



Advanced Traffic Visualization and Mining System (ATVMS)

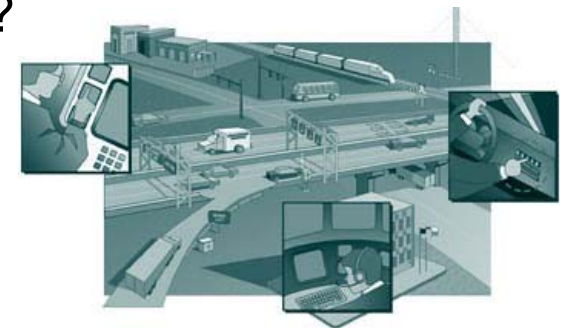
Spatial Data Management Lab

Presented by Arnold P. Boedihardjo

Motivation

- Transportation Manager
 - How is the freeway **performing** today? Yesterday?
 - Which locations are worst performers?
- Traffic Engineer
 - Where are the **congestions** (in time and space)?
 - Which of these recurrent congestion?
 - Which loop detection are not working properly?
- Traveler, Commuter
 - What is the **travel time** on a route?
 - Will I make to destination in time for a meeting?
 - Where are the incidents and events?

Real-Time Analysis



ATVMS: At a Glance

- Tool for **real-time** monitoring and analysis
 - HOV/non-HOV traffic visualization
 - Traffic behavior prediction
 - Traffic comparison
 - Travel time estimation
 - Automatic incident detection
 - Detector status monitoring
- High performance
 - Quick response time: 3 seconds/query
- Web-based user interface



Main Web Interface

Project DEMO

- T_(Time)
 - 1. Traffic Only (Expected Response Time: 3 Sec)
 - 2. Current Traffic and Prediction
- 3. T_(Date)
- 4. S_(Highway) I-66 I-95
- 5. S_(Highway) - T_(Time) I-66 I-95
- S_(Highway) - T_(Day of Week)
 - 6. Series: I-66 I-95
- 7. XY Plot: I-66 I-95
- T_(Time) - T_(Day of Week)
 - 8. Series
 - 9. XY Plot
- 10. Malfuncting Detectors

3,078 Visitors
Since October 27, 2004

TimePlot - Traffic and Trend at a Specific Station during Selected Days (e.g. day, week, month)

Station (91) - EB at Milepost 51.2 between 52(Rt 29) and 47(Rt 234)

stationid: 91 - 51.200 : EB between 47 (Rt 234) and 52 (Rt 29)

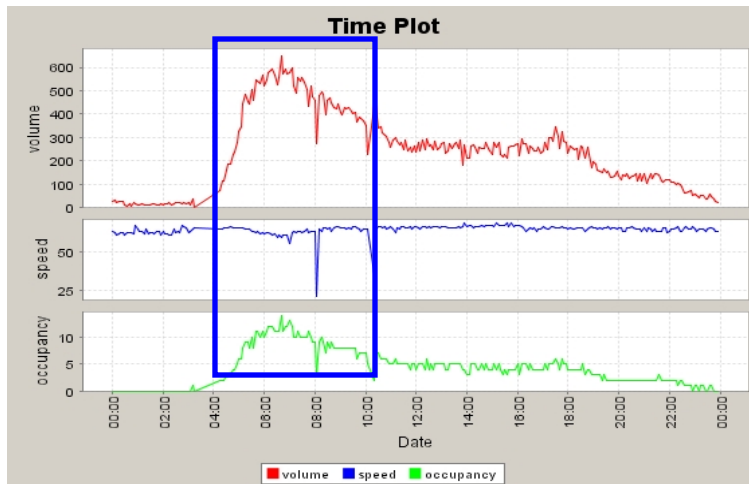
startdate: 03/13/2006

enddate: 03/19/2006

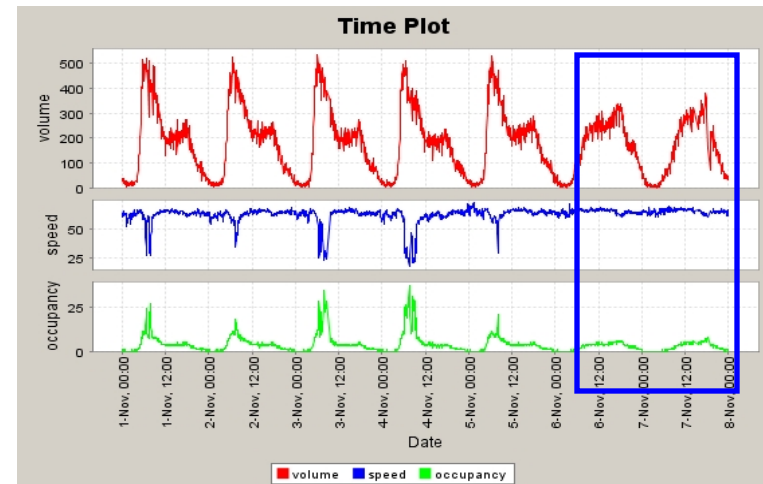
[Click Here to See Query Result](#)

Time Plots

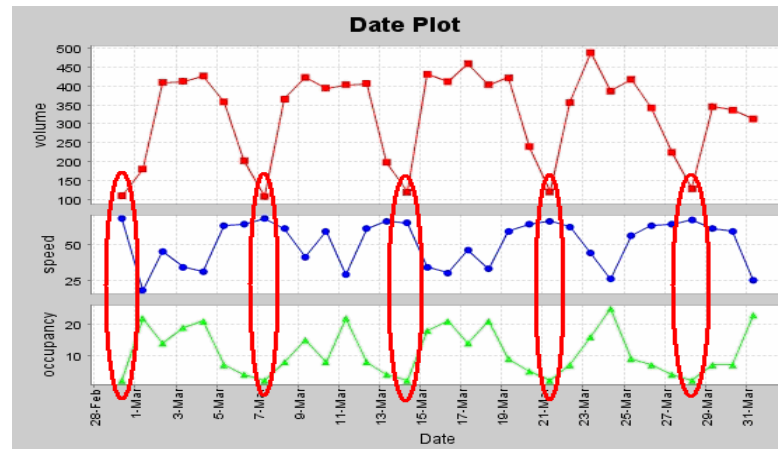
I-66 EB Station 121



Daily Pattern



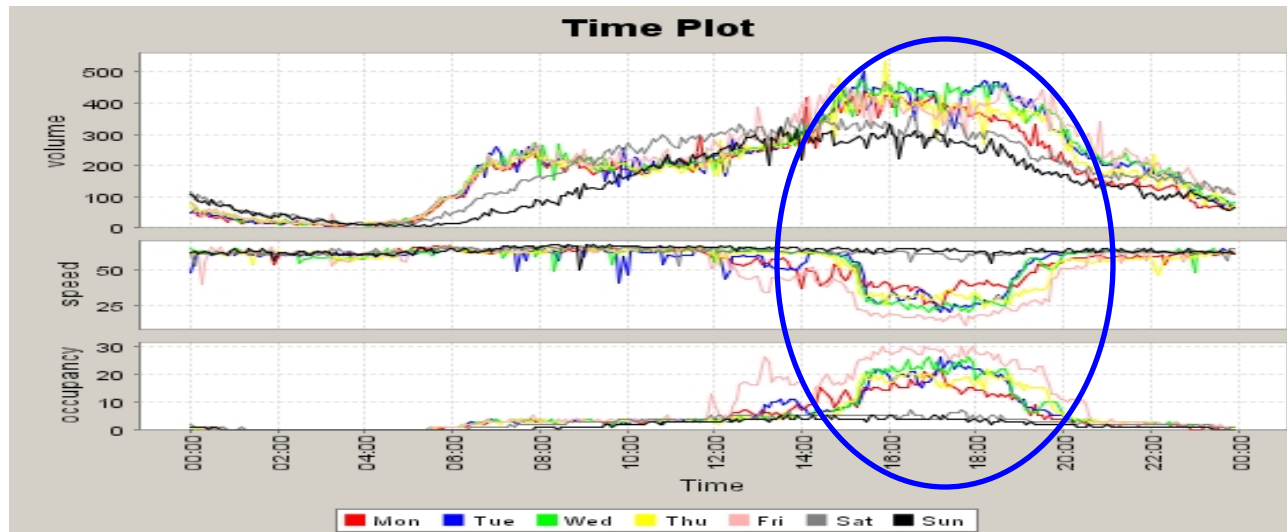
Weekly Pattern



Monthly Pattern at 8:30 AM

Time Plots

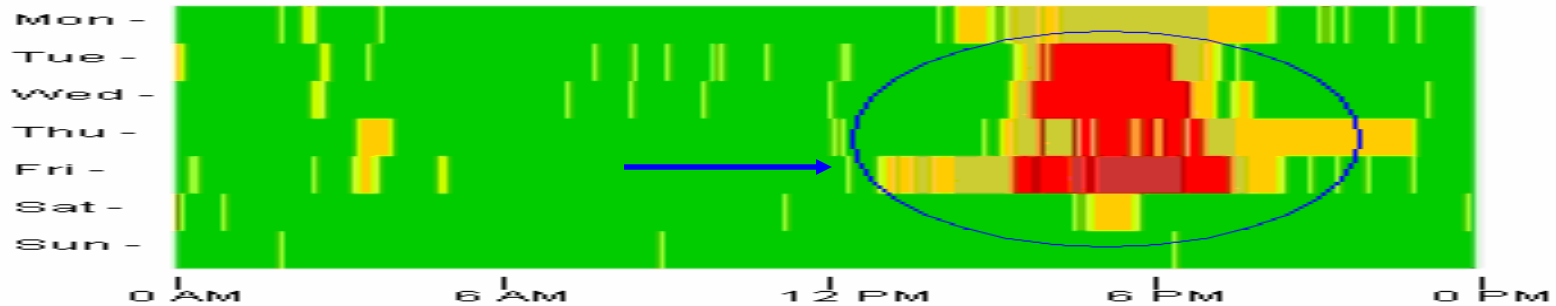
I-66 WB Station 52



Composite View

DayOfWeek -

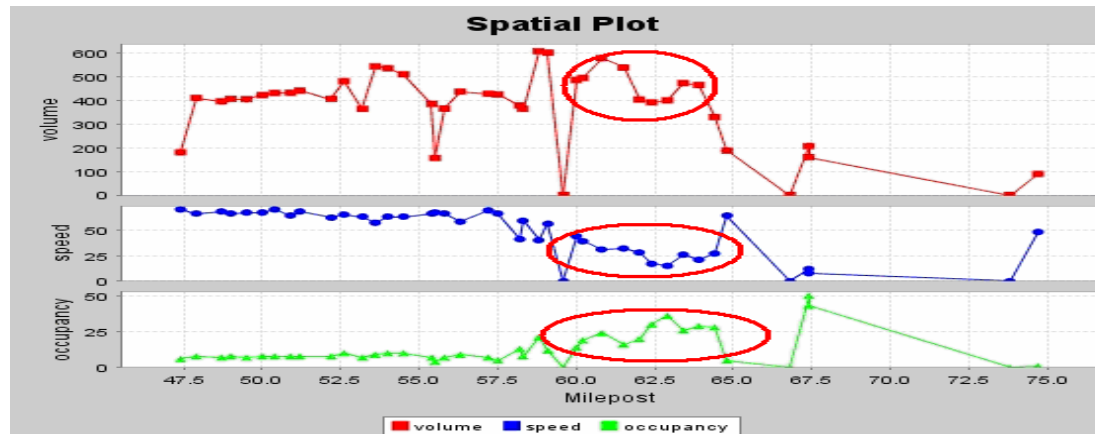
Time/Weekday Plot - Speed



Color-valued Plot

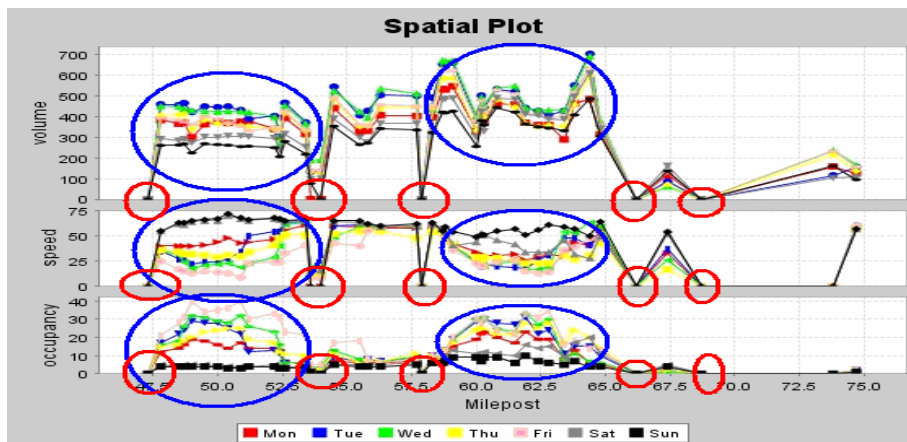
Spatial Plots

I-66 All stations

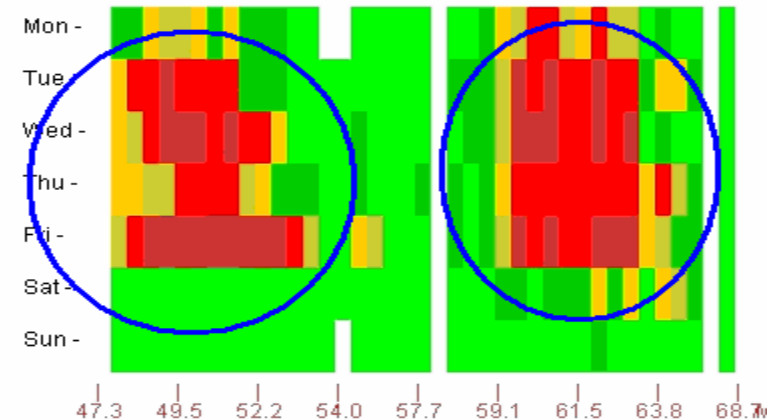


Single Day View (EB 8:30AM)

ayOfWeek - **Spatial/Weekday Plot - Occupancy**



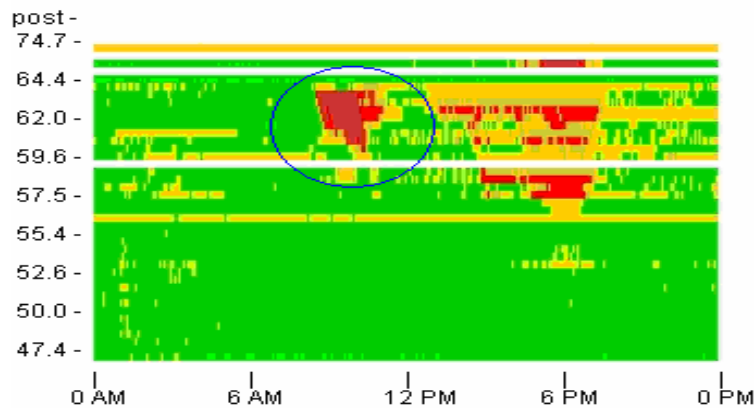
Composite Views (WB 6PM)



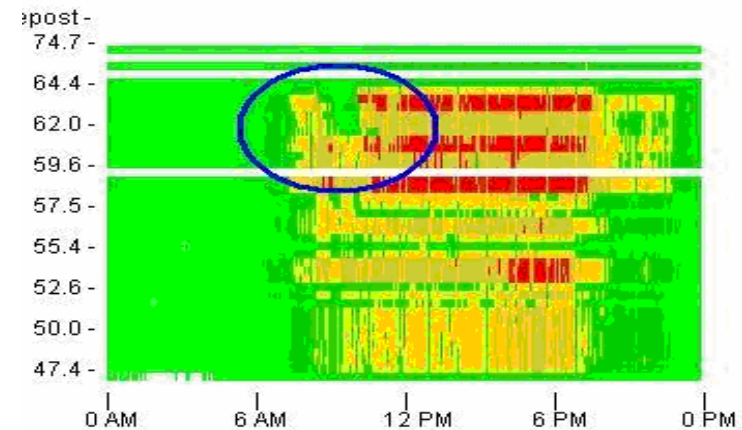
Spatiotemporal Plots

I-66 All stations in a given day

Spatial/Time Plot - Speed

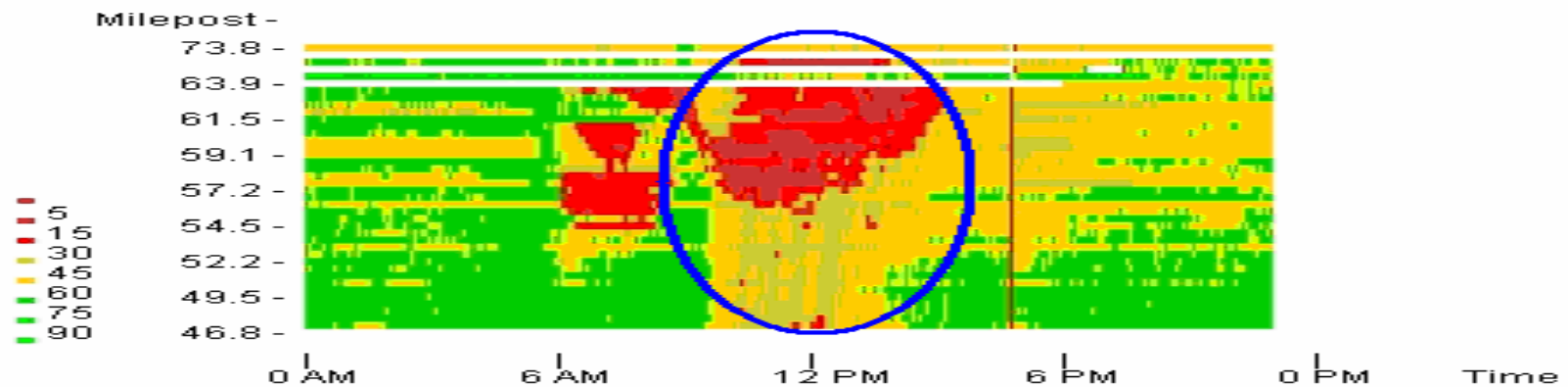


Spatial/Time Plot - Volume



I-66 Saturday Accident

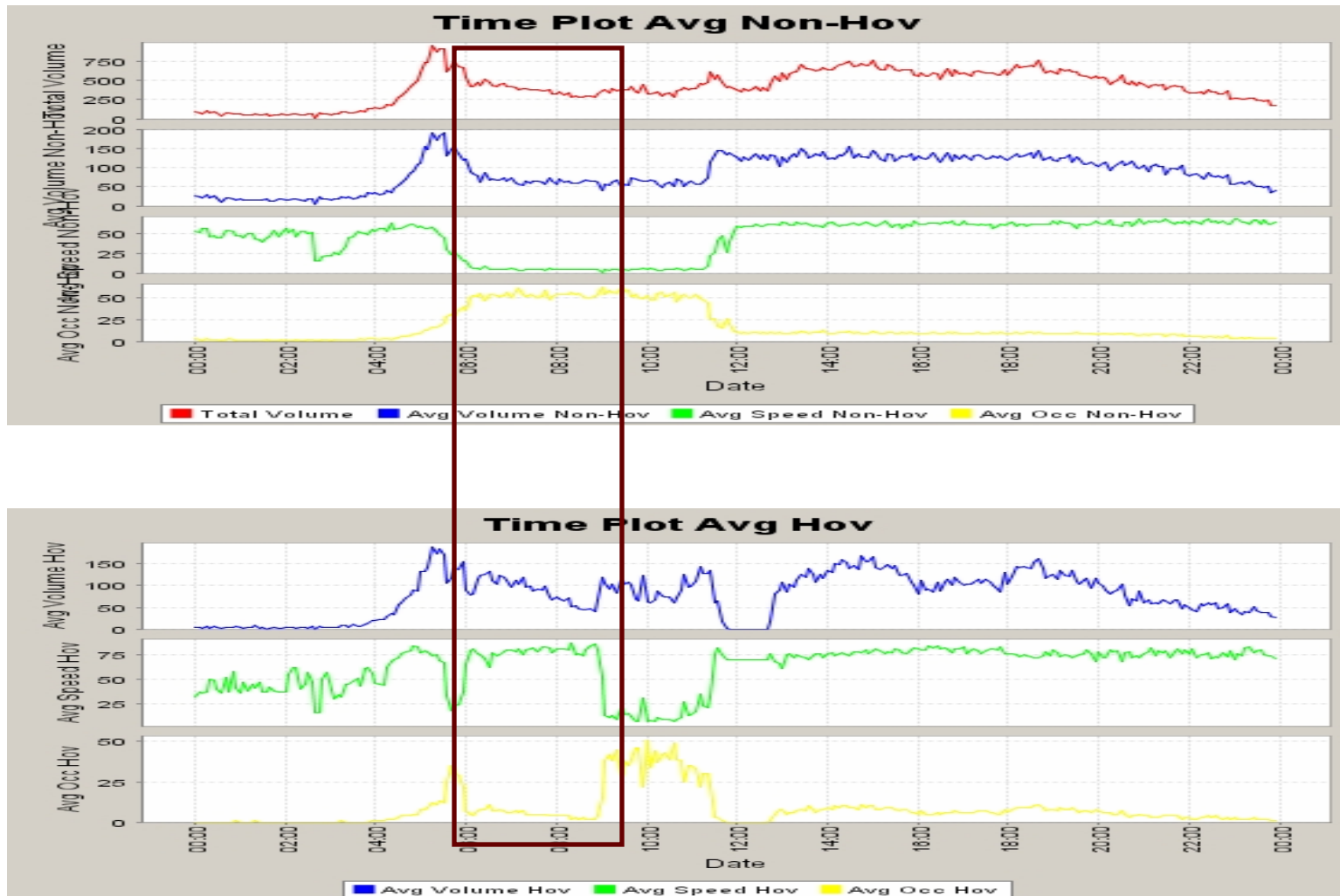
Spatial/Time Plot - Speed



I-66 Severe Inclement Weather

HOV vs. Non-HOV Lanes Time Plots

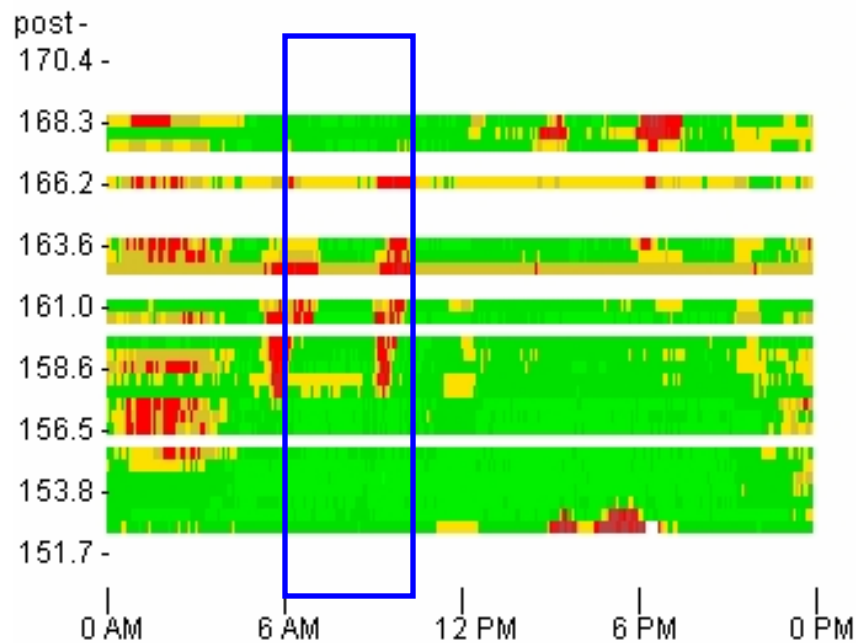
I-95 NB



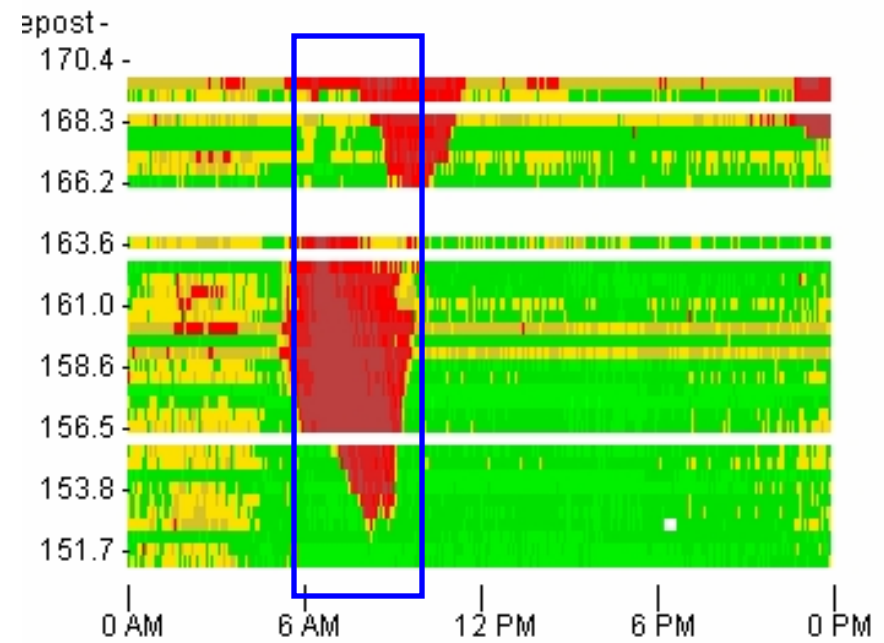
Spatiotemporal HOV Monitoring

Weekday, I-95 NB, Traffic Flow (All Stations)

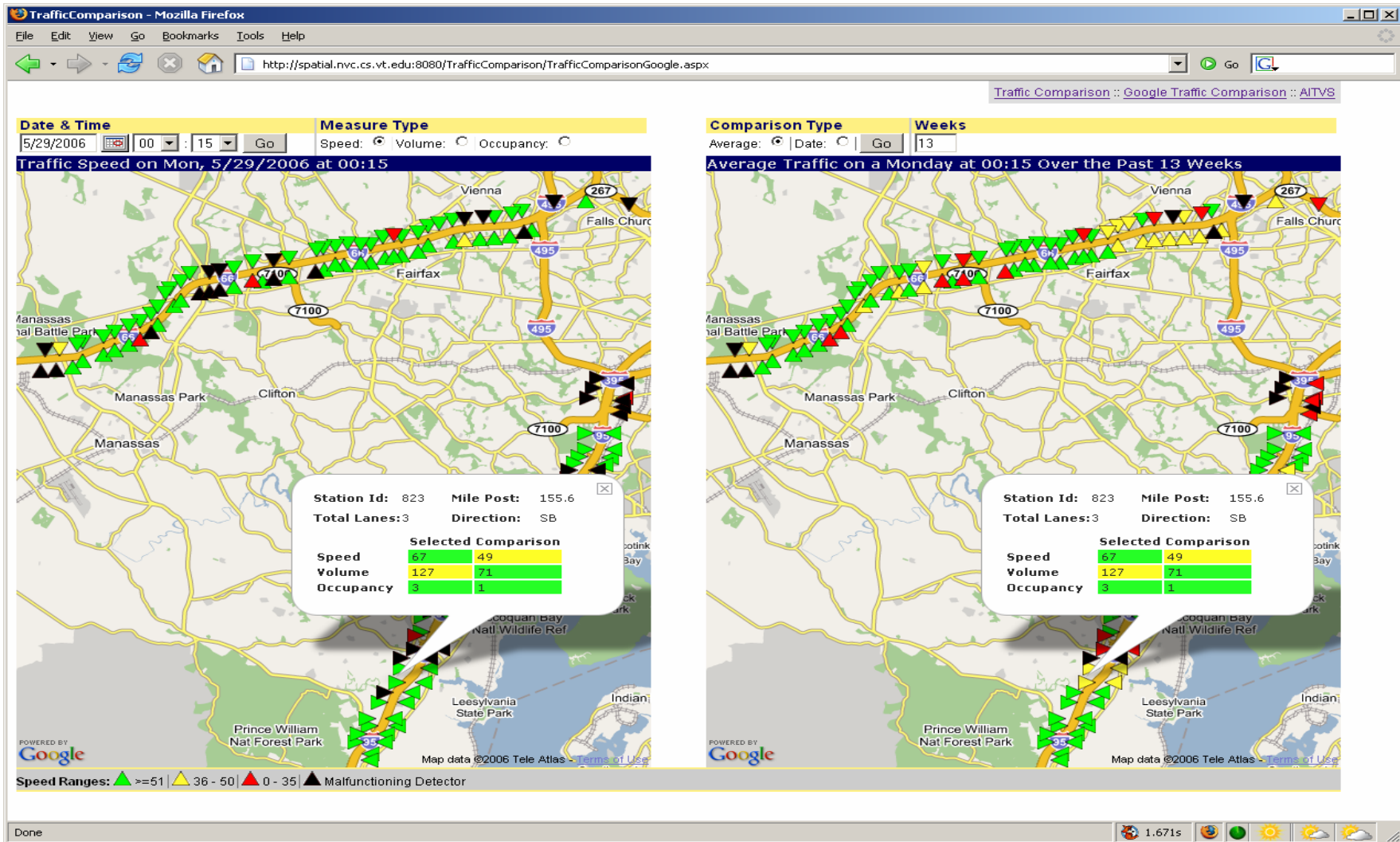
Spatial/Time Plot - Avg Speed Hov



Spatial/Time Plot - Avg Speed Non-Hov



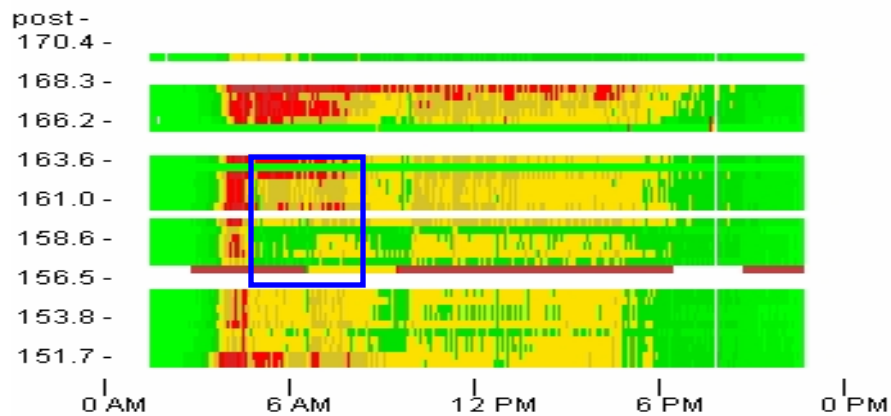
Traffic Comparison and Detector Monitoring



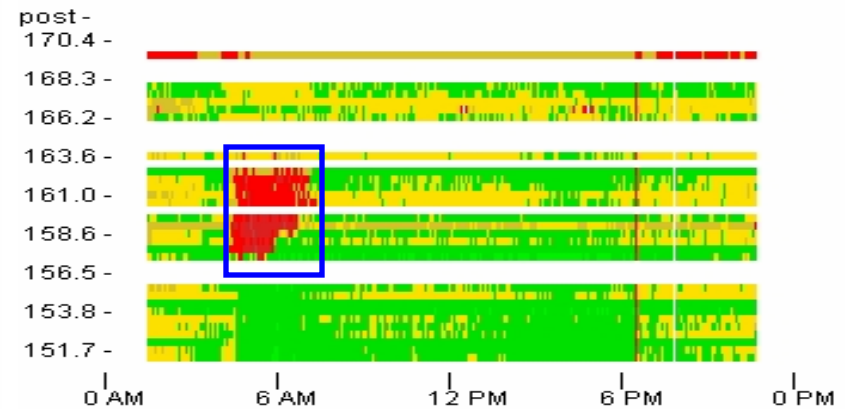
Case Study: #3 Ranked Congestion

Weekday, I-95 NB, Dale Blvd and Prince William Pkwy (Milepost 157-161), 5-7AM

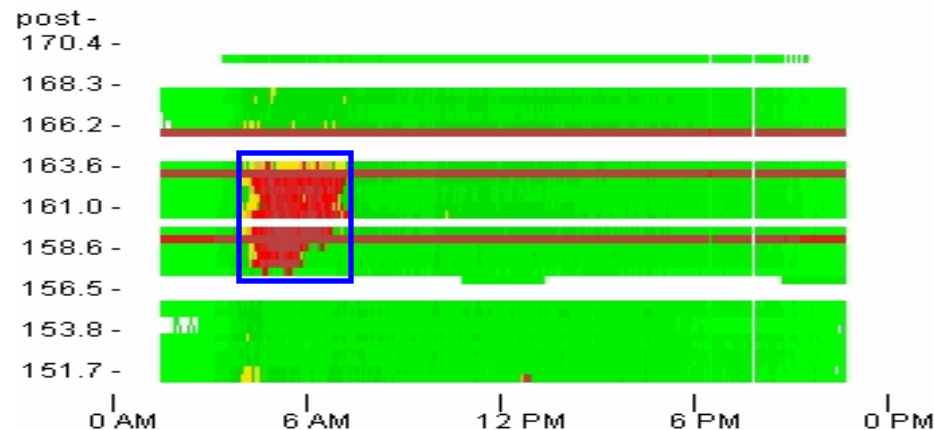
Spatial/Time Plot - Volume



Spatial/Time Plot - Speed



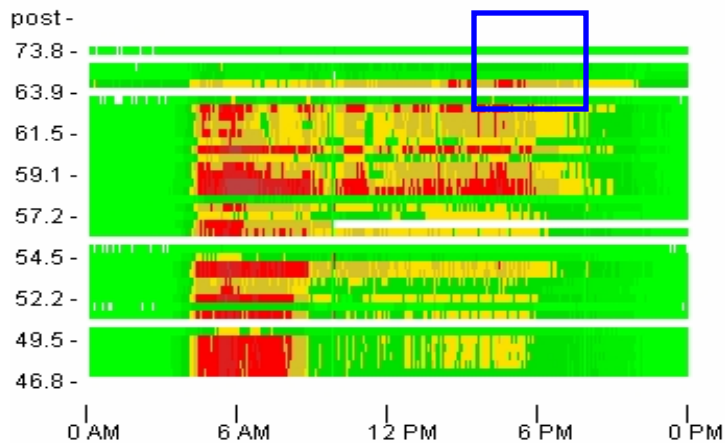
Spatial/Time Plot - Occupancy



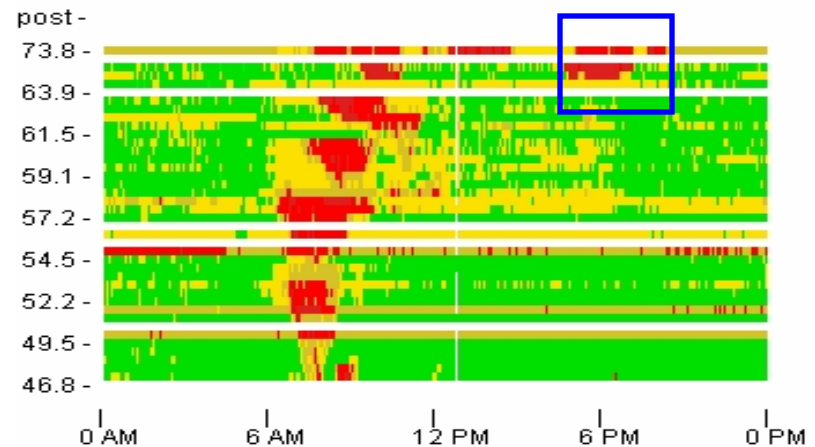
Case Study: #7 Ranked Congestion

Weekday, I-66 EB, between dulles toll and westmoreland st (milepost 64.8-68.7), 5-7PM

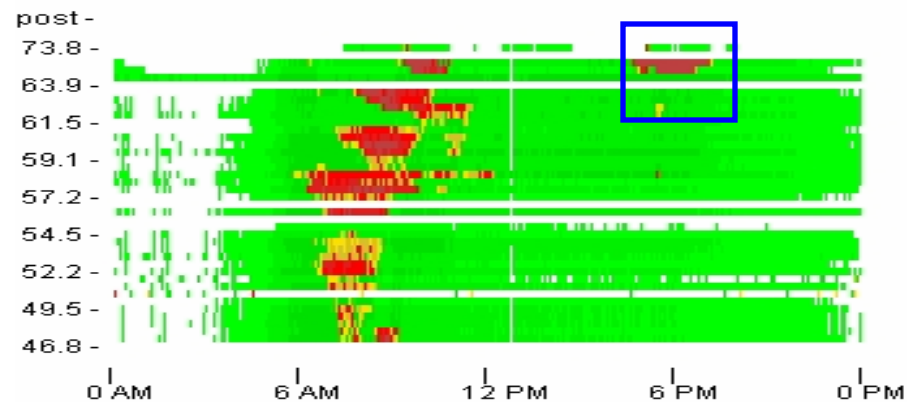
Spatial/Time Plot - Volume



Spatial/Time Plot - Speed



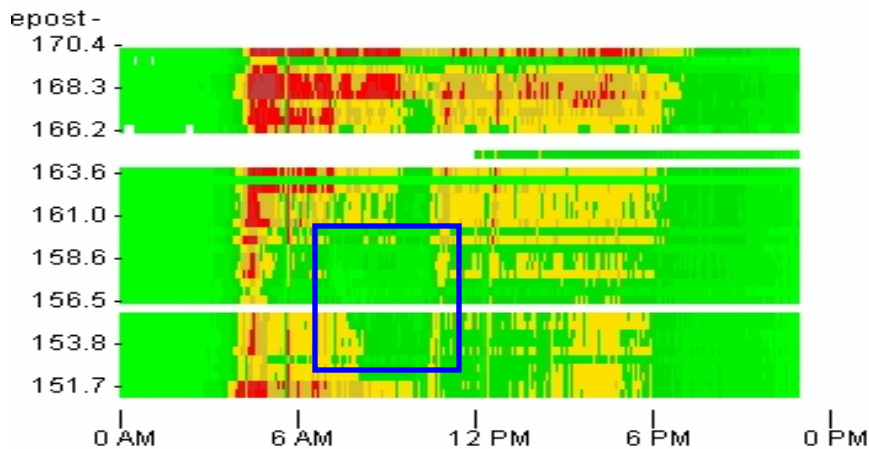
Spatial/Time Plot - Occupancy



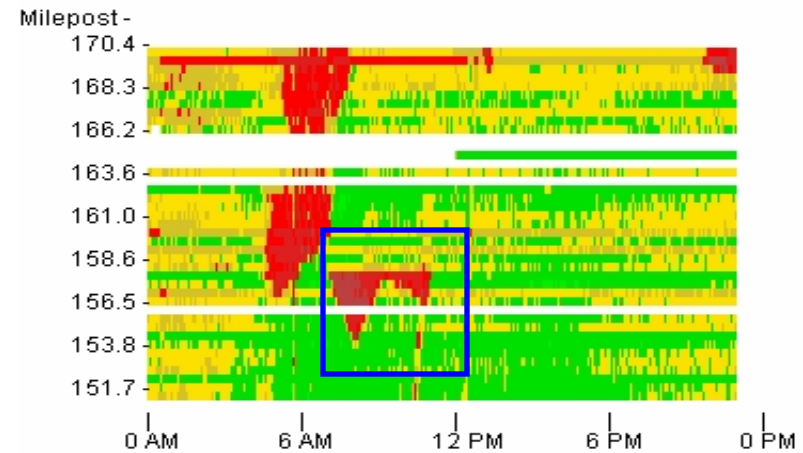
Case Study: Highway Closure

2/8 (Wed), 2006 I-95 NB, Traffic Flow (All Stations), Incident 8-10AM:10-12PM, MP 153.8-157

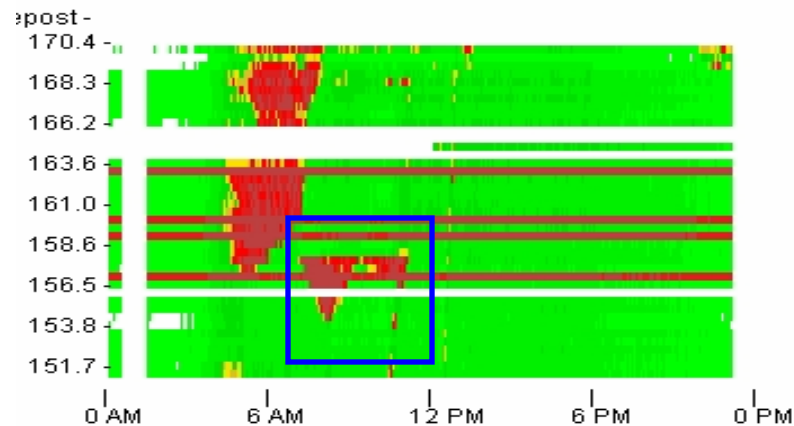
Spatial/Time Plot - Volume



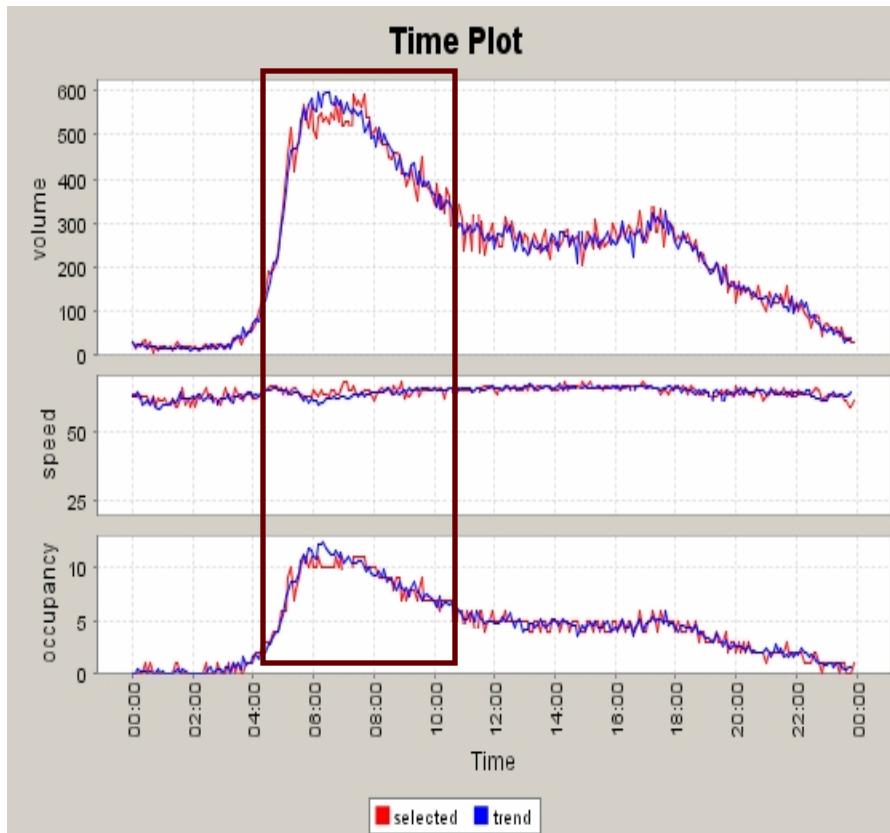
Spatial/Time Plot - Speed



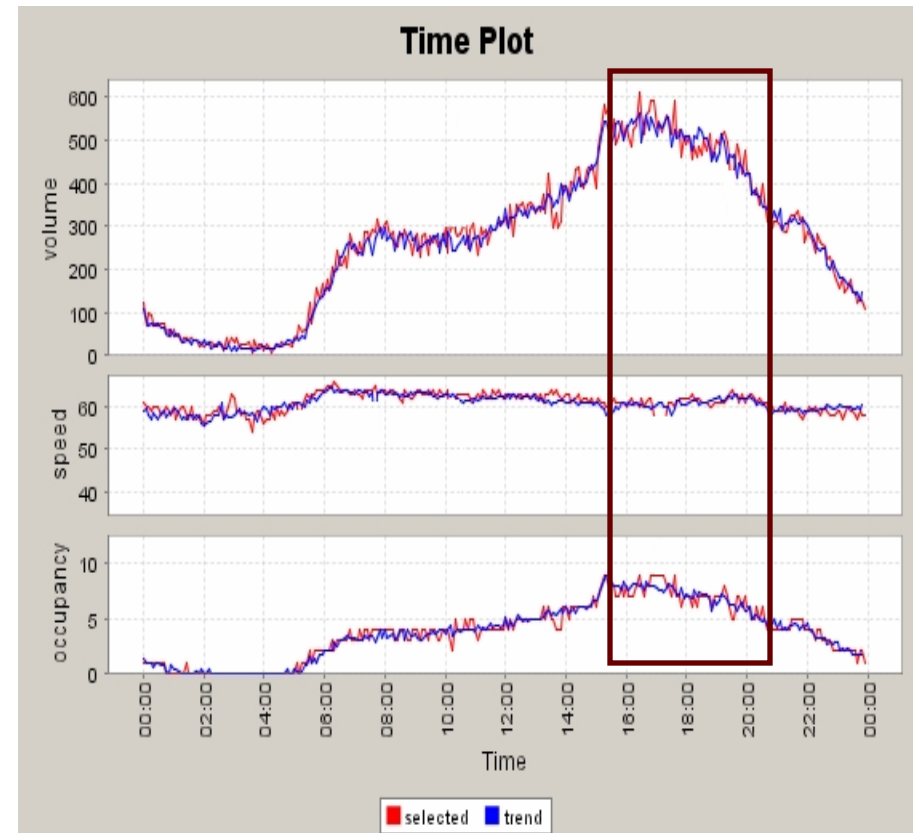
Spatial/Time Plot - Occupancy



Traffic Prediction



I-66 East bound traffic



I-66 West bound traffic

Travel Time Estimation

AITVS Driving Directions - Mozilla Firefox

http://spatial.nvc.cs.vt.edu:8080/AITVSDirections/index.aspx

VirginiaTech
Invent the Future

AITVS Driving Directions

Powered by: Google Maps | ArcGIS Web Services | Virginia DOT

Welcome to the AITVS Driving Directions Website! This site is a result of Independent Study project by Arseny Bogomolov at the Computer Science department at Virginia Tech University. This service provides driving directions and travel time estimations for any route within the United States. Routes that traverse the Washington, DC metro area highways are enhanced with data provided by the Virginia Department of Transportation. Specifically, historic and current traffic conditions are used to improve travel time estimations and visualize the expected congestion areas.

Contact Information :
Professor Chang-Tien Lu
Arseny Bogomolov

1) Please enter route end-points :

Starting Address: Street: _____ City: _____ State*: _____ Zip: _____
Ending Address: Street: _____ City: _____ State*: _____ Zip: _____

* Only states around the Washington, DC area are currently applicable. If and when more state DOTs make their data accessible to this service, additional states will be added. Note that the traffic information must be in a standard OGC WFS format.

2) Please enter travel options :

Approximate Travel Timeframe

Weekday: _____ OR Specific Date: _____

Departure Month: _____

Departure Hour: _____

Please approximate your departure time as precise as possible. The date and time of your departure will be used in conjunction with historic and current traffic data in order to give the best possible travel time estimation and congestion warnings.

Note that narrowing down the departure timeframe to a precise weekday or date and hour of day will significantly reduce server response time since less data will need to be analyzed.

3) Get Directions : Use statistical traffic data

AITVS Driving Directions - Mozilla Firefox

http://spatial.nvc.cs.vt.edu:8080/AITVSDirections/route.aspx?id=fjdley55vr2zjp

Calculated Route Information

Starting Address: Manassas, Virginia, United States
Ending Address: Falls Church, Virginia, United States

Place Point: (-77.4871475,38.7447275)
Place Point: (-77.1719965,38.8842885)

Exact: Yes

Travel Timeframe: Date: Tuesday, November 15, 2005
Time: 8am

Route Summary: Total Distance: 26.82 miles
Total Duration: approx. 50 minutes (was 34)

Driving Directions

A note on the route times: all times and durations below are rounded to whole minutes. Consequently, the total route duration and the sum of all segments' durations may not match exactly.

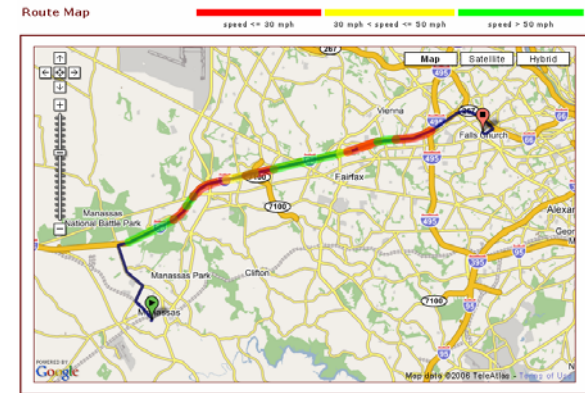
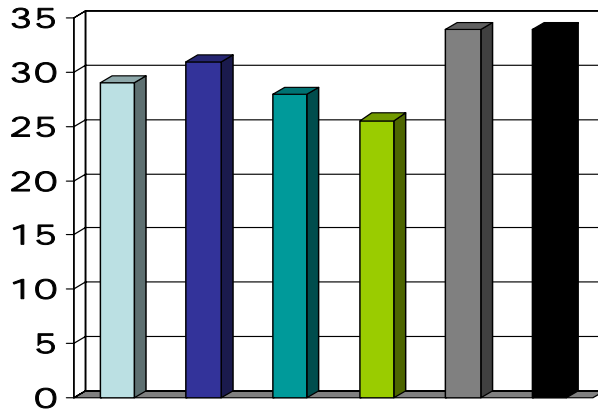
Segment Description	Distance	Time	Duration
Depart Manassas, Virginia, United States	0 miles	8:00 AM	0 min(s)
Go North East on Driveway	0.04 miles	8:00 AM	< 1 min(s)
Take ramp to Wellington Rd	0.01 miles	8:01 AM	< 1 min(s)
Turn left on Wellington Rd	1.31 miles	8:02 AM	3 min(s)
Take ramp to Godwin Dr	0.04 miles	8:05 AM	< 1 min(s)
Straight on Godwin Dr	0.87 miles	8:06 AM	< 1 min(s)
Turn left on SR 234 (Sudley Rd)	2.49 miles	8:07 AM	4 min(s)
Take ramp and go East on I 66	21.15 miles	8:11 AM	39 min(s)
At exit 69 take ramp	0.03 miles	8:50 AM	< 1 min(s)
Straight	0.17 miles	8:51 AM	< 1 min(s)
Bear left on Fairfax Dr	0.04 miles	8:52 AM	< 1 min(s)
Go South West on US 29 (Lee Hwy)	0.53 miles	8:53 AM	< 1 min(s)
Turn right on Park Ave	0.14 miles	8:54 AM	< 1 min(s)
Arrive at Falls Church, Virginia, United States	0 miles	8:55 AM	0 min(s)

Route Map

speed <= 30 mph | 30 mph < speed <= 50 mph | speed > 50 mph

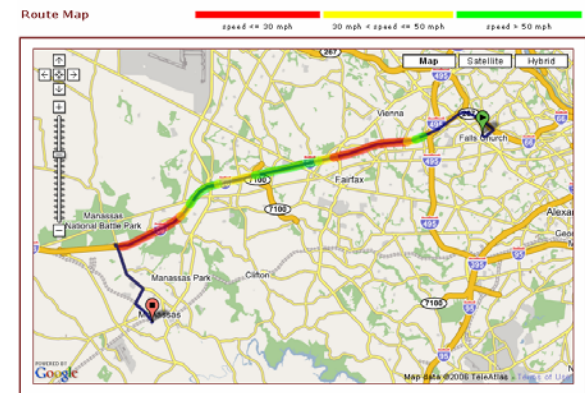
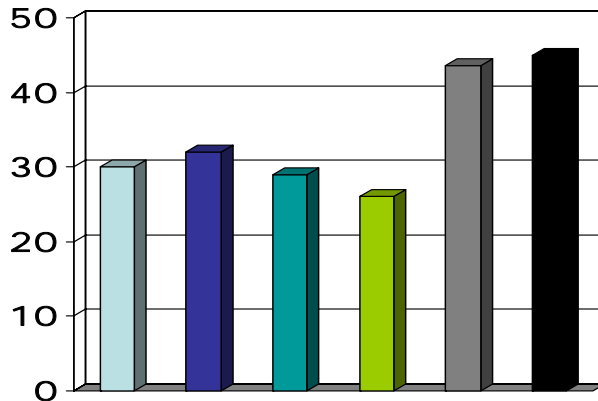
Travel Time Estimation

Time



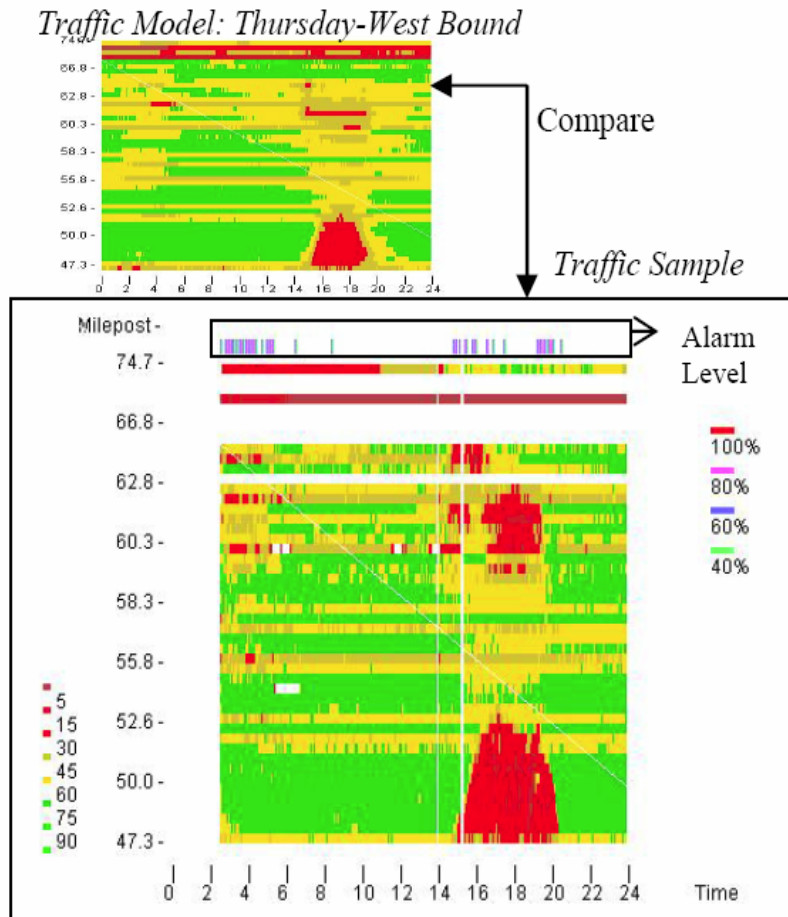
Manassas -> Falls Church (8AM)

Time

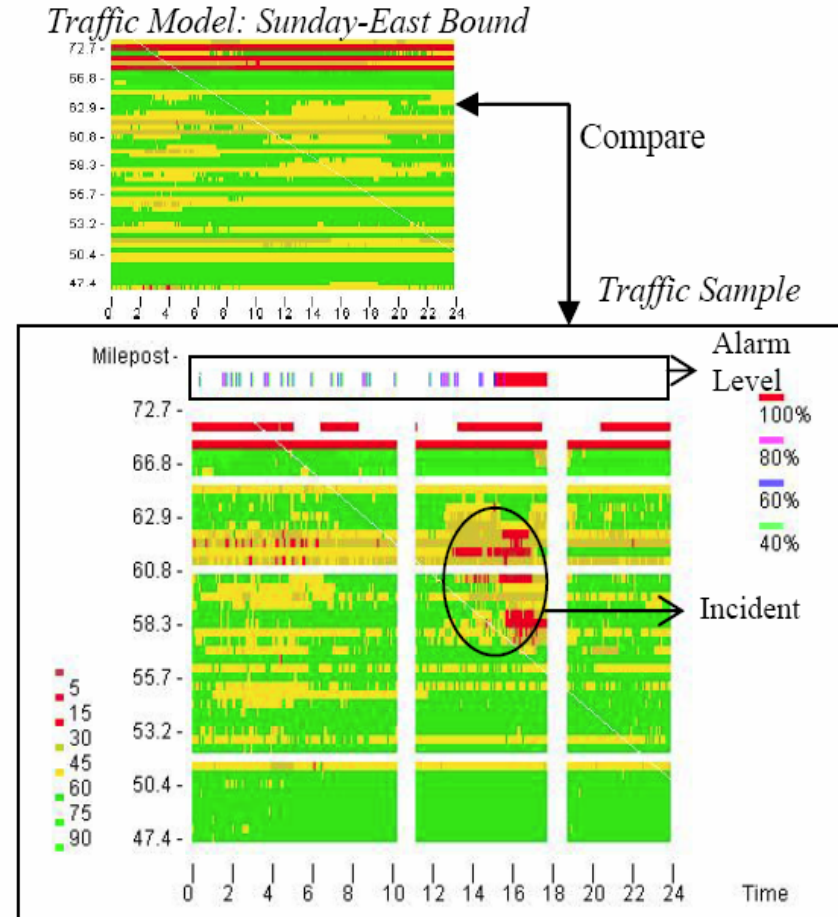


Falls Church -> Manassas (4PM)

Automatic Incident Detection

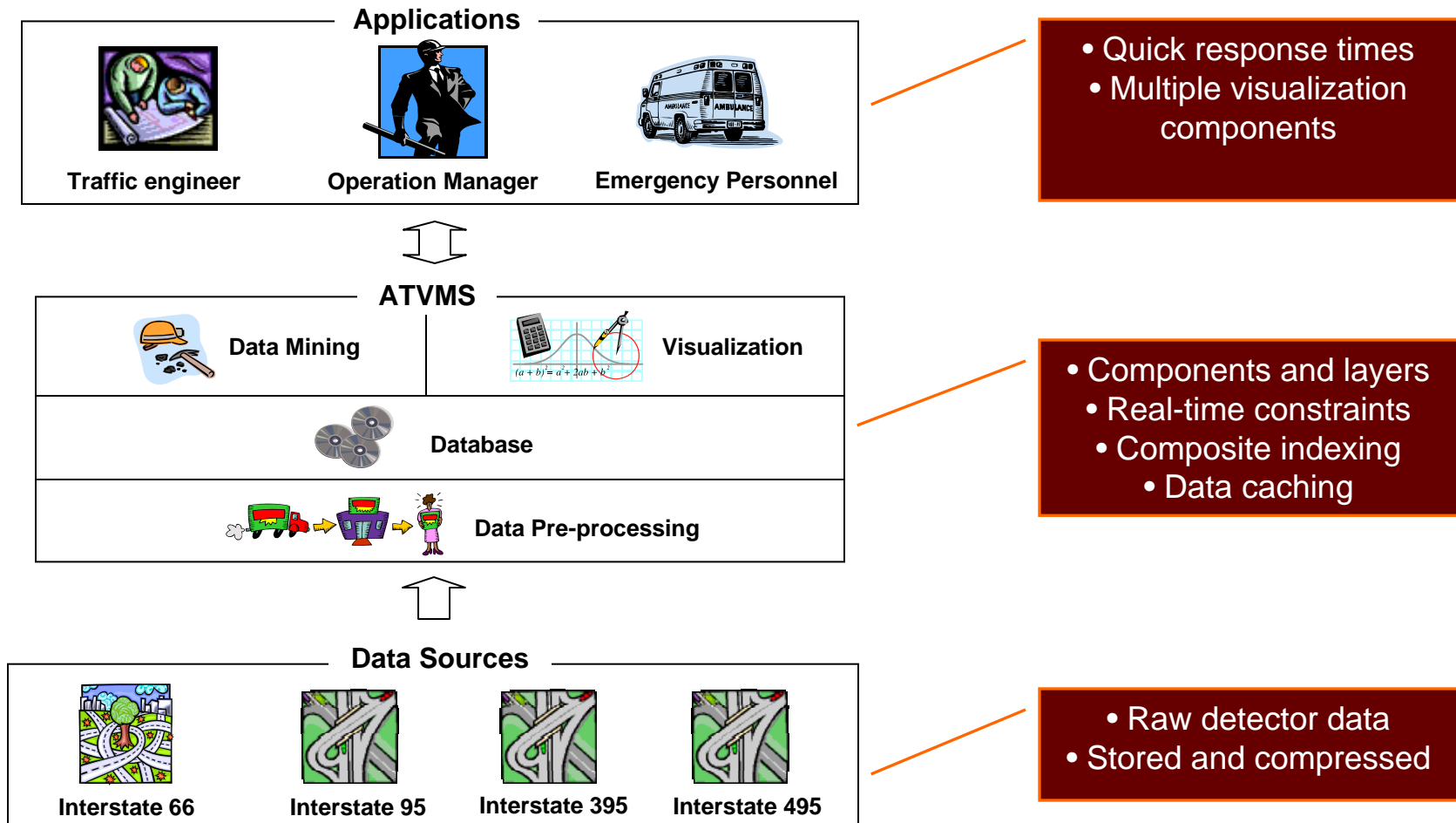


No Incident



Incident

ATVMS Architecture



Conclusion

- Multiple visualizations
- Support data mining tasks
- High performance
- Application: Operations
 - Routing and guidance for travelers and commuters
 - Ramp meter control (freeway operation)
 - **Incident** management

Acknowledgements

- Principal Investigator
 - Professor Chang-Tien Lu
- Research members
 - Arnold Boedihardjo
 - Arseny Bogolomov
 - Jeff Joyner
 - Kenneth Nehring
 - Jack Zhang
 - Jinping Zhang