# Developing a Portable and Reliable Data Collection System for Evaluating Driver Behavior around Law Enforcement

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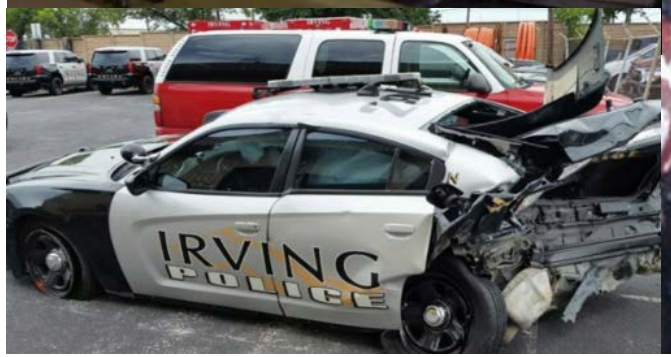
# Problem

- Police officers are injured in vehicle crashes more than any other aspect of their jobs
  - Between 2003 and 2012, 996 police vehicles were involved in fatal crashes in the U.S.
- Visibility treatments added to the police vehicle serve to enhance visibility; however…
  - There are no general guidelines for lighting or painting a police vehicle
  - Most color schemes and lighting configurations are traditional or personal preference

# A Common Occurrence Despite Active Lighting and Retroreflective Markings






# Research Goals

- Evaluate the effects of different lighting configurations
  - Observe changes in traffic speed
  - Observe lane change behavior
- Make recommendations for vehicle lighting based on results
- Other variables existed in the full study
  - Paint color, retroreflection, profile and rear concepts
  - This submission focuses primarily on the lighting aspect of the research

# Design Method

- Create a naturalistic scenario
  - Virginia State Police vehicle was used to simulate routine traffic stop of a confederate vehicle
- Five or Six (depending on location) Radar and Camera systems used to record traffic data
  - Each system was placed on the shoulder of the roadway
  - Typically 1 to 2 meters from white edge line
  - Distance between systems varied by location

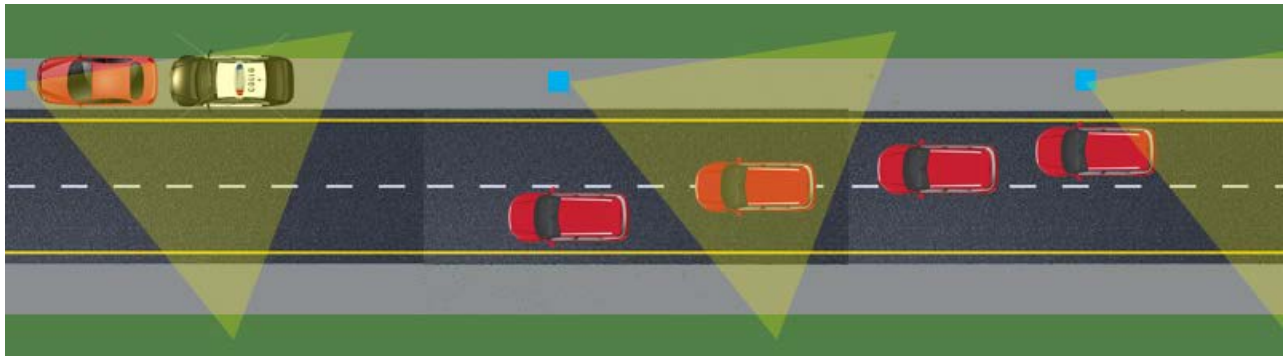
# Hardware Method

- Cameras and radars
  - Mounted 25ft high on telescoping poles
  - Operated via tablet and powered by portable battery
  - Each system was standalone and anchored down with sandbags
- GoPro Camera mounted on plate atop SMS Radar System

# Hardware Method

SMS Radar

- Intended to be mounted to vehicles for collision monitoring
- Utilizes 12 volts for power and communicates via CAN bus
- Communication with radars took place through custom Labview software
- Radars used primarily for speed, not lane position



GoPro Cameras

- Used primarily for determining lane position
- Camera models included Hero 3+ and Hero

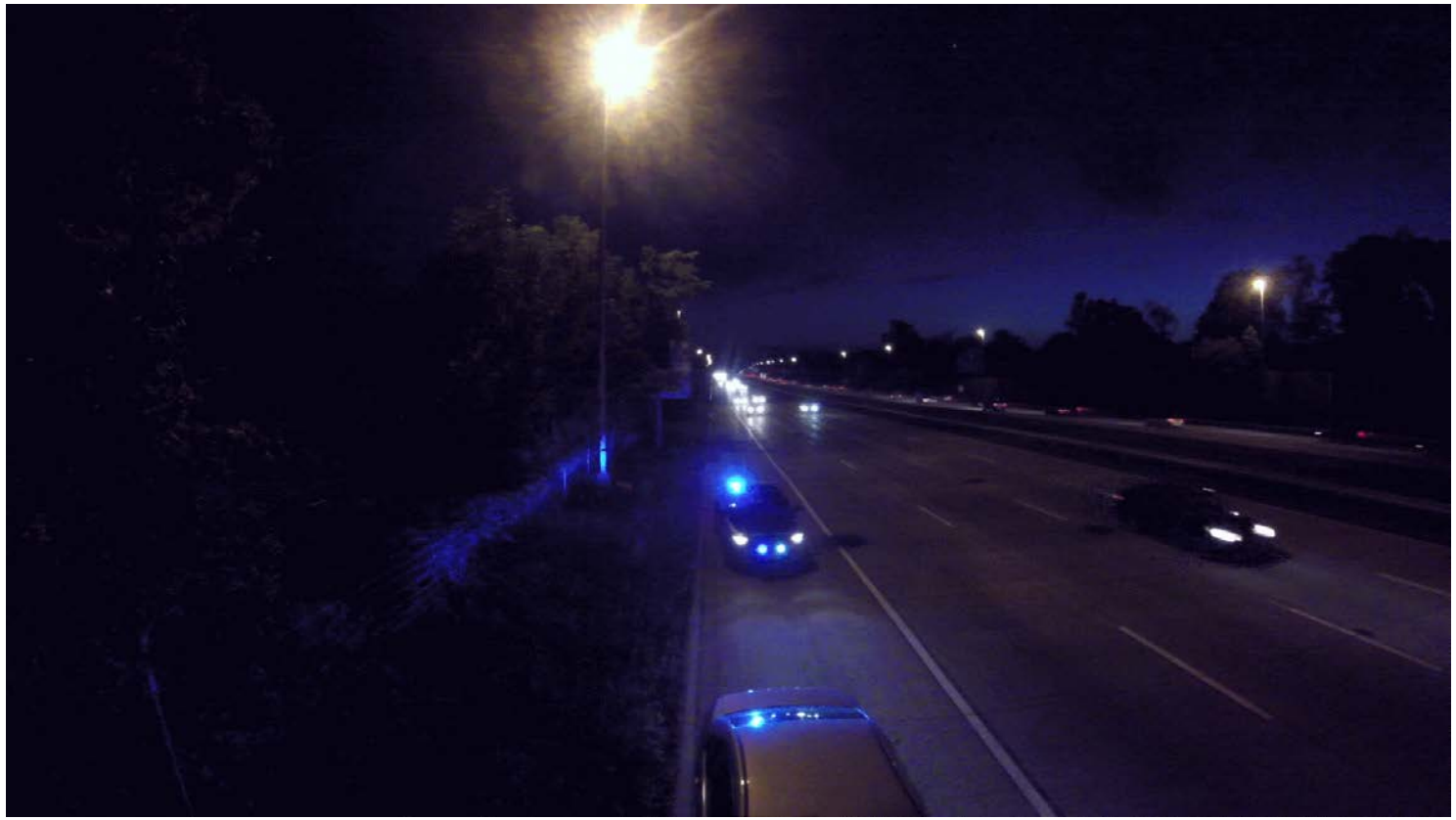
# Setup Method

- VSP provided a buffer for equipment crew on setup and take down to provide safety and visibility
- Setup took approximately 30 minutes and take down approximately 15 minutes
- The data recording sessions lasted between 15 minutes to 75 minutes depending on location
  - 100 vehicles or
  - 15 minutes

# Locations

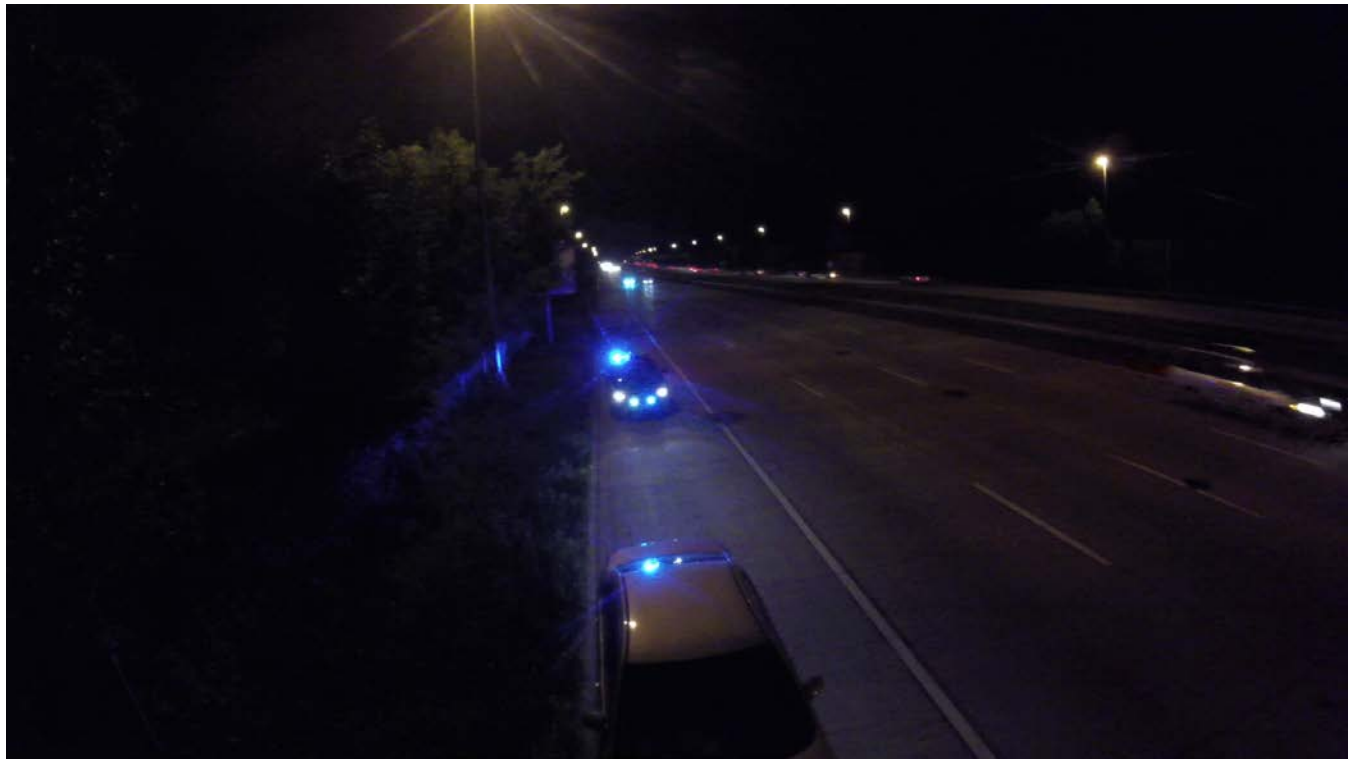
| Roadway | Location | Traffic Density | Lanes | Speed |
|---|---|---|---|---|
| Route 11 | Shawsville, VA | Low – 80/hr | 4 – Divided | 60 MPH |
| 460 | Blacksburg, VA | Medium – 400/hr | 4 – Divided | 65 MPH |
| Prince William Parkway | Manassas, VA | High – 900/hr | 4 – Divided, Stop Controlled | 55 MPH |
| Interstate 81 | Christiansburg, VA | High – 900/hr | 4 – Divided | 70 MPH |
| Interstate 66 | Fairfax, VA | Very High – 4800/hr | 8 – Divided | 55 MPH |

# Baseline



# Baseline + Red

- Added red to standard light bar
- One half red, one half blue



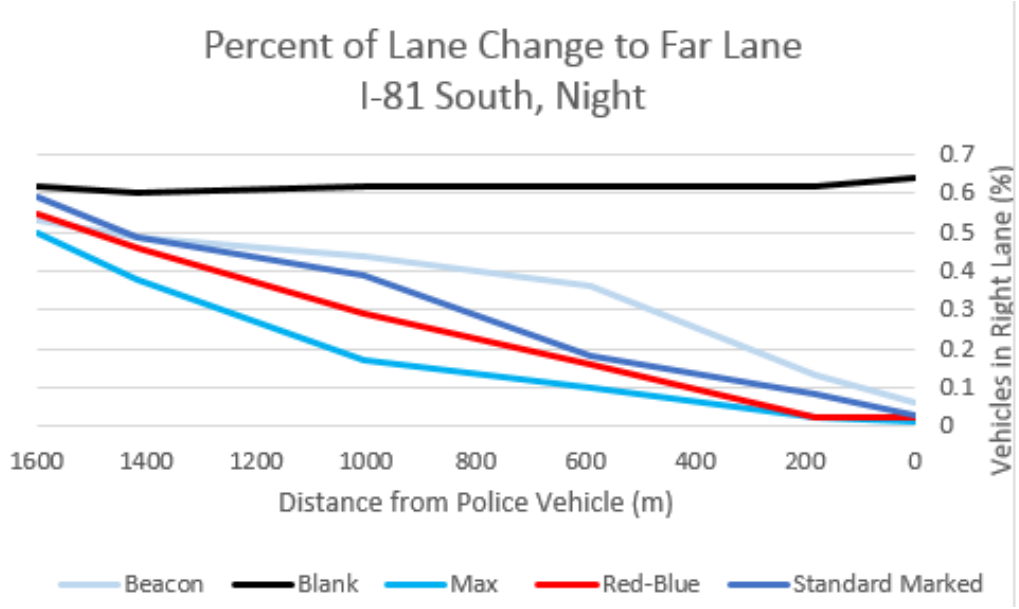
# Max Lighting

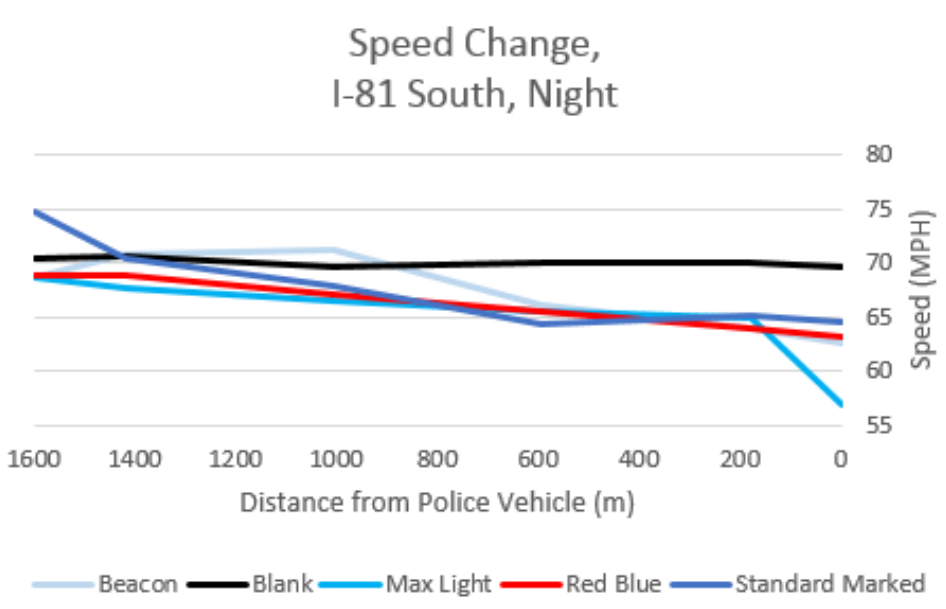
- Additional blue lights to standard light bar
- Lights below side mirrors and to rear license plate
- Light to vehicle sides (near front wheel)

# Minimal Light

- Replace all lighting with single blue “cherry-top” beacon

# Data


Percent of Lane Change to Far Lane
I-81 South, Night
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Vehicles in Right Lane (%)
1600
1400
1200
1000
800
600
400
200
0
Distance from Police Vehicle (m)
Beacon
Blank
Max
Red-Blue
Standard Marked


Speed Change,
I-81 South, Night
80
75
70
65
60
55
Speed (MPH)
1600
1400
1200
1000
800
600
400
200
0
Distance from Police Vehicle (m)
Beacon
Blank
Max Light
Red Blue
Standard Marked

# Early Results

- Addition of red to light bar improved reaction time in day time conditions over all blue light bar
- Max light conditions resulted in early merges and slower speeds
- Lack of response with Beacon indicates intensity is important – lights should not be removed from standard configuration

# Further Testing and Considerations

- Combination of red and blue and max lighting configurations
  - Field Operations Test – Phase 2
  - Deploy 50 to 100 VSP vehicles with new concept configurations and rely on self report data of collision and near misses
- Explore visibility of Troopers/Officers in proximity to vehicle
  - Especially in Max Light conditions (Glare?)
- Explore glare impact of Troopers/Officers in pursuit; i.e. following another actively lighted pursuit vehicle

# Summary

- The naturalistic testing procedure allowed for practical recommendations of lighting configurations
- Portability of systems allowed them to be setup and maneuvered in a number of locations and settings
- Systems operated individually and did not require a network or external power
- Non-Invasive implementation allowed for traffic to pass normally through setup location (with buffer VSP vehicle)
- System deemed a success and project results indicate that safety can be increased based on the findings

# Acknowledgements


- Special Thanks to the local Virginia State Police for their assistance throughout the 18 month Phase 1 of project
- Thanks to Virginia Tech Police and Montgomery County Sherriff's Office for assistance