Analysis of Variables that Affect HOT Speeds on I-85 Express Lanes in Atlanta

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Overview

The purpose of this paper is to analyze the relationship between HOT speed, toll amount, and weaving behavior for vehicles in the I-85 corridor in the primary merge and weaving zones where three major input traffic streams converge. Data from by Peach Pass RFID tag reads from the HOT facility provide detailed information about vehicle movements within and between the HOT and GP lanes. Researchers are able to identify activity in weaving zones as well as entries and exits from the corridor based on these RFID data. The data are also time-stamped, allowing a vehicle's speed to be calculated as it moves from segment to segment. Georgia Tech has developed diagrams that display the frequencies of these movements, speeds, or densities at each point along the length of the Express Lanes. At a higher level, these data provide throughput figures for the various segments of the Express Lanes. Animated graphics, also developed at Georgia Tech, show how the spatial distributions of speeds and volumes change over time. Graphics such as these provide insight into the sections of the corridor that are operating properly or are becoming congested.

The research identifies merge and flow issues that clearly indicate that existing toll rates and caps are not allowing the lane to function properly.

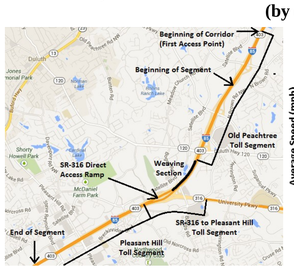
Data Collection

- Peach Pass toll collection system can identify individual vehicles as they travel through the corridor
  - Only for drivers that have Peach Pass RFID tags
  - Data is time-stamped, so speeds between gantries can be calculated
  - Weaving activity can also be determined

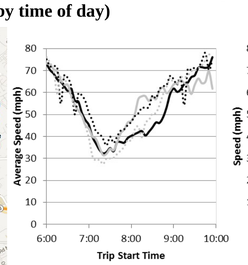
Site Selection

- Northernmost section has the largest negative impact on travel speeds
- Average speeds on the general purpose lanes and on the HOT lane before and after the merge section routinely drop below 45 mph
- Speed drop due to merge bottleneck in the HOT lane.
  - Traffic from I-85 HOT lane, I-85 mainline, and from SR-316 HOT lane
  - Variability in traffic entering from each of the three approaches
  - Tolling is used to manage the demand from each approach

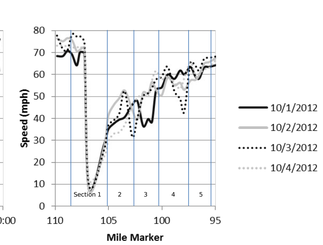
Study Section



HOT Average Speed (by time of day)



HOT speed at 7:30am



Results

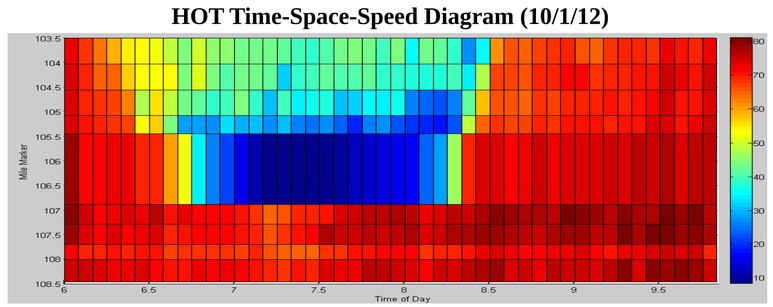
- Linear regression performed
  - Dependent variable : HOT speed
  - Independent variables: GP speed downstream of weaving section, merge bottleneck dummy (1 if HOT speed before merge is less than 30 mph and slower than downstream HOT speed, 0 otherwise).
- If the merge bottleneck is active. HOT speeds are 27 mph slower
- HOT speeds decrease 3.5 mph for every 10 mph drop in GP lane speeds
- Tolling never used as a variable
  - Not set correctly, and does not reflect demand mitigation

HOT Speed Regression Coefficients and Statistics

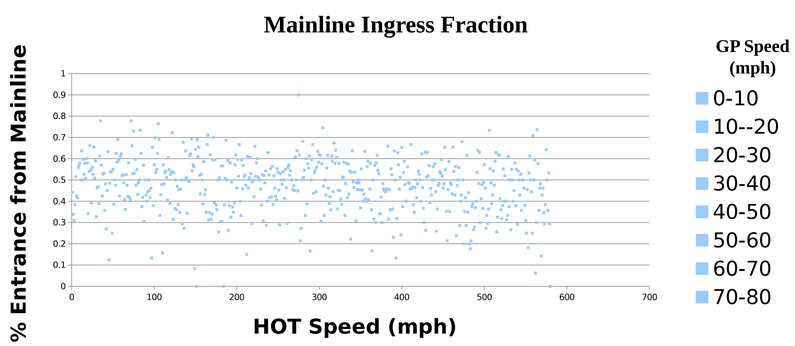
Regression Statistics		Variable	Coeff	Standard Error	t Stat	P-value
Multiple R	0.874	Intercept	48.56	0.677	71.759	0
R2	0.764	Downstream GP speed	0.352	0.0138	25.432	2E-108
Adjusted R2	0.763	Congestion dummy	-26.98	0.760	-35.517	1.5E-174
Standard Error	8.861					
Observations	921					

- Slowly propagating wave starts at end of segment at 6:30am
  - Likely due to decrease in GP speeds (friction factor) and uphill bottleneck
- Speeds drop significantly in the merge section as demand increases
  - Demand comes from I-85 HOT, I-85 mainline, SR-316 HOT
- I-85 HOT and SR-316 HOT drivers do not see slower moving traffic when first entering
- I-85 mainline divers can judge speed of HOT lane before entering
  - A lower faction of drivers in the HOT lane come from the I-85 mainline when HOT speeds fall below 30 miles per hour.
- Other factors: expectation of downstream conditions based on past observation, drivers who know they will receive toll refund for slow speeds.

HOT Time-Space-Speed Diagram (10/1/12)

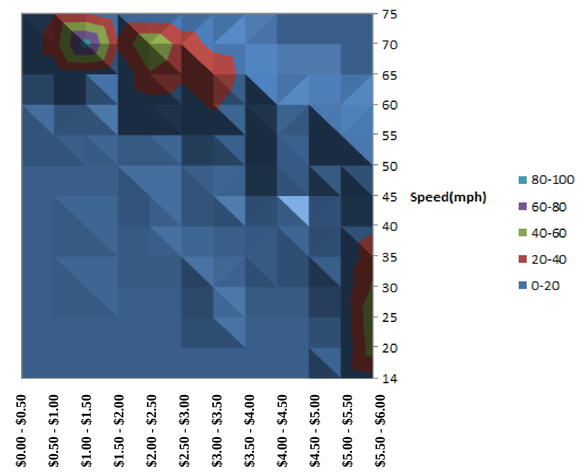


Mainline Ingress Fraction



Tolling Operations Discussion

- Most of the time, HOT speeds remain above 45 mph when the toll is below $3.50.
- SA demand increases and the toll approaches the cap, the lane ultimately breaks down when the toll is too low to ensure that demand does not exceed lane capacity
- Typically, this occurs when the toll is capped at $6.00
- More than three-quarters of five-minute observations of tolls within 10 percent of the cap (greater than $5.40) are paired with HOT speeds below 45 mph.



HOT Full-Length Toll

Future Research

- Lane Retention
  - What percentage of vehicles stay in same lane throughout the corridor?
  - Insight into how much lane changing occurs
- Investigate demand elasticity of express lane
  - Toll cap must be allowed to rise to properly perform this study
  - HOT lane speeds must not break down
  - Toll cap has be raised to $7.50, but congestion in the HOT lane still occurs.

Summary

HOT speeds are highly correlated with general purpose speeds, which is not surprising given that: 1) high speeds in the GP lanes are almost always concurrent with high speeds in the HOT lane, and 2) toll prices are bit being set high enough to prevent HOT flow breakdown, resulting in low GP lane speed being concurrent with failed HOT lane low speed conditions. A full-length toll cap of $6.00 in the month of October 2012 does not create enough impact on demand to use the HOT lane.

More specifically, demand from the I-85 mainline, I-85 HOT and SR-316 HOT will have to be managed separately as not to go beyond the capacity of the merge bottleneck