

# Low-Cost, Minimally-Intrusive, Light-Based Sensors for Vehicle Detection

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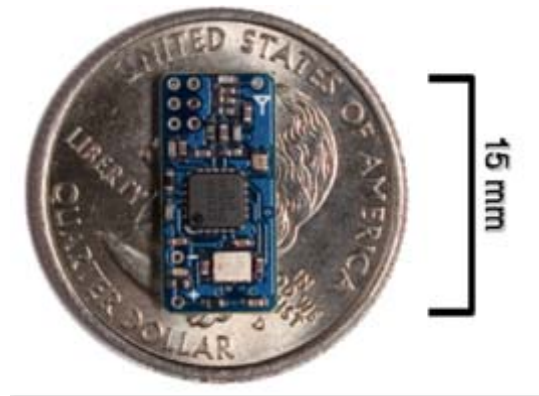
Department of Civil & Environmental Engineering

# Lagrangian vs Eulerian Sensing



# High Density Sensing Platforms

- Low Power/Self-Powered
- Wireless Communication
- Low Cost (across life cycle)
- Onboard Computing



# Vehicle Detection & Characterization

- Visual (light-based) Detection
- Weigh-in-Motion via Roadside Sensing



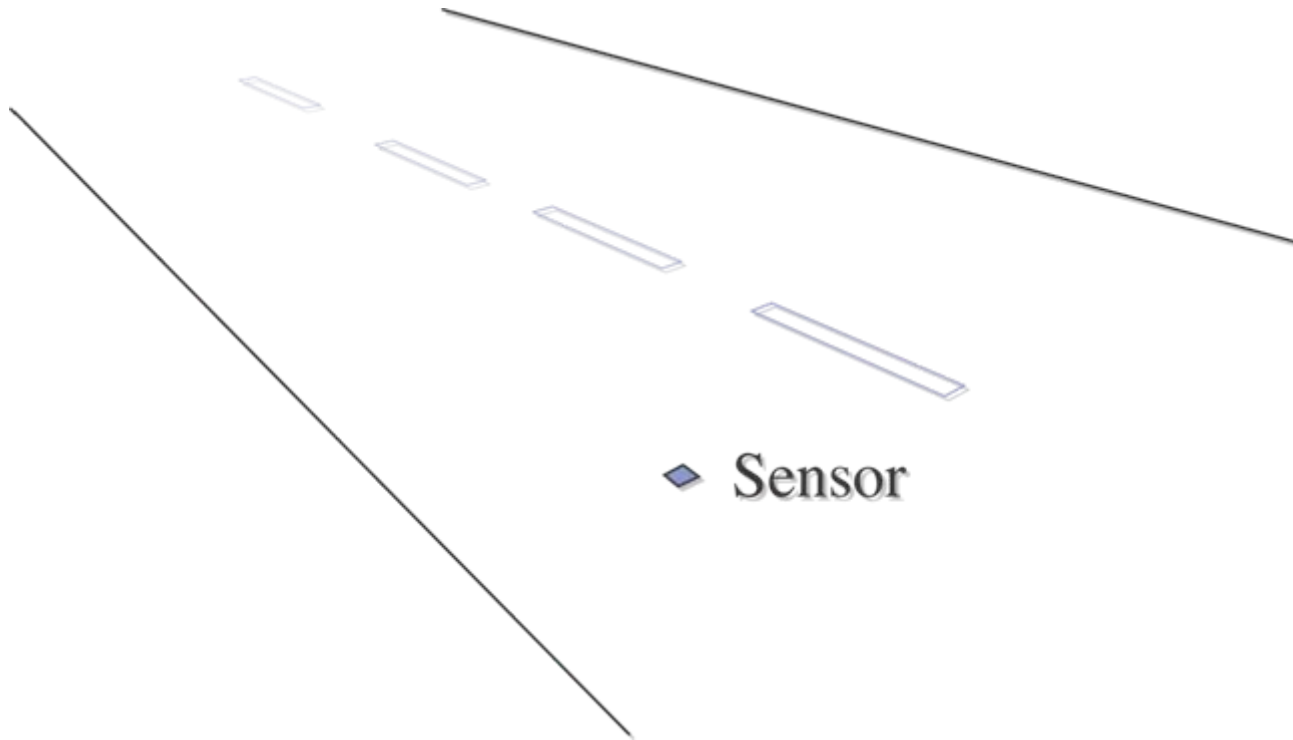
## Image-Based Vehicle Detection

- Relatively small number of relatively expensive sensors
- Relatively large data sets
- Relatively complex processing requirements to extract relatively simple observation data.
- Complicating factors (occlusion, ambient conditions, traffic conditions, etc.)

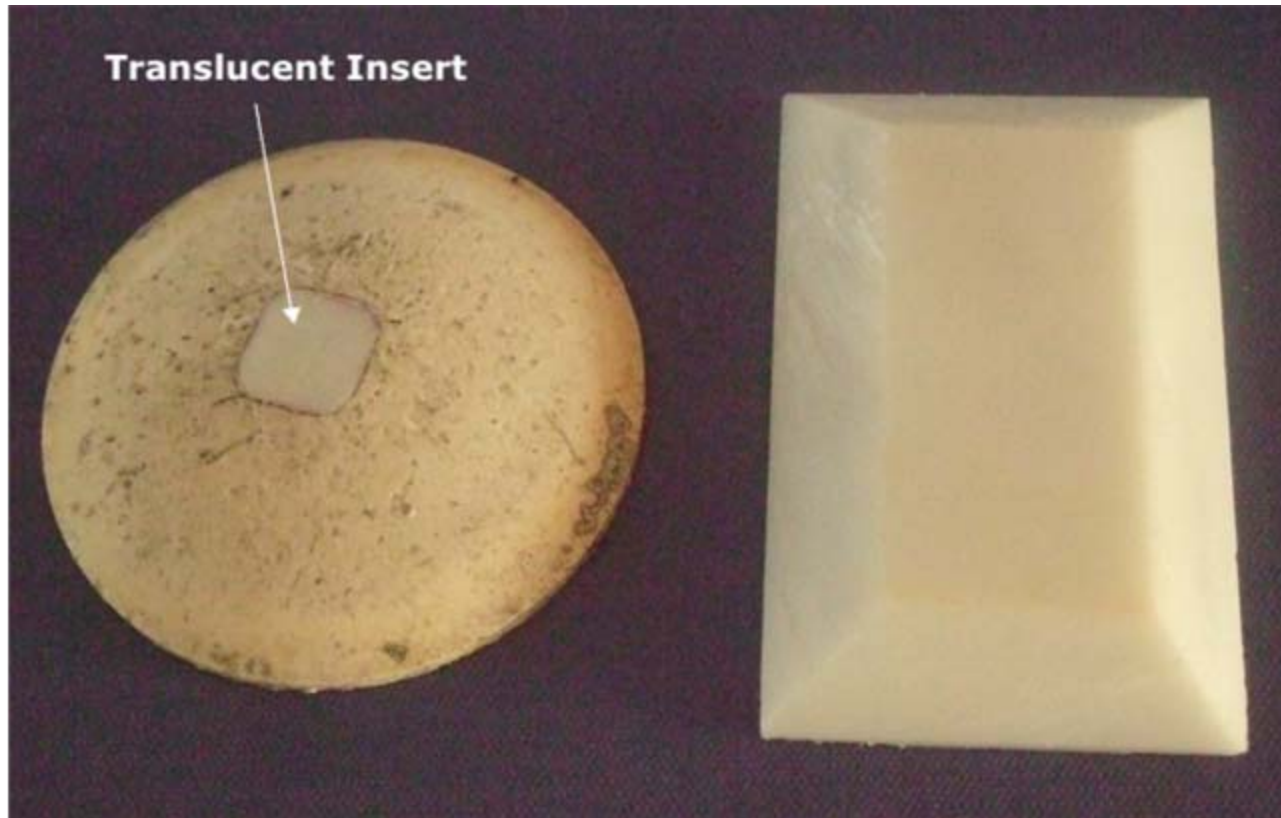
# Vehicle Shadows



# Upward-Facing Single Pixel Camera

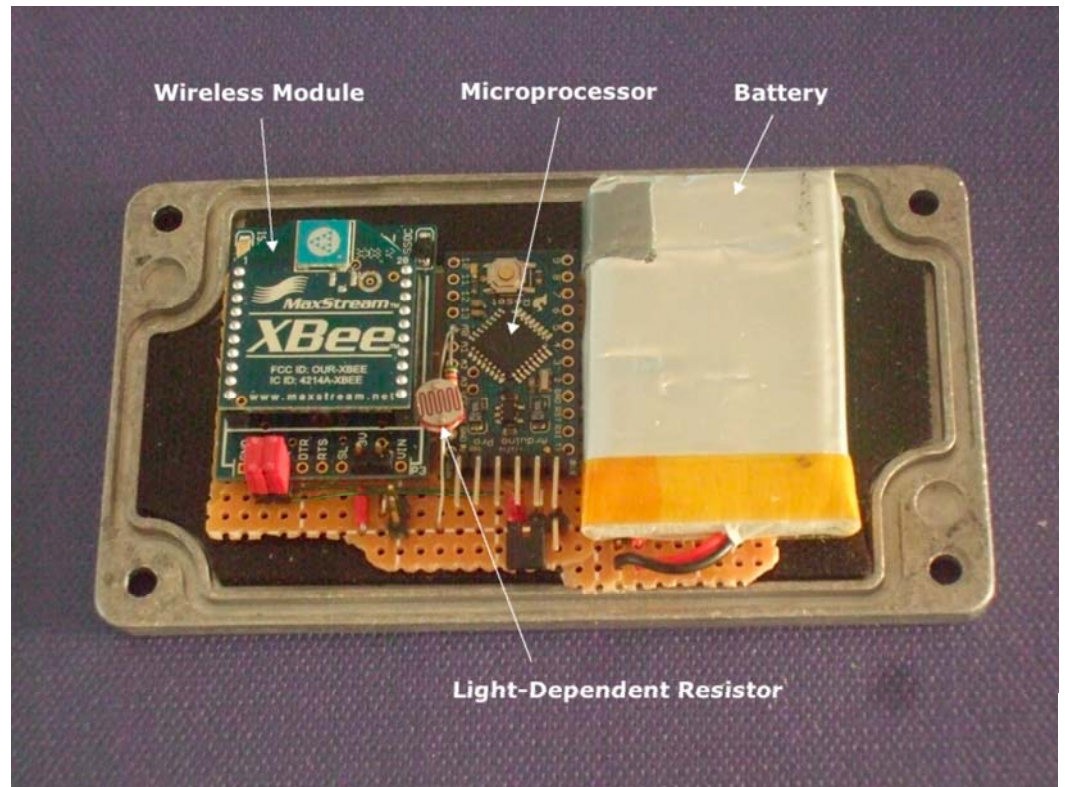


# Prototype Devices

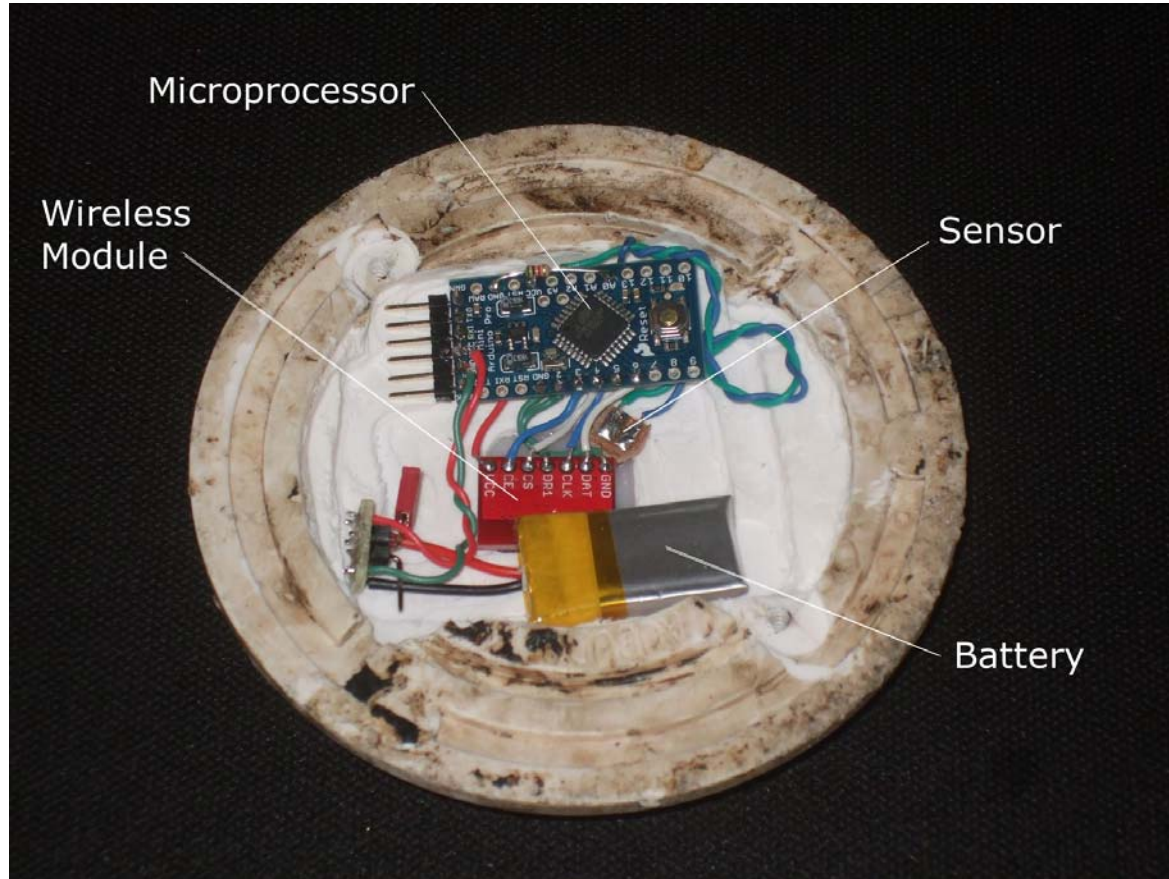




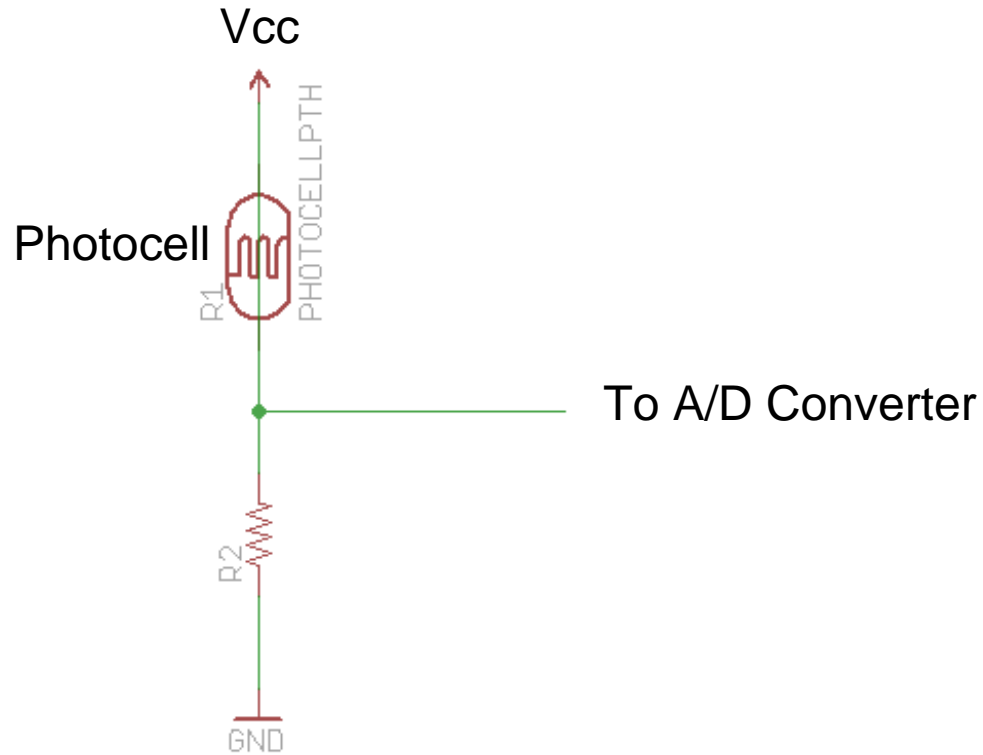
# Prototype Internals



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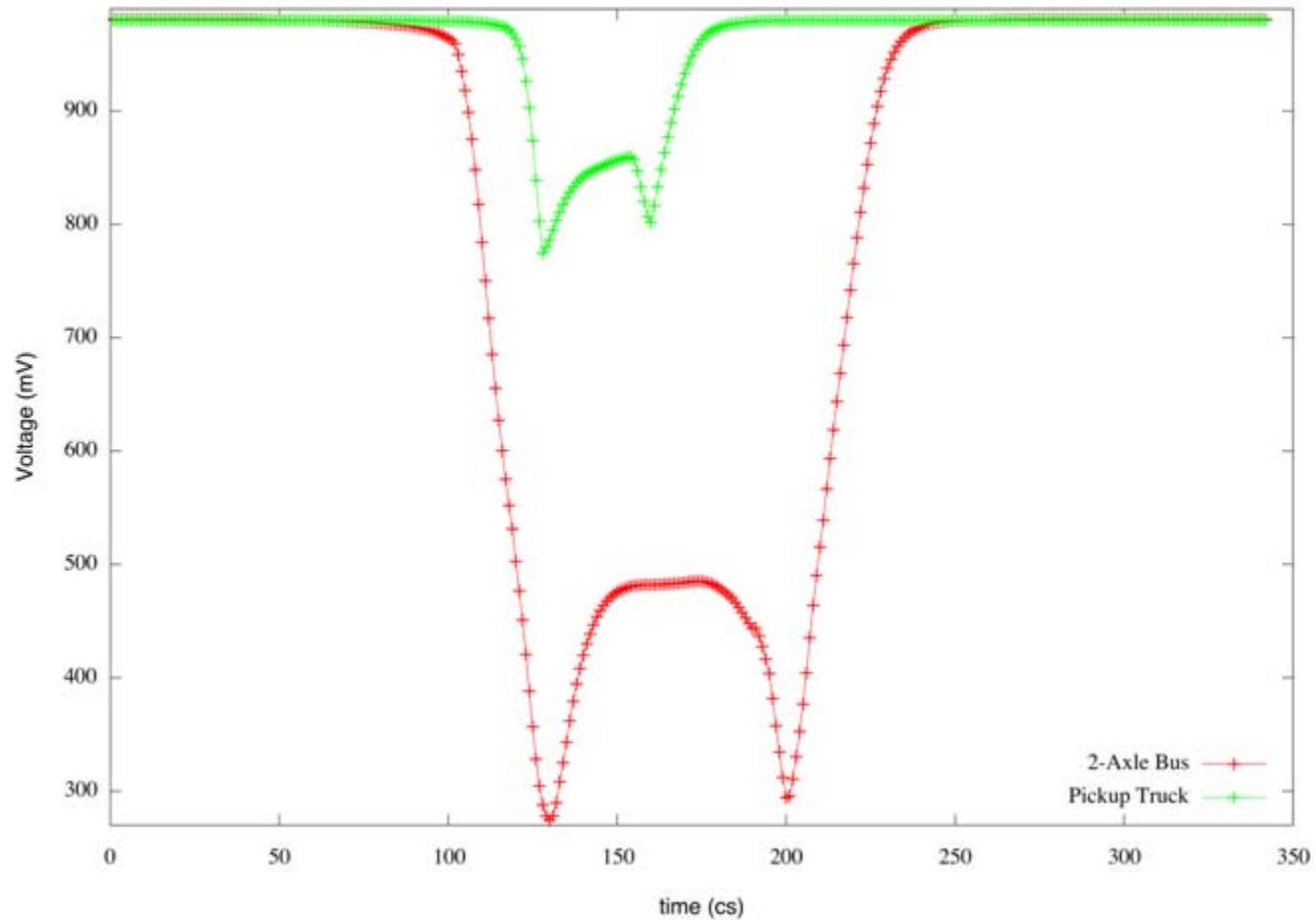
# Elementary Circuit



# Sample Test Site



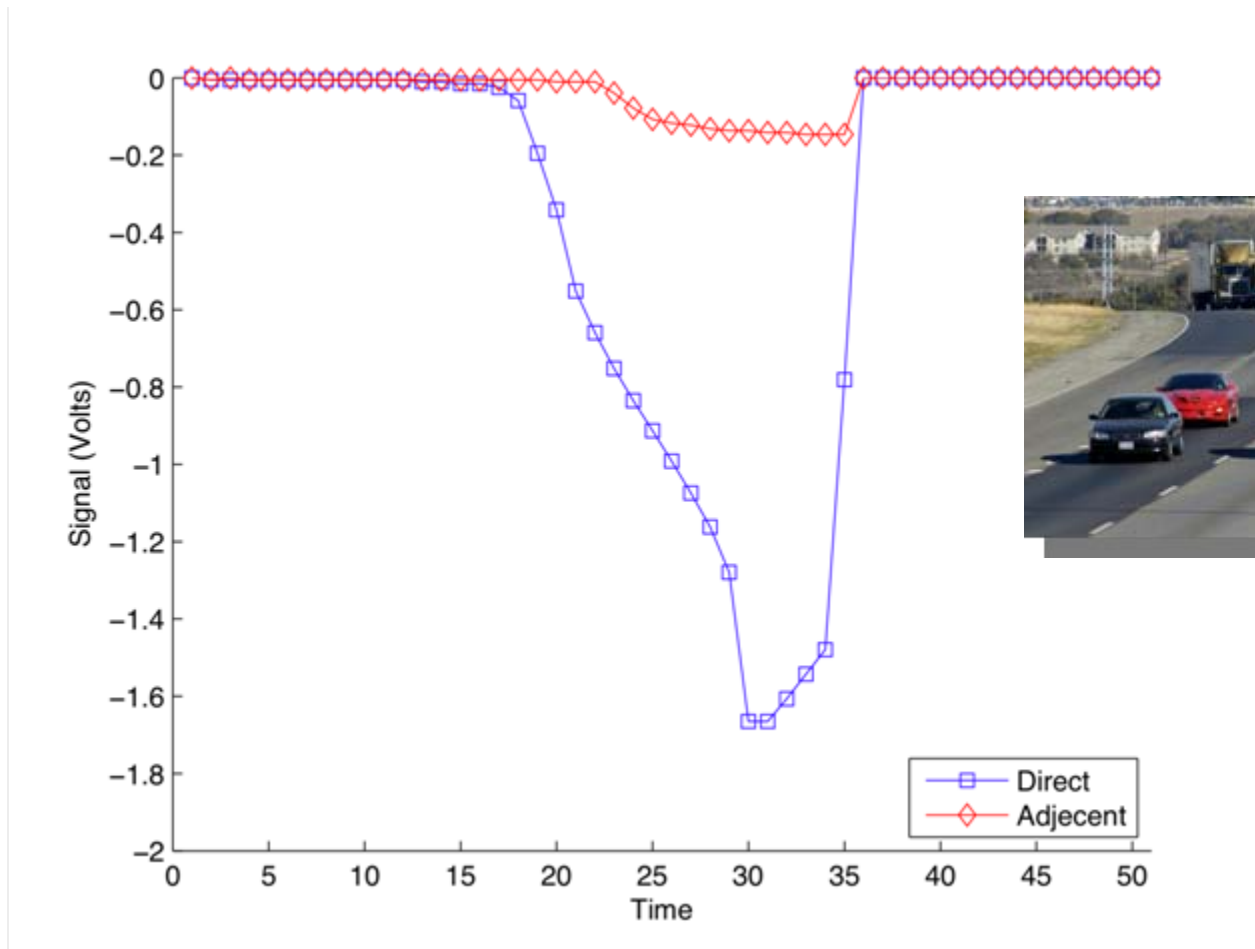
# Representative Data



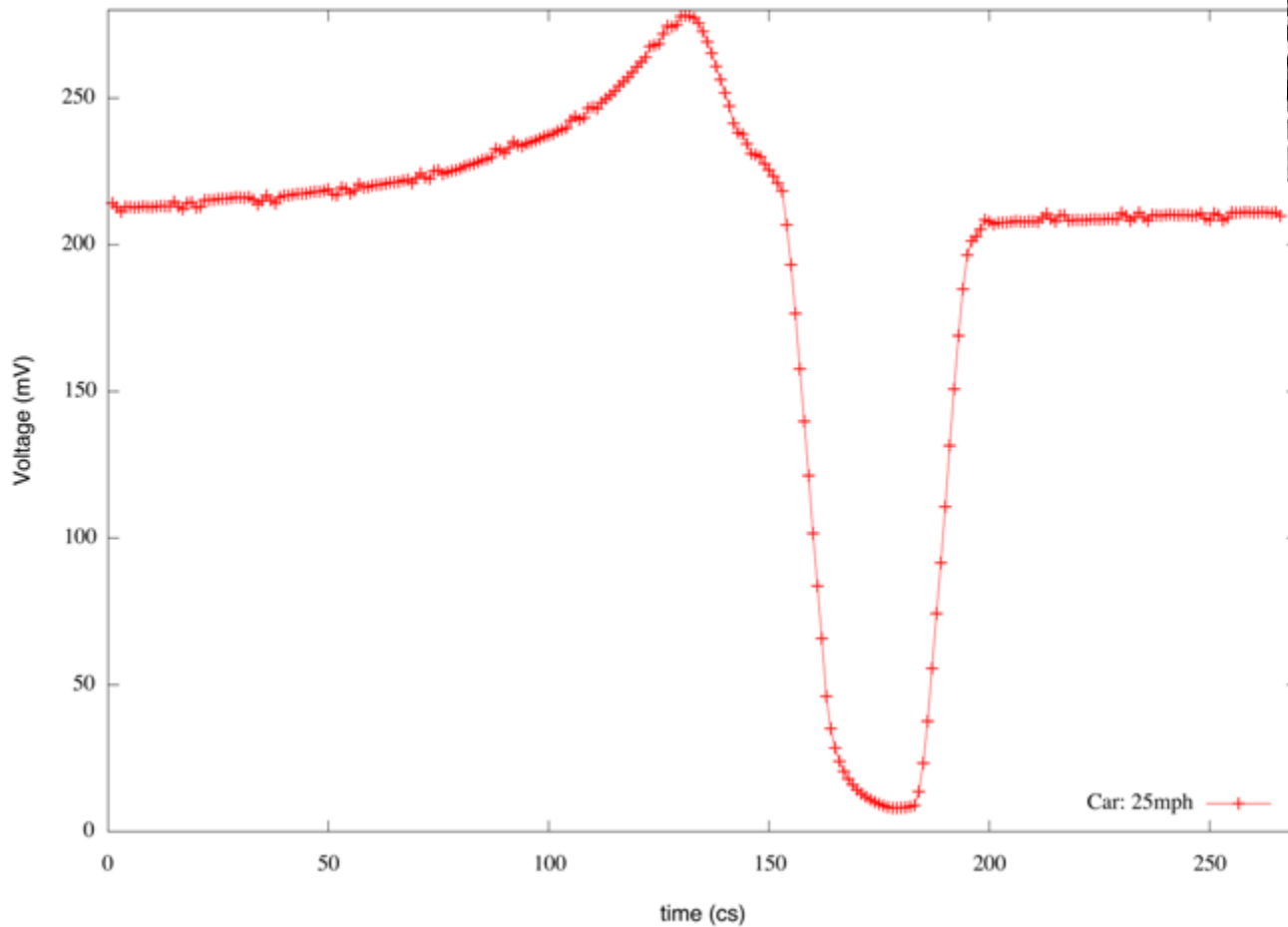
# Fundamental Cases/Issues

- Can passing vehicles be identified using simple light sensor data?
- Is it possible to distinguish between shadows adjacent to vehicles and the darkening associated with being truly under a vehicle?
- Can a full range of ambient lighting conditions be handled, including full sun, overcast skies, and nighttime?
- Can closely spaced vehicles in stop-and-go conditions be distinguished under different conditions of sun angle?

# Adjacent Shadow vs Direct Passover



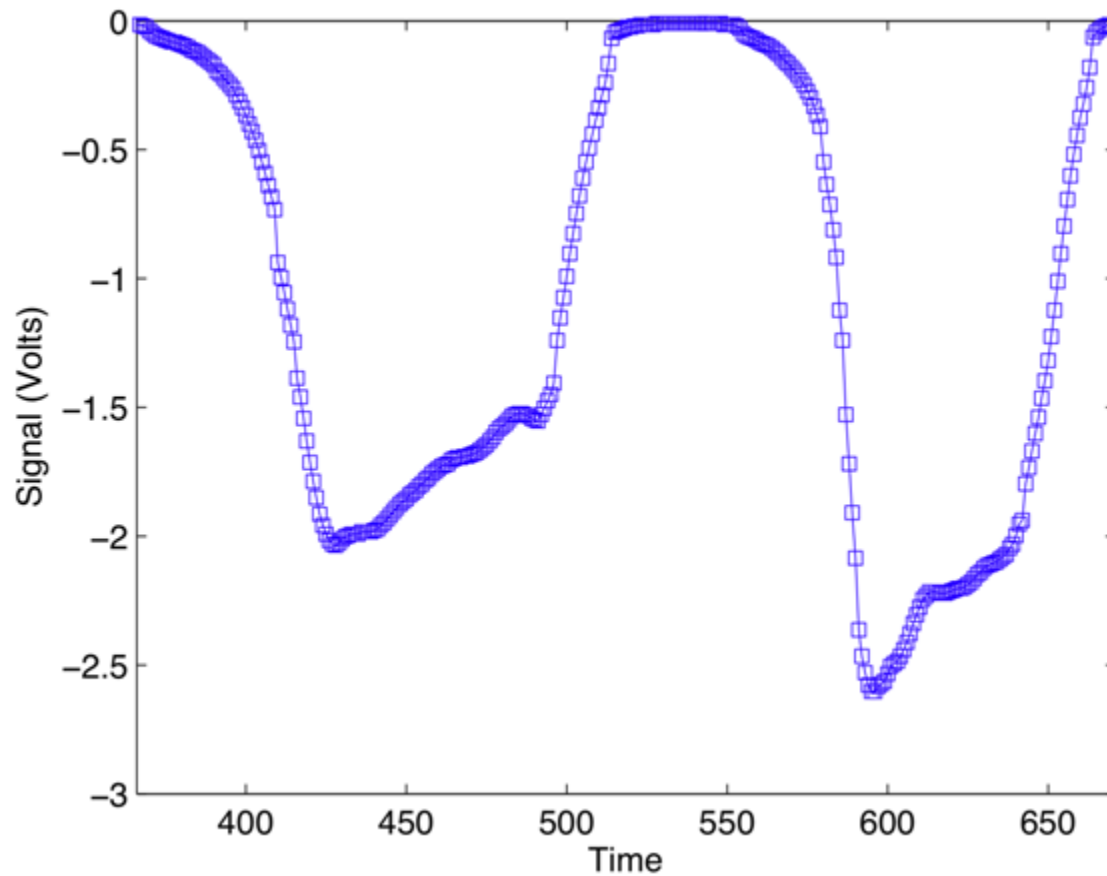
# Night (urban setting: street lights)





# Closely-Spaced Vehicles

(simulating stop-and-go conditions)



# Processing

- Time series event detection algorithms are broadly available
- Process locally or centrally?
- Simple local algorithm developed to successfully identify vehicles for fundamental cases considered to date.

## Conclusions to Date

- Approach is feasible and promising.
- Per-sensor costs can be kept sufficiently low to allow for very high installation density.

## Further Work Required

- Long-term power supply.
- Installation methods/strategies.
- Broader testing in real traffic scenarios.
- Investigate in-box versus out-of-box data processing.

Thank you

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