Comparing Arterial Speeds from “Big-Data” Sources in Southeast Florida (Bluetooth, HERE and INRIX)

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TRB National Transportation Planning Applications Conference (Atlantic City, NJ)

May 19, 2015

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Purposes

- Identify common auto travel speed ‘themes’ on the corridors where Bluetooth data was collected
- Is there a relationship between HERE, INRIX and Bluetooth auto speed data?
  - If yes, can we utilize HERE or INRIX for corridor planning studies instead of collecting Bluetooth or Floating car speed data ?
- What are the free flow and congested speeds in these corridors?
  - How do they compare against the local travel demand model speeds?
  - Is there a need to update model’s free flow speeds? How will it impact model’s congested speeds?

Background

- Bluetooth Data
  - Collected by FDOT D4 prior to the commencement of planning studies
  - 15-minute interval speed data along four corridors available (2012 & 2013)
  - No data clean-up required [performed by the software]
- INRIX Data
  - Purchased by FDOT Central Office
  - 12-month period (2010-2011) 5-minute interval average speed data
  - No further data clean-up required
- HERE Data
  - October 2013 data acquired by FDOT D4 from FHWA
  - Formatting similar to INRIX but not processed for outliers -> clean-up required

Corridors

Corridors	Timeframe of Bluetooth Data Collection	Segment Length (miles)	Number of Lanes*	Average Posted Speed (mph)	Average Daily Traffic Volume
SR-7 / US-441	October 2012	27.5	4LD-6LD (5.6LD Average)	45.1	49,000 (2009 AADT)
SR-817 / University Drive	November 2012	26.1	4LD-6LD (5.8LD Average)	45.0	50,000 (2011 AADT)
SR-820 / Hollywood/Pines Boulevard	Sept-Nov 2013	19.4	4LD-6LD (5.7LD Average)	41.0	38,000 (2012 AADT)
SR-5 / US-1	Sept-Nov 2013	11.4	4LD-6LD (5.1LD Average)	39.3	40,000 (2012 AADT)

*with few exceptions

These corridors were selected because all three data sources were available.

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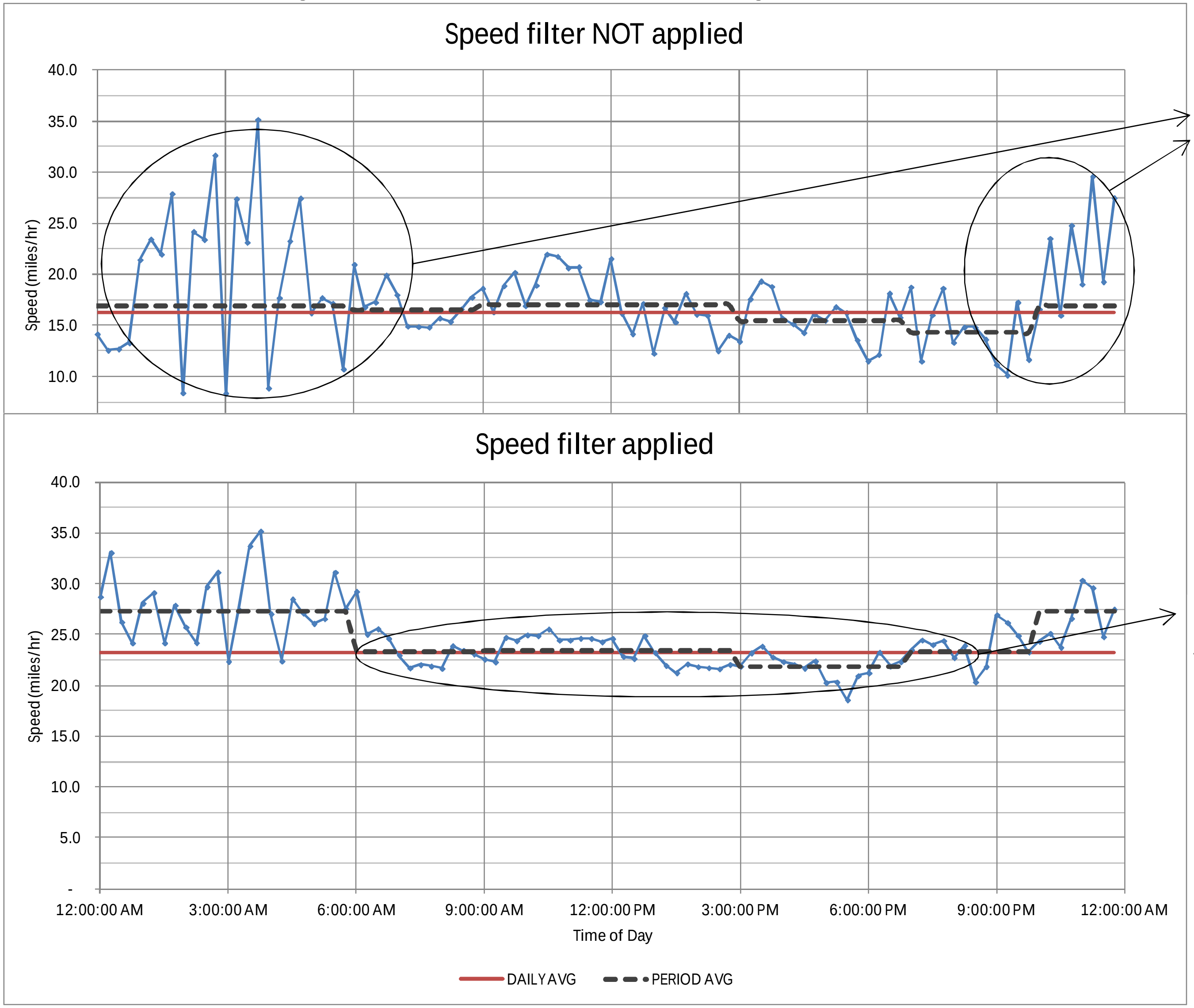
Methodology

- Used Tuesdays, Wednesdays and Thursdays data
- Five time periods used for analysis
  - AM Peak (6AM – 9AM), Midday (9AM – 3PM), PM Peak (3PM – 7PM), Evening (7PM – 10PM) and Night (10PM – 6AM)
- Speed data of 'all vehicles' is summarized by <u>direction</u>, by <u>period</u>, by <u>segment</u> for four corridors in Broward County
  - Average Speed *(period, segment)* = Sum of all TMC distances *(period, segment)* / Sum of all travel times *(period, segment)*
- 66 data points per period from each source
- HERE data filter - removed data with speeds <= 5 mph and >=60 mph (cliffs based on data mining)

HERE Data Speed Filtering – Example

Plots for all Hollywood EB TMCs at every 15 min interval



Very high variability in speeds

Smoother curve during AM, MD and PM periods

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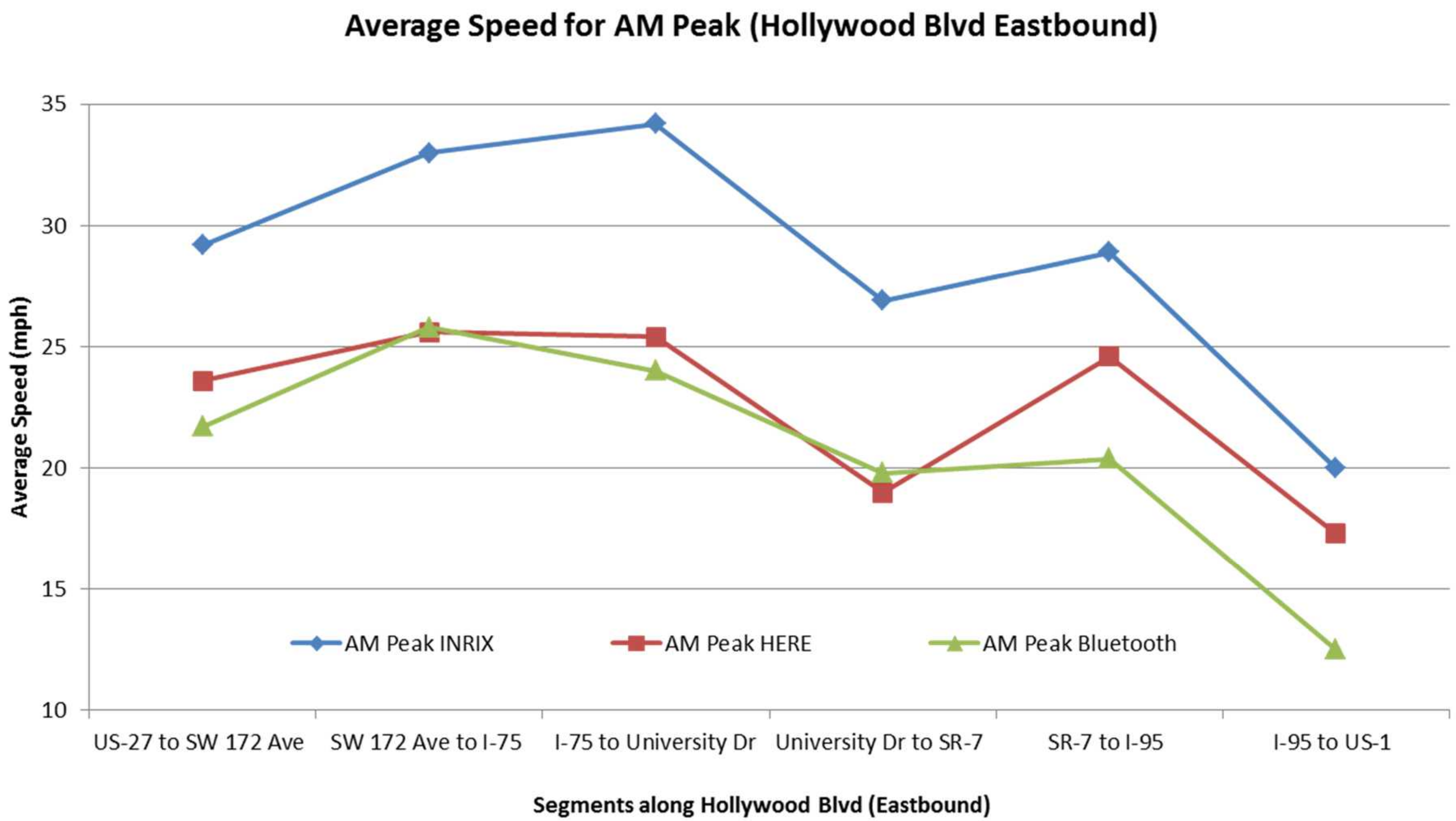
HERE Data Filtering – Why Necessary?

- Very high fluctuation in Evening and Night speeds compared to the day time speeds
- Speed variations are not specific to one TMC
- Abnormal observations (‘noise’) found on TMCs where speed at a given time (t) is very low compared to:
  - Speeds on the same TMC at t+5 and t-5 minutes
  - Speeds on adjacent TMCs at the same time (t)
- Little to no diurnal variations in speed
- Similar conclusions from both Hollywood and SR-7 corridor data
- Speed filtering removes the variations and abnormal observations in the data

Key Findings (1 of 5)



All three data sources estimate largely similar speed profiles both diurnally and along the roadway segments

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Key Findings (2 of 5)

Comparison	Stats	AM Peak	Mid-day	PM Peak	Evening	Night
INRIX vs. HERE	Mean Error (mph)	6.3	4.8	5.0	7.1	7.8
	Mean Percent Error	26%	20%	22%	29%	29%
	Mean Absolute Error (mph)	6.3	4.8	5.1	7.1	7.9
	Mean Percent Absolute Error	26%	20%	23%	29%	29%
	Root Mean Square Error (mph)	7.2	5.6	6.1	8.0	8.8
	Root Mean Square Percent Error	30%	22%	27%	34%	33%
Bluetooth vs. HERE	Mean Error (mph)	1.3	0.9	-0.2	3.6	4.9
	Mean Percent Error	5%	3%	-1%	15%	18%
	Mean Absolute Error (mph)	2.9	3.1	2.9	4.6	5.7
	Mean Percent Absolute Error	12%	13%	13%	19%	21%
	Root Mean Square Error (mph)	3.9	3.9	4.0	5.7	6.6
	Root Mean Square Percent Error	16%	16%	17%	24%	25%

Bluetooth and HERE data sets estimate remarkably similar “average” time of day travel speeds even at a segment-level

Key Findings (3 of 5)

Comparison	Stats	AM Peak	Mid-day	PM Peak	Evening	Night
INRIX vs. HERE	Mean Error (mph)	6.3	4.8	5.0	7.1	7.8
	Mean Percent Error	26%	20%	22%	29%	29%
	Mean Absolute Error (mph)	6.3	4.8	5.1	7.1	7.9
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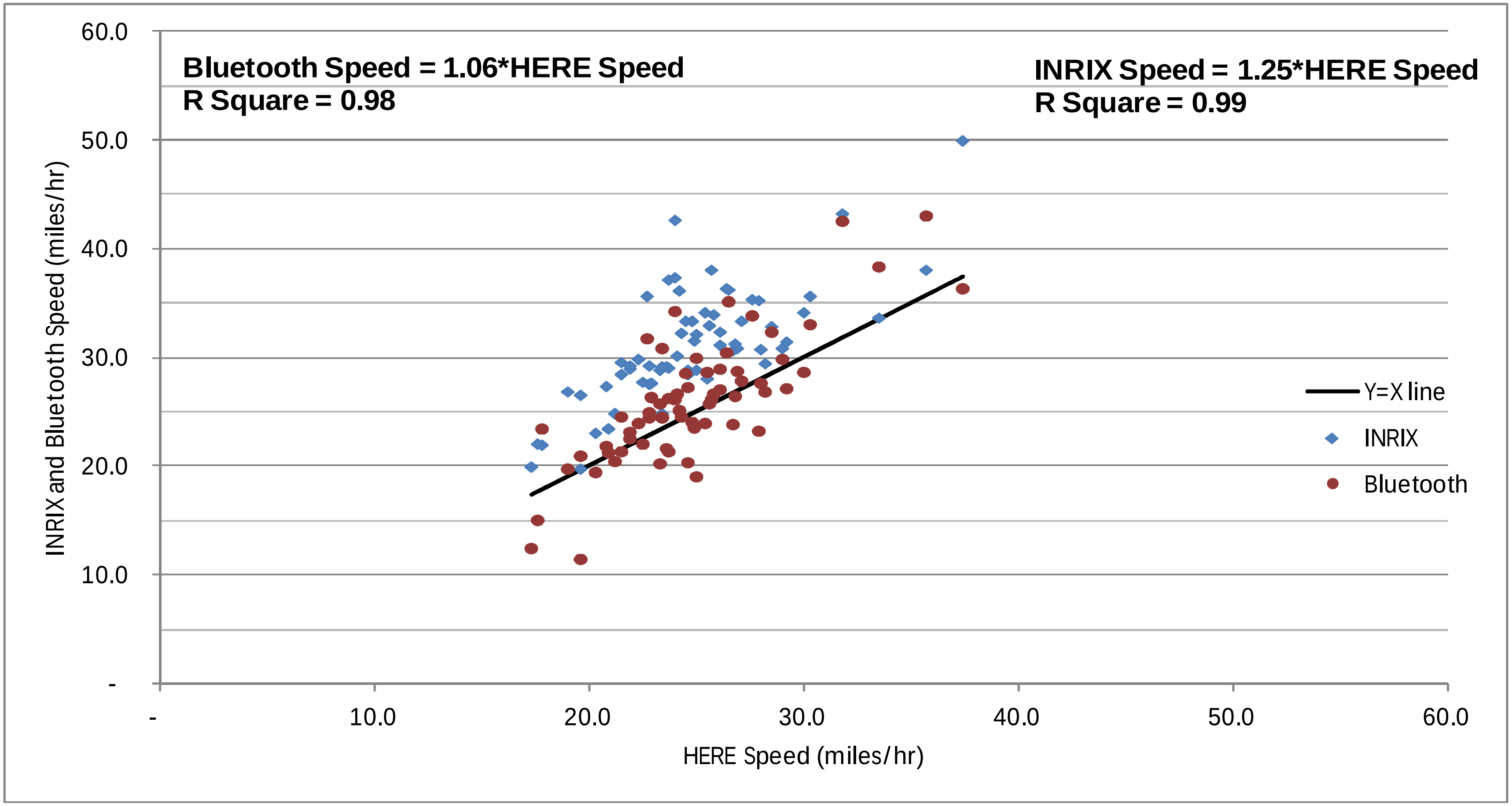
There is a greater variation in the night/early morning travel speeds in the three data sets than the day speeds

Key Findings (4 of 5)

AM Peak



Bluetooth and HERE travel speeds are in general 5 to 10 miles per hour lower than INRIX speeds during the day.

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Key Findings (5 of 5)

- Model free flow speeds on an average 10% faster than the observed Bluetooth speeds
- Model mid-day speeds similar to free flow speeds
  - Observed Bluetooth speeds are significantly slower
  - Difference of up to 15mph in certain segments (45% overall)
- Both AM and PM peak model auto speeds are faster than observed Bluetooth speeds
  - PM peak travel times on these corridors are severely under-estimated (average 30% overall)

The travel speeds estimates from the demand model were generally higher than all three data sources, especially for the mid-day period.

Summary of Key Findings

- All three data sources estimate largely similar speed profiles both diurnally and along the roadway segments
- Bluetooth and HERE data sets estimate remarkably similar "average" time of day travel speeds, even at a segment-level
  - INRIX speed > HERE speed for almost all data points across all five time periods
- Bluetooth and HERE travel speeds are in general 5 to 10 miles per hour lower than INRIX speeds during the day
- Greater variation in the night/early morning travel speeds in the three data sets than the day speeds
- The travel speeds estimates from the local travel demand model are generally higher than all three data sources, especially for the mid-day period

Common Corridor Themes

- The overall average travel speed during the day in the four corridors is 20-25 mph
  - Approximately half of the posted speed limits
  - **Mid-day is as congested as the AM peak**
  - Slowest travel speeds during the PM Peak
- Generally no peak direction of travel - both directions are equally congested -> function of the nature of the corridors selected
- Bluetooth free flow speeds (10 PM to 6 AM) are between 29-37 mph
  - Generally close to or lower than the regional model depending on the corridor

Recommendations

- For a planning study, if the HERE data is available for a corridor similar to the ones analyzed
  - No need to collect Bluetooth or floating car speed data
  - Filtering process necessary to remove the data noise
- Similar analysis necessary for other facility types when observed data becomes available
- Other potential usage of HERE data for planning and operational purposes should be explored further

Acknowledgments

- Scott Seeburger, FDOT District 4
- Shi-Chiang Li , FDOT District 4

THANK YOU!

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