Arterial Performance Measures
Re-Identification Software Demonstration

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Re-Identification Software Demonstration

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SBIR Phase 3 Joint Transportation Research Project
Traffax, Inc.
Purdue University

June 2, 2017

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<th>Deliverable Reference:</th>
<th>D2.4 Software Demonstration</th>
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<td>Contractor:</td>
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<td>Contract Number:</td>
<td>DTFH61-14-C-00035</td>
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<td>Contract Term Start</td>
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<td>Key Personnel</td>
<td>Stan Young, Darcy Bullock, Dennis So Ting Fong</td>
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Recommended Citation

Acknowledgments
This work was supported by Traffax/USDOT SBIR DTFH6114C00035. The contents of this paper reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein, and do not necessarily reflect the official views or policies of the sponsoring organizations. These contents do not constitute a standard, specification, or regulation.
**Presentation Description**

A recorded demonstration was prepared explaining the purpose, development, framework, and potential uses of the developed open-source software described in the previous reports entitled, “Arterial Performance Measures Software” dated February 13, 2017, “Arterial Network Performance Measures Software” dated April 4, 2017, and “Arterial Trip Length Characteristics Software” dated June 30, 2017. The recorded presentation can be viewed at:  
https://webmeeting.umd.edu/p3c5ymxjq97/?OWASP_CSRFTOKEN=e1c84f4446075128a4ceb0979ccc05c3e12da7eb212a4fl4ca957d2e11c4514c

The PowerPoint slide deck included with this deliverable and all of the project reports can be accessed at: https://tinyurl.com/ydz7dm3j.
Arterial Performance Measures: Re-identification Software Demonstration

SMALL BUSINESS INNOVATIVE RESEARCH PROJECT
MAY 29, 2017  v15
Available Reports

Project Title: Sensor Fusion and Measure of Effectiveness Development for Off-line Traffic Analysis of Real Time Data

- Performance Measures of Interrupted-Flow Roadways using Re-Identification and Signal Controller Data, C. Day and D. Bullock, May, 2015 - Full Report and Executive Summary
- Real-Time Monitoring Concepts for Arterials using Re-Identification and High-Resolution Data, S. Young & D So Ting Fong, May, 2015
- Arterial Trip Length Characteristics, S Young & D So Ting Fong, dated Sep, 2016
- Traffic Performance of Arterial Highways and Driver Routing Characteristics During a Freeway Detour, C Day, S Lavrenz, H Li, & D Bullock, Mar, 2016
- Arterial Performance Management System Lexicon, S Young, D Bullock, & D So Ting Fong
- Common Data Formats for Re-Identification and High-Resolution Data, S Young, D Bullock, & D So Ting Fong, Jun, 2015
- Arterial Performance Measures Software, S Young & D So Ting Fong, Feb, 2017
- Arterial Network Performance Measures Software, S Young & D So Ting Fong, Apr, 2017

Project Reports Available at: https://tinyurl.com/ydz7dm3j
Four Key Measures

**Travel Time & Travel Time Reliability**
- Based on sampled travel time from re-identification data
- Statistical distribution of travel time using overlay plots and cumulative frequency diagrams

**Percent Arrivals on Green & Split Failures**
- Based on High-Res Data
- Purdue Coordination Diagram & Green/Red Occupancy Ratio
Software Development Path

SBIR III

EVOLUTION OF BLUSTATS AND VPLEXPLORE
Development Motivation

Improvements in technology and methods are often accompanied by a confused and fragmented market.
- Initial vendor offerings are proprietary and often vertically integrated
- Custom/non-interchangeable data formats encourage vendor lock-in
- Results vary widely in implementation of both methods and visualizations

Market maturation is needed for:
- Consistent user experience: same output for identical input
- Standards based input/output

Software products developed to:
- Reference source for uniformity of analysis / visualizations
- Allow standards based data exchange
- Be used in bid specification/reference code
- Maximize users return on investment
- Encourage maturity and market growth
Accomplishments

A standard protocol for re-identification, CWS5200, was implemented. Sample analysis and visualization routines were coded in an open source visualization/analytics software.

Back-Office BluSTATs
- Traffax owned
- Closed source
- Custom data formats
- Compiled code distributed with hardware

Open Source VPXplore
- UMD/Traffax contributors
- Open source
- Open/standard data formats
- Matlab code can be distributed
- Reference implementations
Case Studies
Case Study 1: Maryland ICC

A tolled freeway in Maryland which connects Gaithersburg in Montgomery County and Laurel in Prince George's County. Opened Nov 22, 2011.
BluSTATs -> CWS5200 -> VPXplore

BluSTATs - Ingest Bluetooth Sensor Data

CWS5200 Data Files

VPXplore - Ingest CWS5200 Data Files

Performance Measures and Visualizations
24 Hour Overlay Plot Comparison

Figure 1

Segment: 2011 Sep ICC I270 to I95 Weekdays Only from 09/04 to 10/03 2011 Length: 35 miles

Before

After
24 Hour Overlay Plot Comparison

Figure 1

Segment: 2011 Sep ICC I270 to I95 Weekdays Only from 09/04-10/03 2011 Length: 35 miles

Before

After
Before ICC – Sept 2011
After ICC – Sept 2012

Figure 4

Segment: 2012 Sep ICC 1270 to 195  Weekdays Only from 09/02-10/01 2012  Length: 36 miles

24 Hour Overlay Plot

Travel Time (min)

AM
Mid-day
PM

Travel Time (minutes)

Percentile

0 10 20 30 40 50 60 70 80 90 100

0 50 100 150 200

Table:

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<tr>
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<th>AM</th>
<th>Mid-day</th>
<th>PM</th>
<th>Unl</th>
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<td>1.24</td>
<td>2.22</td>
<td>1.78</td>
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<tr>
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<td>Median TT</td>
<td>1.45</td>
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<td>2.00</td>
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<td>TT Reliability</td>
<td>2.12</td>
<td>2.87</td>
<td>1.52</td>
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Units: months, minutes, miles, mph
Case Study 2: US 1 in Northern VA

Three mile long section of US-1
From Kings Hwy to Mount Vernon Hwy
11 Signalized intersections     3 lanes each direction
Oct 2011 compared to Oct 2012
US 1 - Overlay Chart: 2011 vs 2012
US 1 - Overlay Chart: 2011 vs 2012
2011 Cumulative Frequency Diagram
2012 Cumulative Frequency Diagram
US-1 PM Peak, by the numbers...

<table>
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<tr>
<th>Year</th>
<th>Travel Time Index (TTI)</th>
<th>Planning Time Index (PTI)</th>
<th>Buffer Time Index (BTI)</th>
<th>Median Travel Time</th>
<th>Travel Time Reliability</th>
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<td>2011</td>
<td>1.29</td>
<td>3.18</td>
<td>2.45</td>
<td>3.17 min/mile</td>
<td>0.46 P(85-15)/P50</td>
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<td>2012</td>
<td>1.41</td>
<td>3.57</td>
<td>2.54</td>
<td>3.43 min/mile</td>
<td>0.45 P(85-15)/P50</td>
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TTI = Travel Time Index, PTI = Planning Time Index, BTI = Buffer Time Index.

Median Travel Time:
- 2011: 3.17 min/mile, 18.9 mph
- 2012: 3.43 min/mile, 17.5 mph

TT Reliability:
- 2011: 0.46 P(85-15)/P50
- 2012: 0.45 P(85-15)/P50
Reference software is provided to:

- Implement research and recommendations in the SBIR III project
- More quickly mature the re-identification market
- Provide reference code to implement data standards, performance measures, and visualizations
- Enable sharing of data, and consistency in use of arterial performance measures

Related Components:

- Visualization Engine
  - Common plotting routines
- Analytics Processing
  - Standard statistical summary
- CWS5200 Segment Re-id Standard
Thank You!

For further information contact:

Stan Young
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Report Sponsor

The “Small Business Innovation Development Act of 1982” (Pub. L. No. 97-219), along with reauthorizing legislation (Pub. L. No. 99-443 and Pub. L. No. 102-564, the “Small Business Research and Development Enhancement Act of 1992”), seeks to encourage the initiative of the private sector and to use small business effectively to meet federal research and development objectives. To comply with statutory obligations of the Act, the U.S. Department of Transportation established the Small Business Innovation Research (SBIR) Program, which conforms to the guidelines and regulations provided by the Small Business Administration. Annually, small businesses are solicited to submit innovative research proposals that address the high-priority requirements of the U.S. Department of Transportation and that have potential for commercialization.

This report was developed through a partnership between Traffax, Inc., and Purdue University with funding from a Phase III SBIR contract (DTFH6114C00035) with the Federal Highway Administration. The project, entitled “Sensor Fusion and MOE Development for Off-Line Traffic Analysis of Real Time Data,” created and refined methods and tools for the characterization of performance along arterial corridors.

Publication

This report is part of a series of reports published in collaboration with USDOT, Traffax, Inc., and Purdue University. The full report series is available for download at http://docs.lib.purdue.edu/apmtp/.

Open Access and Collaboration with Purdue University

The Indiana legislature established the Joint Highway Research Project in 1937. In 1997, this collaborative venture between the Indiana Department of Transportation and Purdue University was renamed as the Joint Transportation Research Program (JTRP) to reflect state and national efforts to integrate the management and operation of various transportation modes. Since 1937, the JTRP program has published over 1,600 technical reports. In 2010, the JTRP partnered with the Purdue University Libraries to incorporate these technical reports in the University’s open access digital repository and to develop production processes for rapidly disseminating new research reports via this repository. Affiliated publications have also recently been added to the collection. As of 2017, the JTRP collection had over 1.5 million downloads, with some particularly popular reports having over 20,000 downloads.