

Automatic Freeway Performance Reporting Using an Open Source Platform

Shu Yang, Ph.D. Candidate
Dr. Yao-Jan Wu, Ph.D. P.E.

Keywords

- ▶ Freeway Performance
- ▶ Automatic Report Production
- ▶ Open Source Platform



Freeway Performance

Information!



Incident Management



Volume Study



Travel Time & Level of Service




Speed Study

Mobility Report Template

GUIDEPOST

- **FREEWAY MOBILITY REMAINED CONSISTENT IN BOTH NOVEMBER PEAKS WITH SOME IMPROVEMENTS NOTED IN THE DECEMBER AM PEAK**
- **DECEMBER PM PEAK TRAVEL WAS IMPACTED BY UNSEASONABLY WARM WEATHER, LEADING TO INCREASED HOLIDAY SHOPPING, AND THE LATE DECEMBER FLOODING**
- **NUMEROUS FREEWAY MERGING CHOKe POINTS STILL EXIST IN BOTH PEAKS ON I-44, I-64, I-70 AND I-270**
- **ARTERIAL TRAVEL IN NORTH COUNTY ON US 67 SLOWED COMPARED TO PREVIOUS MONTHS**
- **HISTORIC RAINS AND FLOODING THE LAST WEEK OF DECEMBER CAUSED INTERSTATE CLOSURES ON I-70, I-44, I-55 AND NUMEROUS STATE ROUTES**
- **FLOODING LEAD TO NUMEROUS CONNECTIVITY ISSUES WITH CAMERAS AND ITS DEVICES OVER A 4 DAY PERIOD DECEMBER 28TH - 31ST**



THE RED DOTS ON THIS SNAPSHOT OF THE MDOT TRAVELER INFORMATION MAP INDICATE ROADWAY CLOSURES CAUSED BY FLOODING DURING RECORD BREAKING RAINFALL AMOUNTS THE LAST WEEK OF DECEMBER.

MOBILITY SNAPSHOT

FREEWAY MOBILITY
NOVEMBER TO DECEMBER COMPARISON:
AM IMPROVED / PM DECLINED

FREEWAY AVERAGE 24 HOUR VOLUMES
Nov 2014 → Nov 2015: -3.03%
Dec 2014 → Dec 2015: +0.60%

MAJOR INCIDENTS
NOVEMBER 2015: 3 → DECEMBER 2015: 5

AVERAGE INCIDENT DURATION NOV → DEC
LANE CLEARANCE: 27:36 → 30:16
INCIDENT CLEARANCE: 26:40 → 31:09
(MINI SEC)

MAJOR IMPACT WORK ZONES
NOVEMBER → 0 DECEMBER → 0

MODERATE IMPACT WORK ZONES
NOVEMBER → 1 DECEMBER → 1

FREEWAY MOBILITY
DECLINED COMPARED TO PREVIOUS MONTH

FREEWAY AVERAGE 24 HOUR VOLUMES
Feb 2014 → Feb 2015: DOWN
JAN 2015 → FEB 2015: UP

MAJOR INCIDENTS
JAN 2015: 9 → FEB 2015: 7
2014 Avg. → 5.9 2015 Avg. → 8.0

AVERAGE INCIDENT DURATION JAN → FEB
LANE CLEARANCE: 26:49 → 26:59
INCIDENT CLEARANCE: 27:20 → 27:35
(MINI SEC)

MAJOR IMPACT WORK ZONES
JANUARY 1 → FEBRUARY 0

MODERATE IMPACT WORK ZONES
JANUARY 1 → FEBRUARY 0

YEAR TO YEAR MOBILITY COMPARISON
Feb 2014 → Feb 2015

MAJOR IMPACT WZ:	SAME
MODERATE IMPACT WZ:	SAME
MAJOR INCIDENTS:	INCREASED
FREEWAY MOBILITY:	IMPROVED
TRENDING:	UP

ZONING IN

TMS WORK ZONES

- ◆ NOVEMBER 2015: 192
- ◆ DECEMBER 2015: 218

WORK ZONE BREAKDOWN:

- ◆ MAJOR: 0 - 0.0%
- ◆ MODERATE: 2 - 0.6%
- ◆ MINDR: 297 - 99.4%

WORK ZONE CRASHES: 19

GUIDEPOST

- **FREEWAY MOBILITY DECLINED IN BOTH THE AM AND PM PEAKS WITH TRAVEL SLOWED BY WINTER WEATHER ROAD CONDITIONS**
- **ARTERIAL PEAK PERIOD TRAVEL REMAINED CONSISTENT WITH SLIGHT NB PM IMPROVEMENTS ON US 67 IN NORTH COUNTY**
- **MO 21 HAS BEEN ADDED TO ARTERIAL MAPS THIS MONTH**
- **WINTER WEATHER CONTRIBUTED TO AN INCREASE IN INCIDENTS**
- **CRASHES INVOLVING TRACTOR TRAILERS INCREASED FROM 37 IN JANUARY TO 63 IN FEBRUARY**
- **WORK ZONE VISIBILITY RATINGS DROPPED 2% BELOW GOAL TO 89%**
- **SIGNAL OPTIMIZATION RESULTS ON MO 47, MO 340, MO 100, AND ROUTE 141 ESTIMATED TO SAVE \$4,676,058 IN YEARLY FUEL COSTS**



RESPONDERS REMOVE ONE OF THE 63 TRACTOR TRAILER CRASHES THAT IMPACTED THE REGION'S MOBILITY DURING THE MONTH OF FEBRUARY.

MOBILITY SNAPSHOT

FREEWAY MOBILITY
NOVEMBER TO DECEMBER COMPARISON:
AM IMPROVED / PM DECLINED

FREEWAY AVERAGE 24 HOUR VOLUMES
Nov 2014 → Nov 2015: -3.03%
Dec 2014 → Dec 2015: +0.60%

MAJOR INCIDENTS
NOVEMBER 2015: 3 → DECEMBER 2015: 5

AVERAGE INCIDENT DURATION NOV → DEC
LANE CLEARANCE: 27:36 → 30:16
INCIDENT CLEARANCE: 26:40 → 31:09
(MINI SEC)

MAJOR IMPACT WORK ZONES
NOVEMBER → 0 DECEMBER → 0

MODERATE IMPACT WORK ZONES
NOVEMBER → 1 DECEMBER → 1

FREEWAY MOBILITY
DECLINED COMPARED TO PREVIOUS MONTH

FREEWAY AVERAGE 24 HOUR VOLUMES
Feb 2014 → Feb 2015: DOWN
JAN 2015 → FEB 2015: UP

MAJOR INCIDENTS
JAN 2015: 9 → FEB 2015: 7
2014 Avg. → 5.9 2015 Avg. → 8.0

AVERAGE INCIDENT DURATION JAN → FEB
LANE CLEARANCE: 26:49 → 26:59
INCIDENT CLEARANCE: 27:20 → 27:35
(MINI SEC)

MAJOR IMPACT WORK ZONES
JANUARY 1 → FEBRUARY 0

MODERATE IMPACT WORK ZONES
JANUARY 1 → FEBRUARY 0

YEAR TO YEAR MOBILITY COMPARISON
Feb 2014 → Feb 2015

MAJOR IMPACT WZ:	SAME
MODERATE IMPACT WZ:	SAME
MAJOR INCIDENTS:	INCREASED
FREEWAY MOBILITY:	IMPROVED
TRENDING:	UP

ZONING IN

TMS WORK ZONES

- ◆ FEB 2014: 144
- ◆ FEB 2015: 146

WORK ZONE BREAKDOWN:

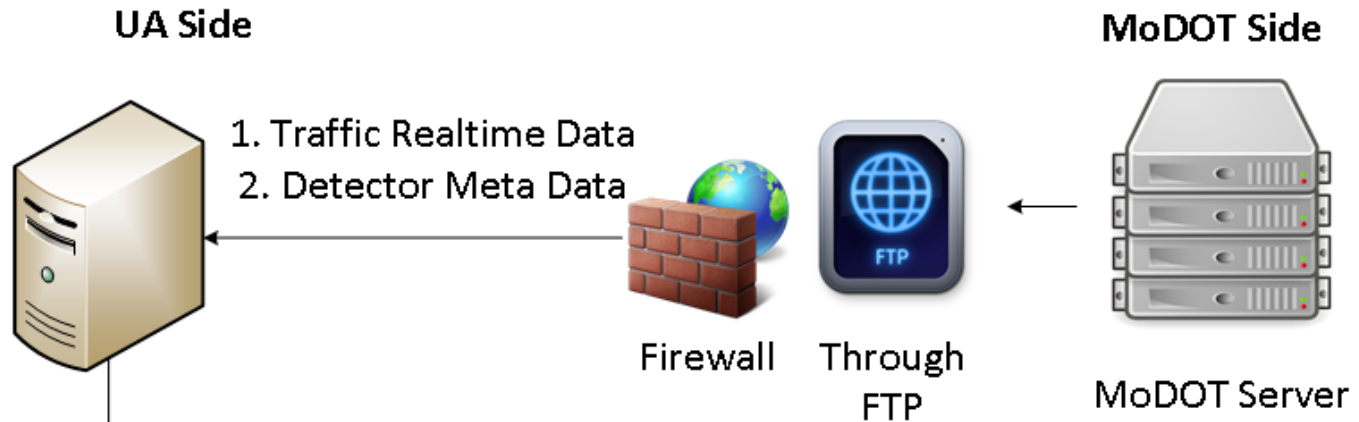
- ◆ MAJOR: 0 - 0%
- ◆ MODERATE: 0 - 0%
- ◆ MINDR: 131 - 100%

WORK ZONE CRASHES: 1

Five Components

I. Archiving real-time traffic data

Component 1: Archiving Real-time Traffic Data



Component 3: Tabulating and Plotting

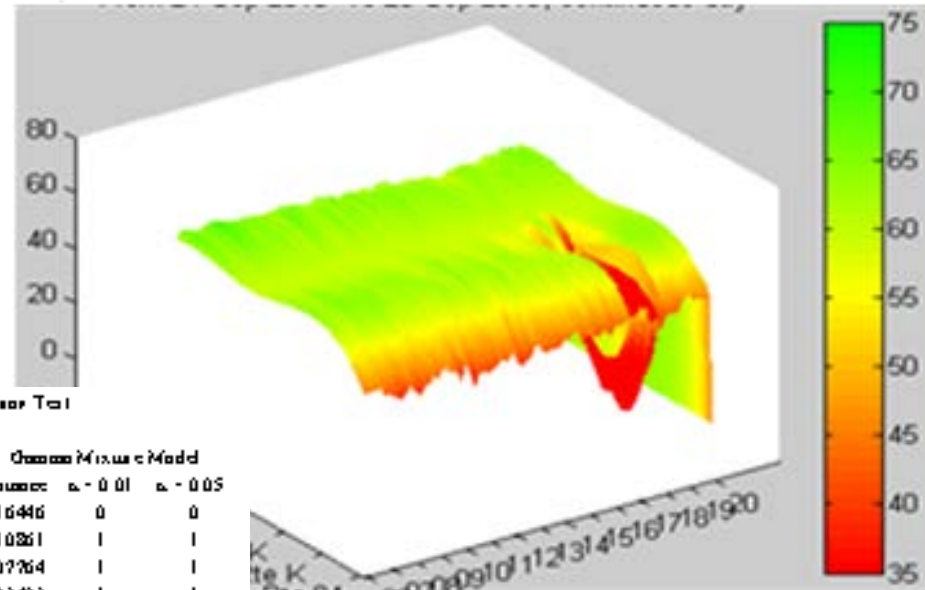


Table 2. Testing Using One-Sample Kolmogorov-Smirnov Test

Z'	Gaussian Mixture Model			Lognormal Mixture Model			Gaussian Mixture Model		
	Distance	$\alpha = 0.01$	$\alpha = 0.05$	Distance	$\alpha = 0.01$	$\alpha = 0.05$	Distance	$\alpha = 0.01$	$\alpha = 0.05$
1	0.21541	0	0	0.16713	0	0	0.16446	0	0
2	0.14159	0	0	0.07199	1	1	0.10261	1	1
3	0.03226	1	1	0.02672	1	1	0.07764	1	1
4	0.02936	1	1	0.01451	1	1	0.03403	1	1
5	0.01418	1	1	0.01368	1	1	0.06536	1	1
6	0.01325	1	1	0.00730	1	1	0.02614	1	1

Z'	Gaussian Mixture Model			Lognormal Mixture Model			Gaussian Mixture Model		
	Distance	$\alpha = 0.01$	$\alpha = 0.05$	Distance	$\alpha = 0.01$	$\alpha = 0.05$	Distance	$\alpha = 0.01$	$\alpha = 0.05$
1	0.14020	0	0	0.16556	0	0	0.12539	0	0
2	0.02773	1	1	0.04322	1	1	0.11997	1	1
3	0.04506	1	1	0.04427	1	1	0.05431	1	1
4	0.04761	1	1	0.00502	1	1	0.0227	1	1
5	0.00709	1	1	0.00526	1	1	0.05917	1	1
6	0.00661	1	1	0.00608	1	1	0.04492	1	1



Component 4: Plotting Using GIS Platform

GIS Data Format

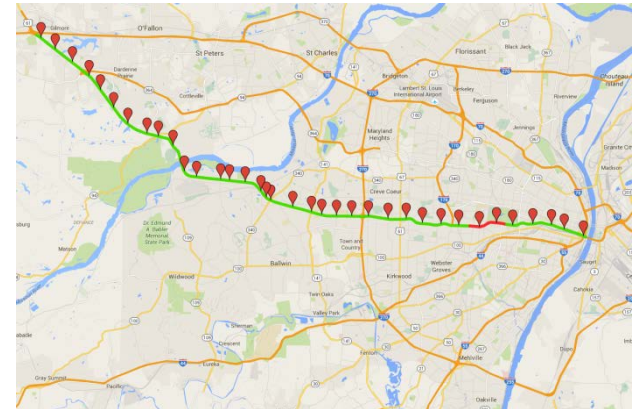


KML

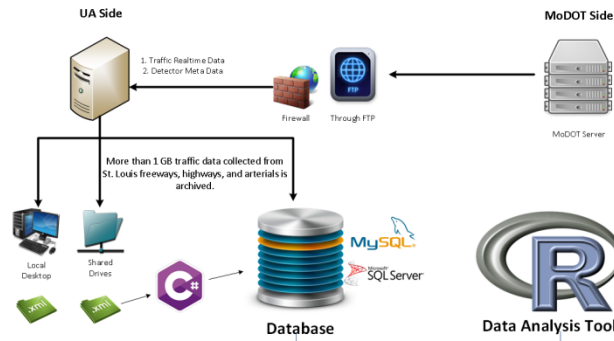


Shapefile

GIS Tools

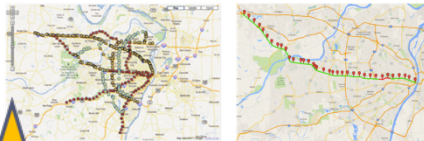


1. Archiving Traffic Data



2. Data Analysis & Modelling

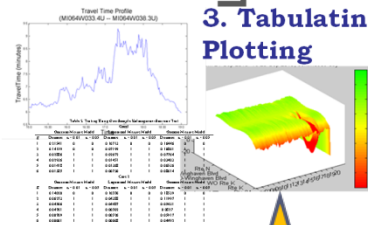
4. Plotting Using GIS Platform



Traffic Models



3. Tabulating & Plotting



5. Automatic Report Production

The screenshot shows a report titled 'Regional Transportation Mobility Monthly Report' prepared for the 'Regional Traffic Management Center'. It features a navigation menu on the left and a main content area with sections like 'GuidePost', 'Freeways Speed Profiles', and 'Critical Road Segments on Interstate 64 Westbound'. The report includes status indicators (green for increase, red for decline) for various road segments and speed profiles.

Reports:

Type I: Daily Data Quality Report

label.modot-realtimedata

Shu

1-100 of 1,455

<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/28/2016 8:33:37 AM The number of Realtime Files: 2829 The number of Missing Files:		Mar 28
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/27/2016 8:33:34 AM The number of Realtime Files: 2828 The number of Missing Files:		Mar 28
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/26/2016 8:33:32 AM The number of Realtime Files: 2810 The number of Missing Files:		Mar 27
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/25/2016 8:33:30 AM The number of Realtime Files: 2828 The number of Missing Files:		Mar 26
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/24/2016 8:33:29 AM The number of Realtime Files: 2223 The number of Missing Files:		Mar 25
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/23/2016 8:33:27 AM The number of Realtime Files: 2820 The number of Missing Files:		Mar 24
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/22/2016 8:33:25 AM The number of Realtime Files: 2756 The number of Missing Files:		Mar 23
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/21/2016 8:33:23 AM The number of Realtime Files: 2827 The number of Missing Files:		Mar 22
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/20/2016 8:33:22 AM The number of Realtime Files: 2813 The number of Missing Files:		Mar 21
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/19/2016 8:33:20 AM The number of Realtime Files: 2759 The number of Missing Files:		Mar 20
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/18/2016 8:33:18 AM The number of Realtime Files: 2831 The number of Missing Files:		Mar 19
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/17/2016 8:33:16 AM The number of Realtime Files: 2827 The number of Missing Files:		Mar 18
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/16/2016 8:33:15 AM The number of Realtime Files: 2815 The number of Missing Files:		Mar 17
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/15/2016 8:33:13 AM The number of Realtime Files: 2829 The number of Missing Files:		Mar 16
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/14/2016 8:33:11 AM The number of Realtime Files: 2823 The number of Missing Files:		Mar 15
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/13/2016 8:33:09 AM The number of Realtime Files: 2712 The number of Missing Files:		Mar 14
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/12/2016 8:33:08 AM The number of Realtime Files: 2816 The number of Missing Files:		Mar 13
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/11/2016 8:33:06 AM The number of Realtime Files: 2814 The number of Missing Files:		Mar 12
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/10/2016 8:33:04 AM The number of Realtime Files: 2821 The number of Missing Files:		Mar 11
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/9/2016 8:33:02 AM The number of Realtime Files: 2821 The number of Missing Files:		Mar 10
<input type="checkbox"/>	smartranslab	Realtime Data Summary - Date and Time: 3/8/2016 8:33:01 AM The number of Realtime Files: 2820 The number of Missing Files:		Mar 9

Reports:

Type II: Mobility Report

▶ Video

The screenshot shows a web browser window with the address bar containing the file path: `file:///C:/MySVN/JA-Research/Markdown/Freeway/SpeedMap/Tests/TestTable.html#_freeways_speed_p`. The page title is "Freeways Speed Profiles".

Freeways Speed Profiles

[Overview] Speed Profile on I64 Westbound, PM Peak hours

The following picture shows the average daily speed profile on I64 westbound during PM peak hours

1. The read balloon points represent traffic sensors along the freeway
2. The "green-red" line represents average daily speed

The map displays the I-64 freeway corridor in St. Louis, Missouri, with red balloon markers indicating sensor locations and a green line representing the average daily speed profile. The map includes labels for various neighborhoods and landmarks such as O'Fallon, St. Peters, St. Charles, Florissant, Black Jack, Bridgeway, Lambert St. Louis International Airport, University, Ferguson, Riverview, Marylhurst, Jennings, Town and Country, Kirkwood, Webster Groves, Town Oaks, Valley Park, Shrewsbury, Chester, Gray Summit, and Pacific.

Notes

- ▶ Division of work
- ▶ Tools



Tool Integration

Data Collection



Information



Tables & Figures



GIS Tools



Template



Notes

- ▶ Division of work
- ▶ Tools
- ▶ Full stack developer





THE UNIVERSITY OF ARIZONA

Shu Yang

shuyang@email.arizona.edu

Dr. Yao-Jan Wu

yaojan@email.arizona.edu

