Project Title: Using Truck GPS Data for Freight Performance Analysis in the Twin Cities Metro Area
Prepared by: Chen-Fu Liao (PI)
Task Due: 12/31/2012

TASK #2 DELIVERABLE: SUMMARY OF DATA REQUEST

Introduction

Since 2002, the American Transportation Research Institute (ATRI) has partnered with FHWA and the trucking industry to continuously collect GPS data on key national corridors, using nearly 500,000 commercial trucks in North America. This massive amount of truck GPS data can provide public agencies at both the federal and regional level with tools that can increase understanding of freight activity, identify impediments along the freight network, and provide for near-real-time operations decision-making.

Aside from its official use by the U.S. DOT, ATRI's data has now been used by more than a dozen MPOs and 9 state DOTs to conduct truck- and freight-related analyses. Other "providers" of traffic data who claim to incorporate "commercial vehicles" primarily use taxis and limos to meet this definition. Those same providers do have some large trucks, but their total truck populations do not exceed 35,000 for the entire U.S. According to ATRI, "no other traffic provider in the U.S. has more than 10% of the large truck units that ATRI has". The ATRI data also includes descriptive data for their truck units at a high-level. Existing research has concluded that there are no good surrogate data for large trucks. That is, it's inadequate to use cars or taxis as a surrogate for large truck analyses.

Truck Data

ATRI Truck GPS data

We have established a data sharing agreement with ATRI. The University of Minnesota is in the process of signing the agreement with ATRI official. The data attributes to be reported for each record will include a unique vehicle number, latitude, longitude, and date/time. No two trucks will use the same identifier. We will receive 12-month (Oct. 2012 ~ Sep. 2013) of truck GPS data in the Twin Cities Metro Area (TCMA).

Example of truck GPS data:

Truck ID	XXXX-41DB-AD7F-D1B4A041E147-XXXXXXXX
Date & Time String	2000-09-01 23:00:33
Longitude	-92.8956
Latitude	44.9458
Highway	I94

MnDOT WIM Data (Volume/Speed/Class/Weight)

There are 4 WIM stations in the study area. The WIM data will be used for both truck speed and volume comparisons at each location. See sample WIM data and corresponding data file din Appendix A and B.

We have received data of the four WIM sites in TCMA. The data for WIM #37 in Otsego is current through 12/4/12. The data for WIM #40 in South St. Paul is current through 12/05/12.

MnDOT WIM data contact: Ben Timerson (Benjamin.Timerson@state.mn.us)

- WIM #36 in Lake Elmo (State Highway 36)
- WIM #37 in Otsego (Interstate Highway 94)
- WIM #40 in West St. Paul (US Highway 52)
- WIM #42 in Cottage Grove (US Highway 10/61)

MnDOT ATR Data

1. ATR Volume – Volume of all traffic. This data cannot be used for truck volume comparison.
2. ATR Volume/Speed – No vehicle classification information. This data cannot be used for truck speed comparison.
3. ATR Volume/Speed/Class - The Vehicle Classification counts can provide volumes for heavy commercial vehicles. However, MnDOT only collects 4 hours of data then expands that to 24 hours to get Heavy Commercial Annual Average Daily Traffic (HCAADT) for each location.

ATR data samples:

- Volume by hour of day

Date	Oct. 30, 2012	
Hour	EB	WB
1	1	5
2	2	1
3	0	1
4	1	3
5	4	1
6	21	5
7	42	16
8	48	31
9	45	26
10	38	19
11	30	25
12	25	29
13	22	27
14	34	35
15	29	40
16	46	50
17	47	50
18	53	51
19	29	43
20	20	35
21	8	22
22	9	25
23	3	13

24	9	8
TOTAL	566	561

- Speed in 13 different speed bins by hour of day

HOUR	40 MPH	45 MPH	50 MPH	55 MPH	60 MPH	65 MPH	70 MPH	75 MPH	80 MPH	85 MPH	100 MPH	110 MPH	>110 MPH
07:00	6	0	0	0	0	0	0	1	0	0	2	21	18
08:00	6	0	1	0	0	0	0	0	0	2	1	18	18
09:00	3	1	1	0	1	0	0	0	0	4	2	16	10
10:00	3	0	0	0	1	1	0	0	0	1	3	7	16
11:00	2	0	0	0	0	0	0	0	0	0	2	8	13
12:00	1	1	0	0	0	0	0	0	1	0	2	10	7
13:00	4	1	0	0	0	0	0	0	0	1	2	4	22
14:00	4	2	0	0	0	0	0	0	0	0	3	9	12
15:00	5	2	0	0	3	0	0	0	0	1	4	17	14
16:00	6	0	1	0	1	0	0	0	0	0	3	14	23
17:00	5	2	0	0	0	0	0	0	0	0	1	14	31
18:00	3	0	0	1	0	0	0	0	0	2	1	9	13

- Vehicle counts by class and hour of day

Time	Lane #	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 14
8:00	1	0	37	8	0	0	0	0	0	0	0	0	0	0	0
8:00	2	0	15	8	0	0	0	0	3	0	0	0	0	0	0
9:00	1	0	24	9	0	1	0	0	4	0	0	0	0	0	0
9:00	2	0	11	7	0	0	0	0	1	0	0	0	0	0	0
10:00	1	0	13	15	0	0	0	0	1	0	1	0	0	0	0
10:00	2	0	14	6	0	2	0	0	3	0	0	0	0	0	0
11:00	1	0	19	4	0	0	0	0	2	0	0	0	0	0	0
11:00	2	0	24	5	0	0	0	0	0	0	0	0	0	0	0
12:00	1	0	14	7	0	1	0	0	0	0	0	0	0	0	0
12:00	2	0	13	8	1	0	0	0	5	0	0	0	0	0	0
13:00	1	0	25	9	0	0	0	0	0	0	0	0	0	0	0
13:00	2	0	22	13	0	0	0	0	0	0	0	0	0	0	0
14:00	1	0	21	4	0	2	0	0	0	2	0	0	0	0	0
14:00	2	0	29	7	0	4	0	0	0	0	0	0	0	0	0
15:00	1	0	26	15	0	3	0	0	1	0	1	0	0	0	0
15:00	2	0	34	15	0	0	0	0	1	0	0	0	0	0	0
16:00	1	0	31	14	0	1	0	0	1	0	0	0	0	0	0
16:00	2	0	33	13	0	1	0	0	3	0	0	0	0	0	0
17:00	1	0	33	17	0	2	0	0	1	0	0	0	0	0	0
17:00	2	0	37	14	0	0	0	0	0	0	0	0	0	0	0
18:00	1	0	22	6	0	1	0	0	0	0	0	0	0	0	0
18:00	2	0	34	9	0	0	0	0	0	0	0	0	0	0	0

MnDOT ATR data contact: Gene Hicks (gene.hicks@state.mn.us) and Mike Merrill (michael.merrill@state.mn.us)

MnDOT Wavetronix Data

According to MnDOT, the Wavetronix units can only store binned data on the unit. A live connection to the Waventronix can be configured to log individual vehicle data from a computer.

Summary

The average truck speed calculated from the ATRI GPS data will primarily be compared with the data from 4 WIM stations in the TCMA from Oct. 2012 to Sep. 2013. The ATR data will be used to compare volume by hour of day at selected locations where vehicle classification is available.

Web Links

- MnDOT Online Mapping Application, http://www.dot.state.mn.us/traffic/data/tma.html
- Metro trunk highway HCAADT map, http://www.dot.state.mn.us/traffic/data/maps/th_adt_overview/2011_HCAADT_Metro_Map.pdf
- Greater MN trunk highway HCAADT map, http://www.dot.state.mn.us/traffic/data/maps/th_adt_overview/2011_HCAADT_Gr8MN_Map.pdf
- MN Road data ftp site, ftp://ftp2.dot.state.mn.us/pub/outbound/TDA/WIM/WIM_Sites/
- Web link for the WIM Data Analyst's Manual, http://www.fhwa.dot.gov/pavement/wim/pubs/if10018/if10018.pdf
- Web link to the monthly WIM reports, http://www.dot.state.mn.us/traffic/data/html/wim_reports.html

Appendix A: Raw WIM Data

A listing ASCII vehicle data records as collected and stored by the system, including diagnostic and calibration records. A file in this format may be used as input to other data processing programs. Each record ends with a carriage return (ASCII code 013); fields are delimited by commas. Each record will contain between 47 and 67 fields. Fields without data are filled with zeros, with the exception of the external data tag and external information fields, which have a null entry if there is no data (the field delimiting commas will still be present). The external data tag and external information fields are optional; if present they always appear as a pair. There may be between 0 and 10 pairs of external data/information fields; the number of pairs used will be determined by the requirements of the data collection site, but will be a fixed number for that site.

The data fields include:

- year,
- month,
- day,
- hour,
- minute,
- second,
- error number,
- status code
- record type,
- lane,
- speed,
- class,
- length,
- GVW,
- ESAL,
- weight axle 1,
- axle spacing 1-2,
- weight axle 2,
- axle spacing 2-3,
- weight axle 3,
- axle spacing 3-4,

  …
- weight axle 13,
- axle spacing 13-14,
- weight 14,
- External data tag 1 (optional), External information 1 (optional),

  …
- External data tag n (optional), External information n (optional),
- temperature

Appendix B Sample of Raw WIM Data

The sample below is a report listing raw ASCII records of vehicle data for a 3 minute period starting at 12:00 PM on May 15, 2012 at WIM station #39:

```
12,5,15,12, 0, 8,0,00000000,12,1,54,9,61,74.4,1.7040,12.0,14.5,16.8,4.4,15.7,29.8,14.2,4.7,15.8,0.0,. . . ,,,91
12,5,15,12, 0,13,0,00000000,12,1,50,2,15,3.0,0.0004,1.6,8.7,1.4,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 0,21,0,00000000,12,1,48,3,18,5.5,0.0013,3.2,11.6,2.4,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 0,58,0,00000000,12,1,47,2,15,4.2,0.0013,3.0,9.0,1.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1, 9,0,00000000,12,1,17,2,12,4.2,0.0004,2.1,8.9,2.1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,22,0,00000000,12,2,45,9,57,71.9,1.6885,10.5,12.8,14.1,4.2,14.7,28.2,16.6,4.2,15.9,0.0,. . . ,,,91
12,5,15,12, 1,25,0,00000000,12,2,43,2,14,3.5,0.0004,2.0,8.6,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,27,0,00000000,12,2,45,2,18,3.2,0.0004,2.1,9.6,1.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,31,0,00000000,12,2,48,3,27,5.3,0.0013,3.0,12.0,2.3,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,33,0,00000000,12,2,47,2,16,3.0,0.0004,1.9,8.7,1.1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,35,0,00000000,12,2,46,3,17,5.3,0.0013,3.3,9.9,2.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,39,0,00000000,12,2,48,5,15,7.4,0.0062,5.3,8.9,2.1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,39,0,00000000,12,1,46,9,72,49.1,0.3365,10.8,16.4,9.3,4.3,9.0,36.4,9.9,4.2,10.0,0.0,. . . ,,,91
12,5,15,12, 1,41,0,00000010,12,1,44,5,15,10.0,0.0612,8.5,9.6,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,48,0,00000000,12,1,51,2,15,3.5,0.0004,2.0,8.6,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,54,0,00000000,12,2,47,2,20,2.8,0.0004,1.9,8.7,0.9,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 1,57,0,00000000,12,1,52,2,16,3.9,0.0004,2.3,9.3,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,19,0,00000000,12,2,51,5,21,11.2,0.0160,5.4,13.0,5.9,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,23,0,00000000,12,1,60,3,17,3.5,0.0004,2.3,10.7,1.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,26,0,00000000,12,2,57,3,18,3.8,0.0004,2.3,10.0,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,27,0,00000000,12,2,58,3,13,3.8,0.0004,2.2,9.9,1.6,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,35,0,00000000,12,1,53,9,63,25.7,0.0992,10.0,18.5,5.8,4.3,5.1,29.9,2.1,4.1,2.6,0.0,. . . ,,,91
12,5,15,12, 2,38,0,00000000,12,1,52,5,24,11.0,0.0240,3.6,14.7,7.4,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,48,0,00000000,12,1,59,3,17,4.5,0.0013,2.6,10.0,1.9,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 2,58,0,00000000,12,1,52,2,5,2.0,0.0004,0.8,5.3,1.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,19,0,00000000,12,1,48,2,16,3.3,0.0004,2.0,9.2,1.3,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,20,0,00000000,12,1,50,3,18,4.7,0.0013,2.8,11.3,1.8,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,21,0,00000000,12,2,48,2,14,3.6,0.0004,2.1,8.8,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,23,0,00000000,12,2,48,2,17,3.7,0.0004,2.4,9.3,1.3,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,25,0,00000000,12,2,45,3,20,4.8,0.0013,2.2,11.2,2.6,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,28,0,00000000,12,2,48,3,18,4.0,0.0004,2.4,9.9,1.7,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,30,0,00000000,12,2,46,2,15,3.8,0.0004,2.2,8.6,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,31,0,00000000,12,2,46,3,19,5.6,0.0013,3.3,12.5,2.3,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,39,0,00000000,12,2,47,2,11,3.2,0.0004,1.7,6.7,1.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,43,0,00000000,12,1,58,2,17,3.6,0.0004,2.2,9.0,1.4,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 3,52,0,00000000,12,2,55,2,16,4.0,0.0004,2.0,8.7,2.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,14,0,00000000,12,2,46,6,38,24.2,0.0810,8.5,18.2,7.8,4.2,7.9,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,15,0,00000000,12,1,41,2,16,3.3,0.0004,2.1,9.3,1.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,17,0,00000000,12,2,44,2,15,2.7,0.0004,1.7,8.8,1.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,18,0,00000000,12,2,43,2,13,2.1,0.0004,1.4,8.7,0.8,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,19,0,00000000,12,2,42,2,16,3.4,0.0004,2.1,9.3,1.3,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,19,0,00000000,12,1,48,5,23,15.5,0.0710,6.3,14.3,9.2,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,22,0,00000000,12,1,50,3,18,4.3,0.0004,2.5,11.2,1.8,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,31,0,00000000,12,1,47,9,50,26.0,0.0700,9.3,15.2,4.3,4.2,5.4,21.3,3.8,4.2,3.2,0.0,. . . ,,,91
12,5,15,12, 4,49,0,00001000,12,1,48,9,61,73.0,1.9270,7.7,18.0,17.5,4.3,17.6,28.9,14.2,4.1,16.1,0.0,. . . ,,,91
12,5,15,12, 4,52,0,00000000,12,1,45,2,17,3.8,0.0004,2.3,9.7,1.4,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,54,0,00000000,12,1,44,3,18,5.0,0.0013,3.3,10.5,1.7,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,. . . ,,,91
12,5,15,12, 4,58,0,00000000,12,1,45,9,56,27.9,0.0745,9.4,13.7,6.0,4.7,4.8,27.9,2.5,4.0,5.3,0.0,. . . ,,,91
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