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TRAFFIC SIGNAL CONTROL WITH CONNECTED AND AUTONOMOUS VEHICLES IN THE TRAFFIC STREAM

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Research Project Overview

- Developing signal control strategies for autonomous, connected, and conventional vehicles
- Funding from NSF ($1.3M) and FDOT ($392K)
- Developing simulation environment (VISSIM)
- Timeframe: 2.5 years completed/ 4 years total
- Planning field testing in Gainesville/UF as part of the I-STREET testbed

Project Team

Elefteriadou, Lily	**PD/PI**
Ranka, Sanjay	**Co-PI**
Crane, Carl	**Co-PI**
Ridgeway, Shannon	**Staff Scientist**
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Martin Gasulla, Maria	Graduate Student/CCE
Letter, Clark	Graduate Student/CCE
Esposito, John	Graduated, MS in MAE
Kim, Mincheul	Graduated, MS in MAE
Kiriazes, Rebecca	Undergraduate Student/CCE
Lucic, Michael	Undergraduate Student/ISE
Bedros, Saad	ISS Staff
Swingen, Cory	ISS Staff
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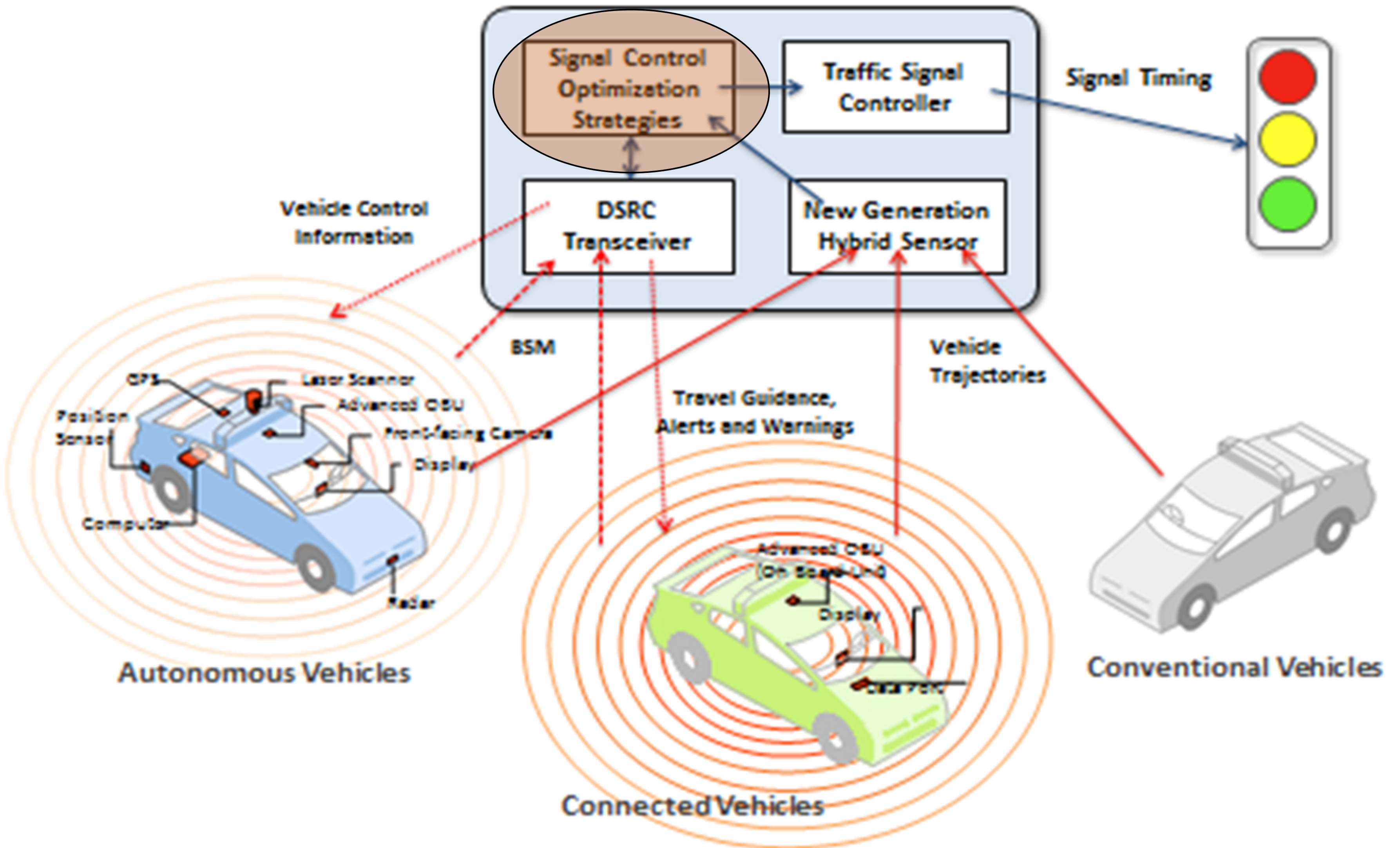
Research Objectives

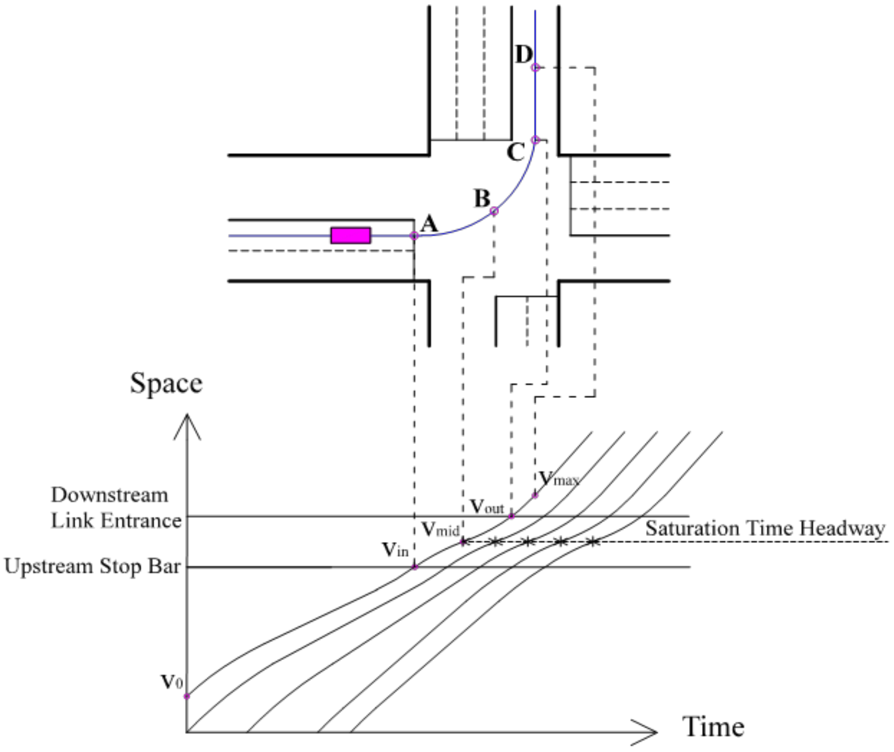
- Develop novel optimization algorithms for AV trajectories and signal control
- Consider Connected Vehicles (CV) and conventional vehicles and their effects on optimal trajectories and control
- Develop simulation environment for testing
- Develop novel sensors and data fusion algorithms to implement our algorithms in mixed traffic
- Implement the algorithm at an intersection in the field

Intelligent Intersection Control System

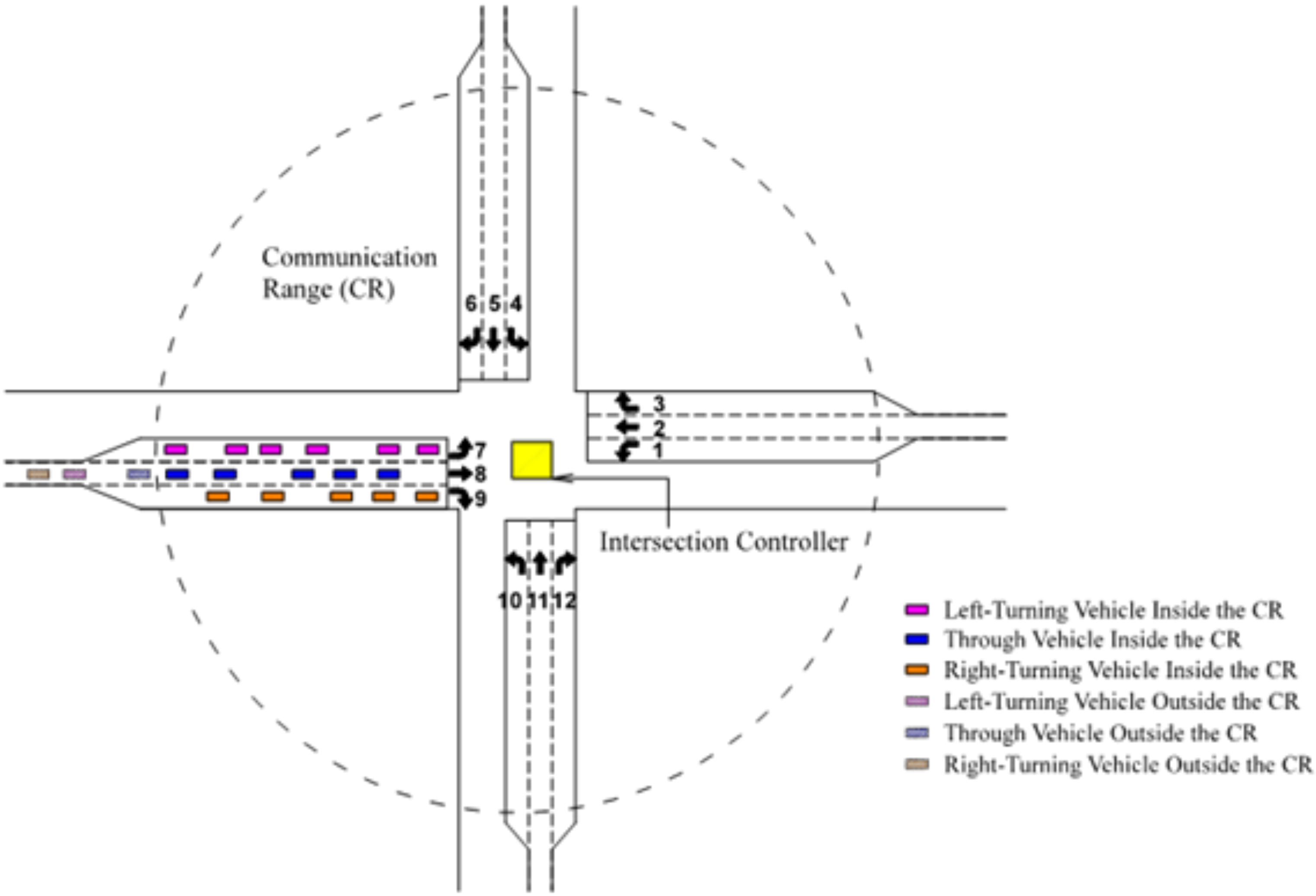


Optimal AV Trajectory Determination

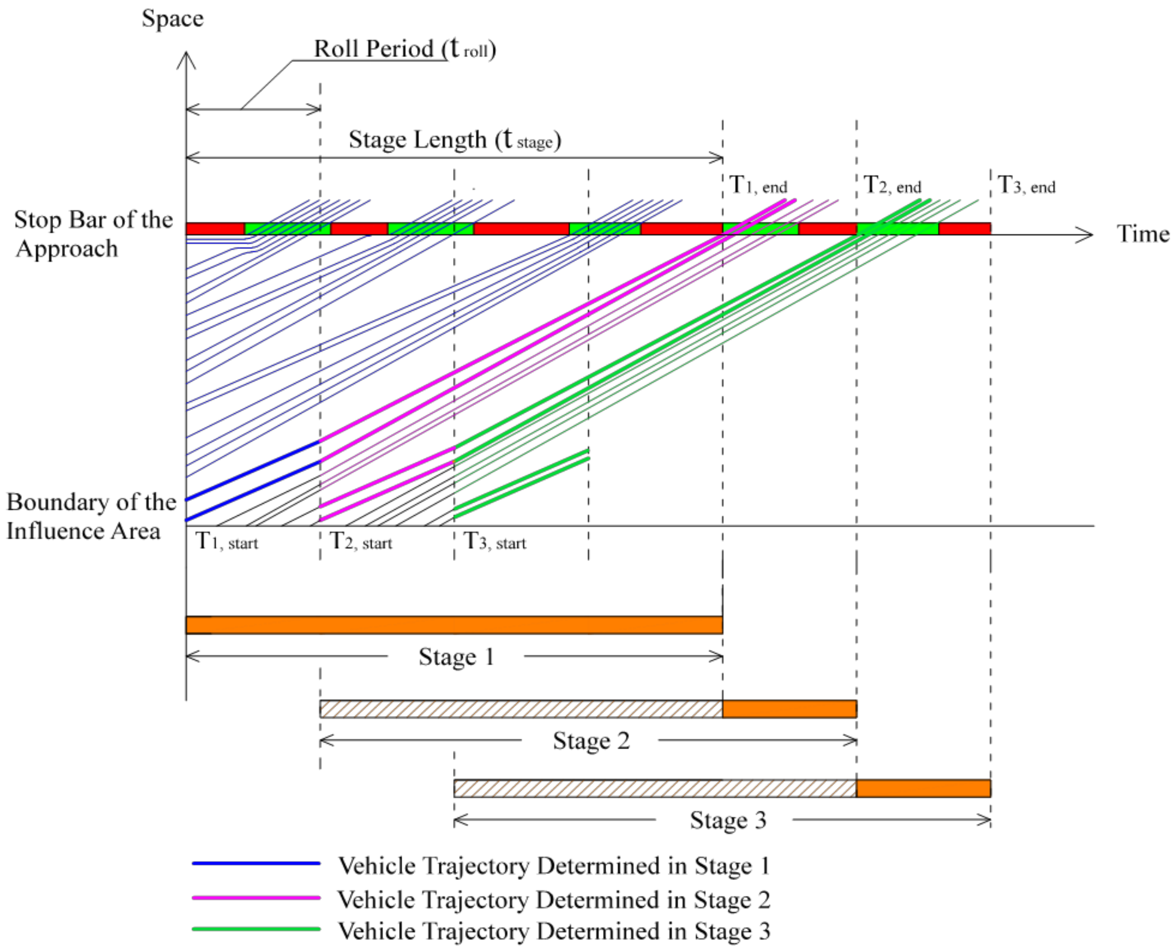
- Optimization determines three/ four component trajectories for AV
- Need to have destination, which affects speed



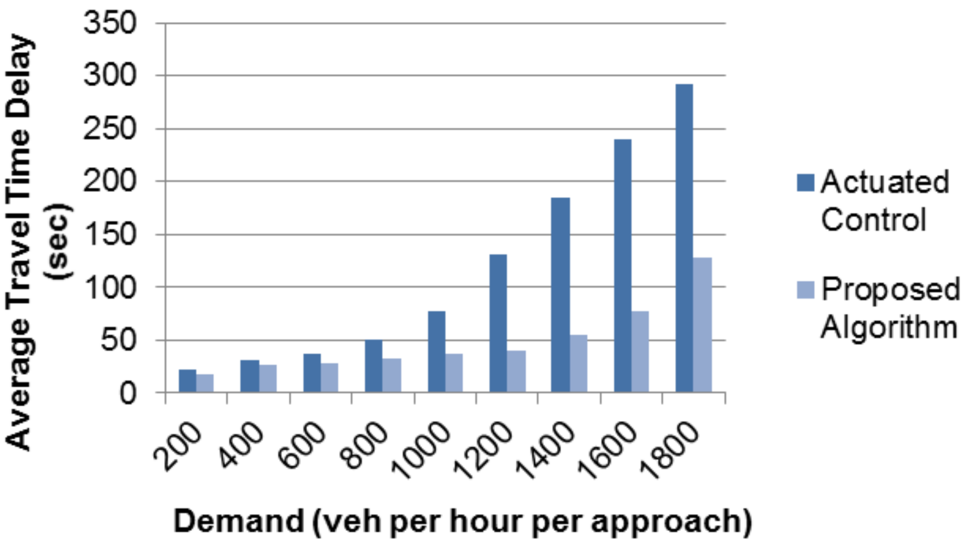
Optimization for AV Only



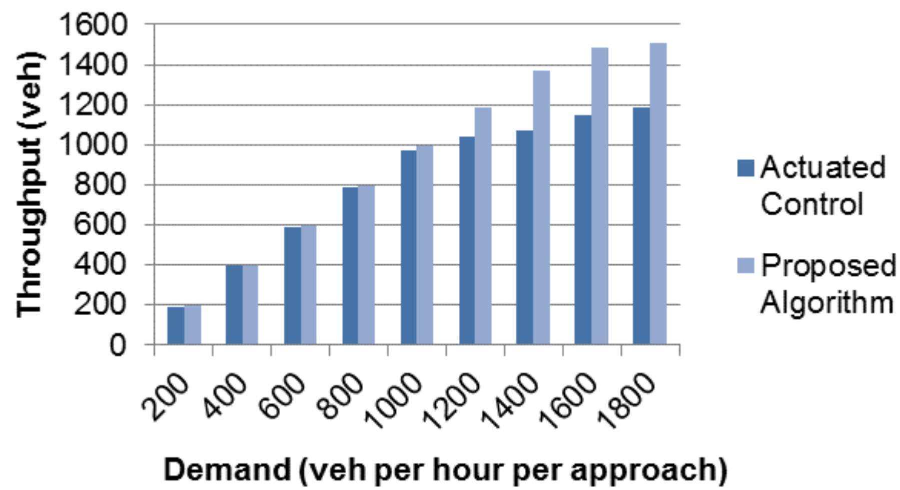
Optimization Horizon Scheme



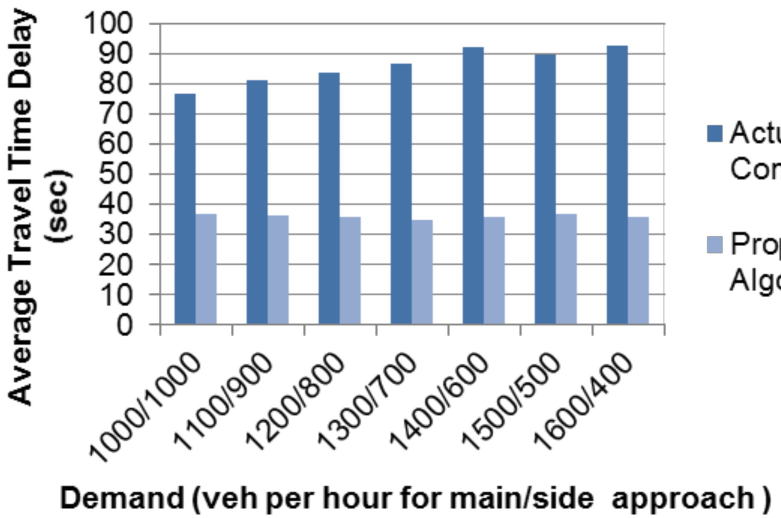
Comparisons – Balanced Demand



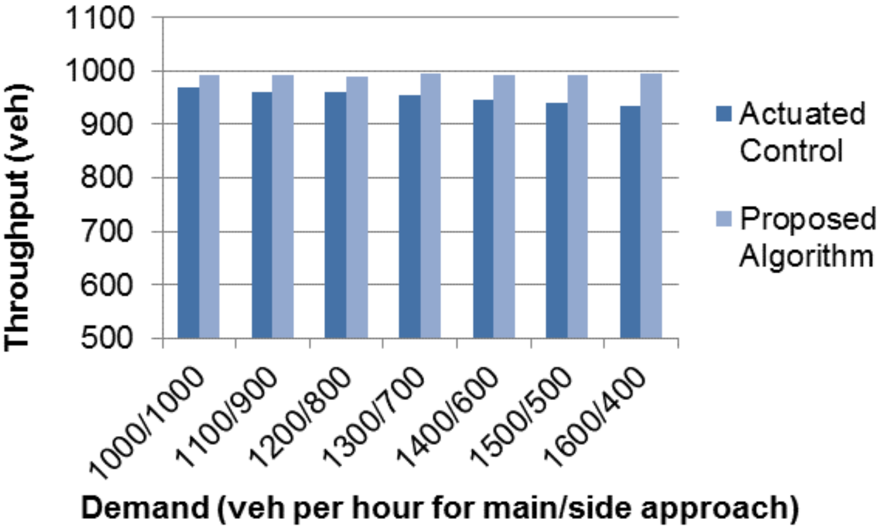
Delay reduced by 16.3% to 79.3% depending on demand: the higher the demand the higher the benefit



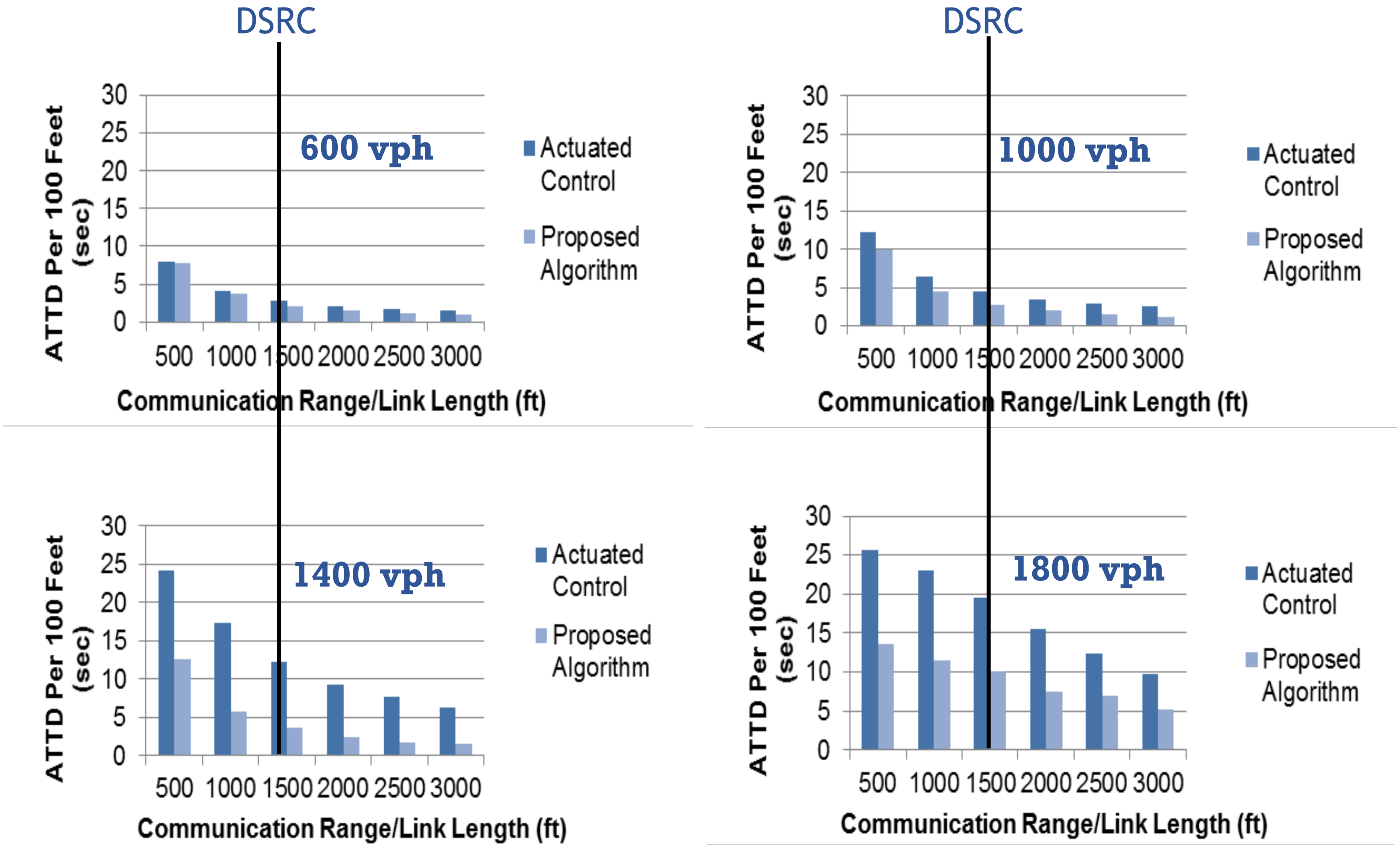
Comparisons – Unbalanced Demand



Varying demands by approach do not affect the performance: total demand is more important

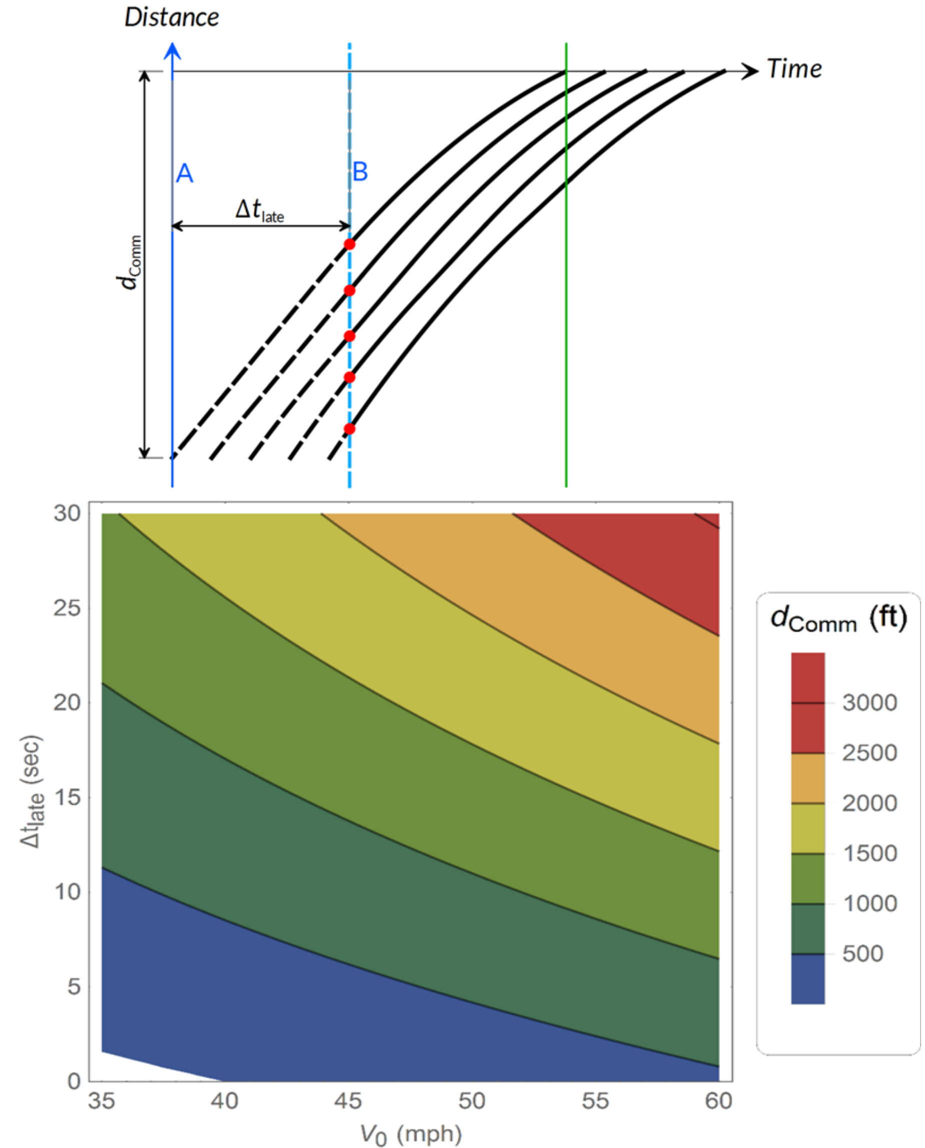


Effects of Communication Range



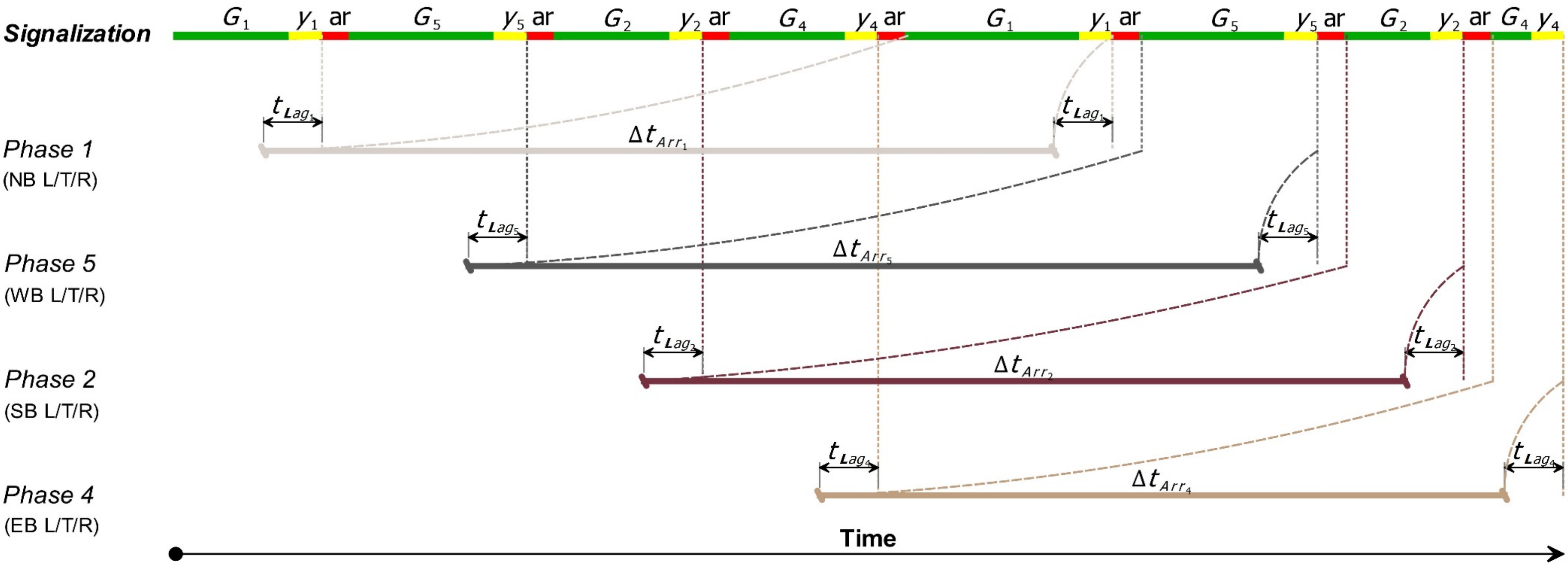
Considerations for Field Implementation

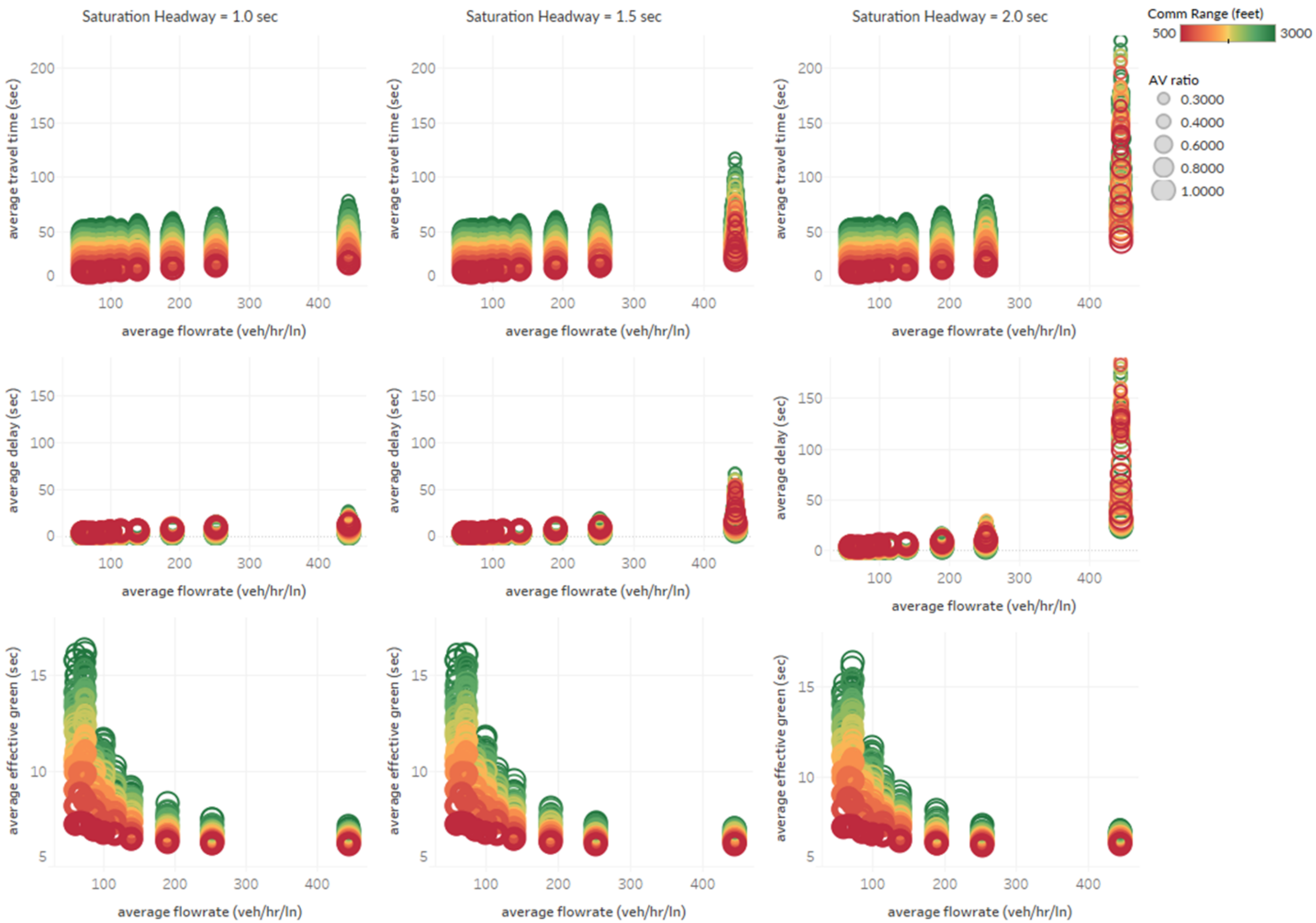
- Optimization interval vs. initial trajectories
- Communication range vs. optimization interval
- Approach speed vs. communication range



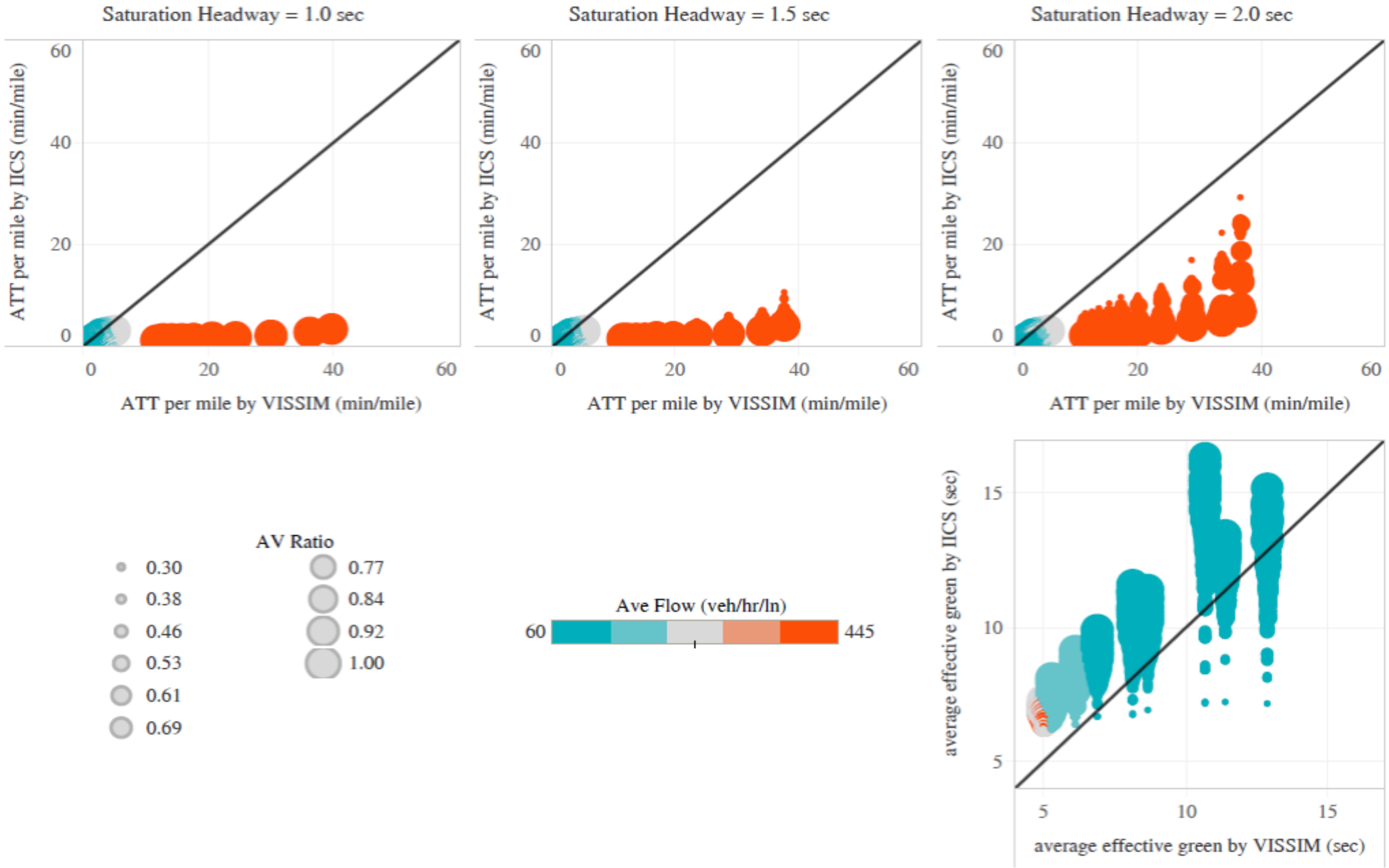
Optimization for Mixed Traffic

- Need to have conventional signalization
- Need to account for conventional vehicle movement
- Assumed Gipps car following for conventional vehicles





- Higher AV % results in lower delays
- Min. saturation headway significantly affects travel time
- Communication range does not significantly affect delay
- Higher flow rates result in lower effective greens, with frequent switching between phases



- IICS is most effective for higher flows and lower saturation headways
- IICS results in higher average effective greens, since it prevents gap outs.

Transition To Practice: Initial Testing

- Initial testing in Gainesville and TERL in Tallahassee
- DSRC communication established – one “suitcase” at UF and three more at FDOT/ TERL
- Completed fusion for radar & DSRC, now adding video

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Next Steps

- Transitioning code to Python to enhance speed and prepare it for field implementation
- Adjustments planned for consideration of pedestrians and bicycles
- Optimization will consider cycle failures
- New optimization will interact with VISSIM
- Developing fusion approach for multiple inputs (radar, video, DSRC) to determine location/speed of conventional vehicles and pedestrians/bicyclists
- Continuing field tests at Gainesville intersection for radar, DSRC, video

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Questions?

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