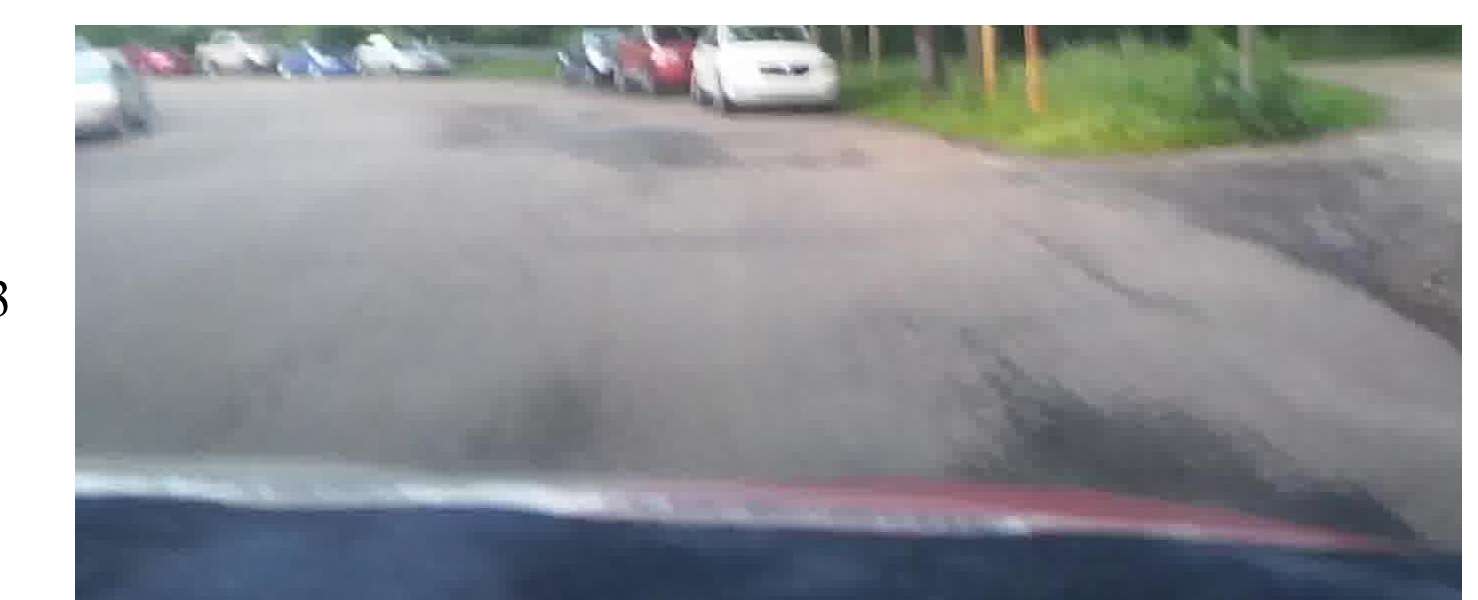
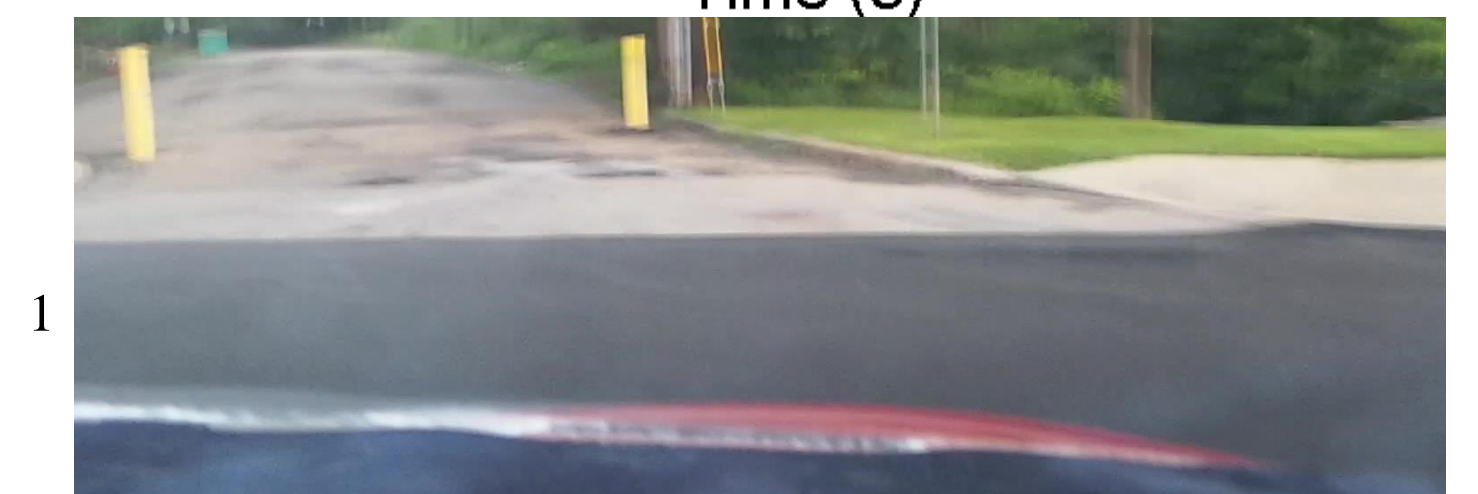
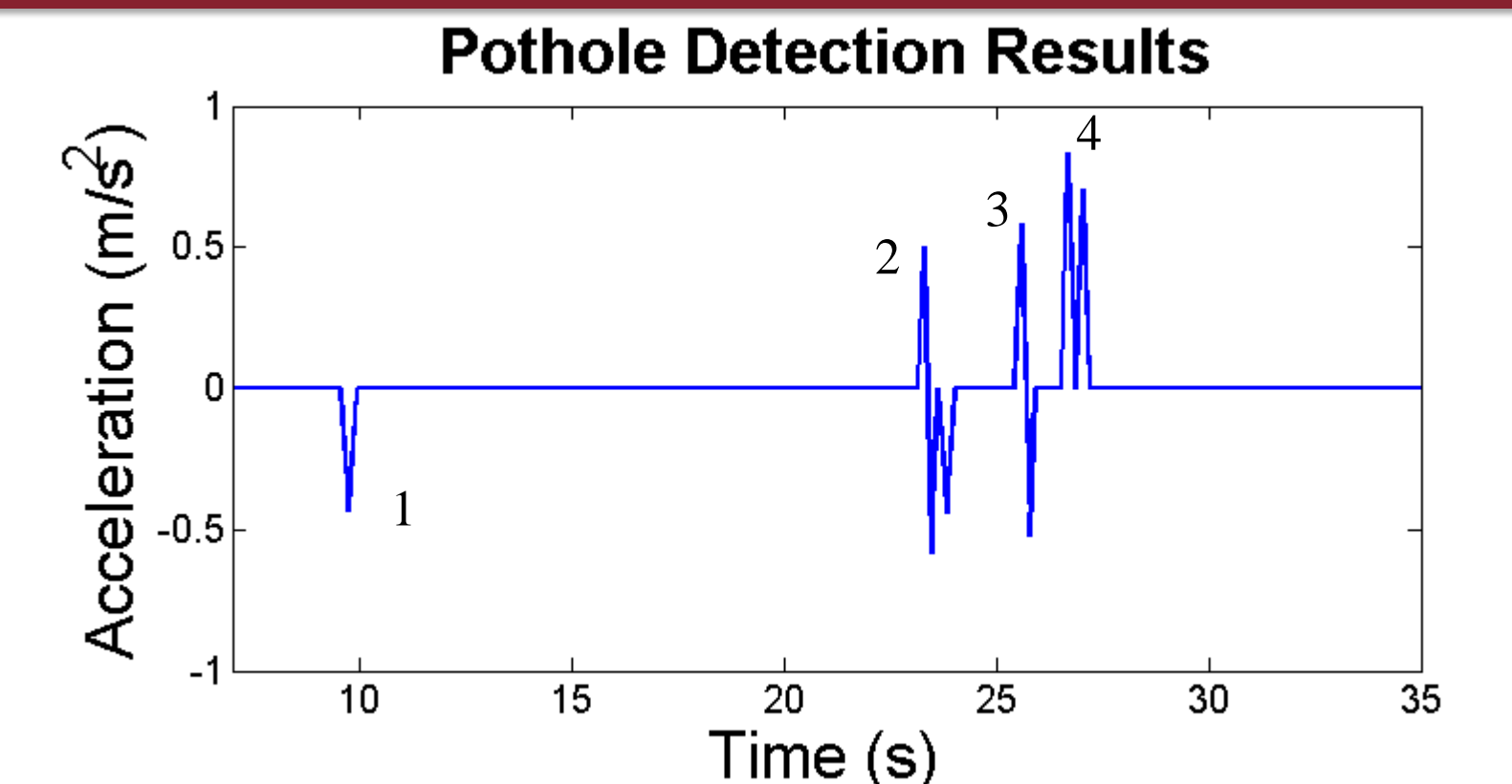
- **Vertical Height:** filters the data based on a vertical peak threshold that varies with speed
  - Removes events which do not impact the car enough to be a pothole
  - Speed variation ensures that peaks which are artificially high from high speeds do not get mislabeled as potholes



- **Vertical/Horizontal (left/right) Ratio:** filters the data based on the ratio of horizontal acceleration to vertical acceleration
  - Removes events that impact both sides of the car at the same time



## Conclusions



Above: Precision recall curve for the pothole detection system

## References

- [1] Eriksson, J., Girod, L., Hull, B., Newton, R., Madden, S., Balakrishnan, H.: The Pothole Patrol: Using a Mobile Sensor Network for Road Surface Monitoring. In: MobiSys'08. pp. 29–39 (2008)