From Big Data to Smart Decisions: Using Connected Vehicle Data to Power Regional Transportation System

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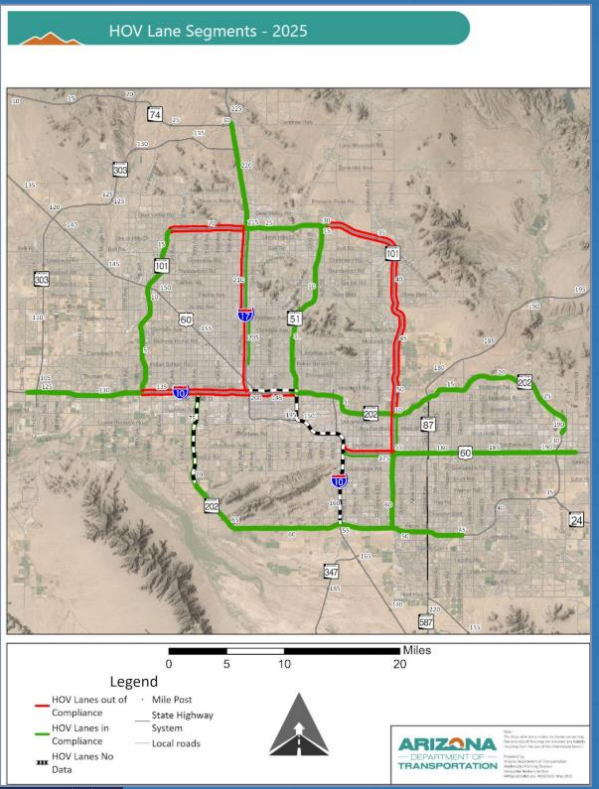
Background

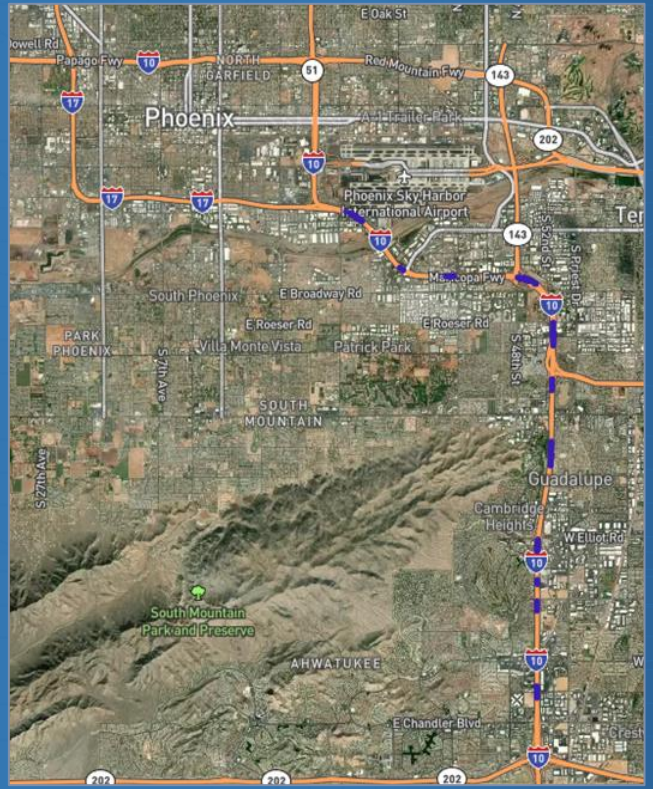
- **What is Connected Vehicle Data(CVD)**
- CVD trajectory data in **high frequency** (every 3-second)
- Reports **Timestamp, Latitude, Longitude, Speed, Heading**
- **About 5% of traffic** (passenger vehicle) in the MAG region
- Anonymous, privacy protected, consent obtained
- **MAG experience of using CVD data**
- Began to use CVD data since 2020
- Evaluated and worked with various CVD datasets and providers
- Developed many use cases in **system measuring and planning**
- Using several analytics/solutions developed from CVD data
- **Massive value and benefit in regional transportation system measurement and planning**
- High-resolution spatial-temporal measurement: **queuing, harsh braking, control delay, speeding, O/D, etc.**

Use Case 1:
Virtual Detector: Measuring HOV Lane Speed Based on CVD

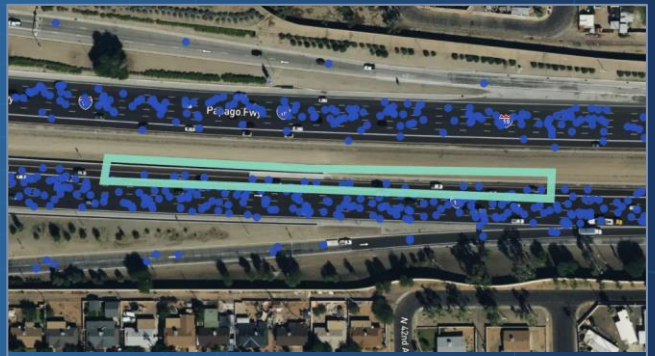
Data Missing
Due to Detector Malfunction/Construction



Virtual Detector Concept Demo



Speed Measurement Example



1. Remove outliers based on heading and speed
2. Calculate average speed using trajectory speed by time/ segment
3. Compare with ground truth speed
4. QC with sample size

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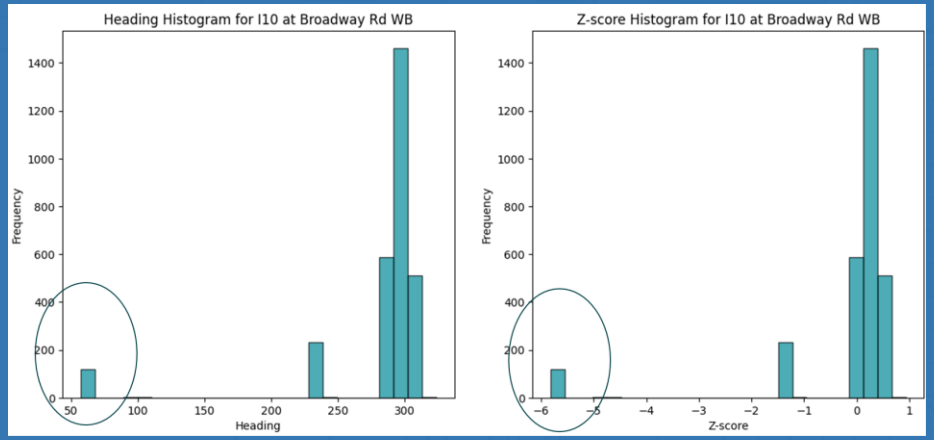
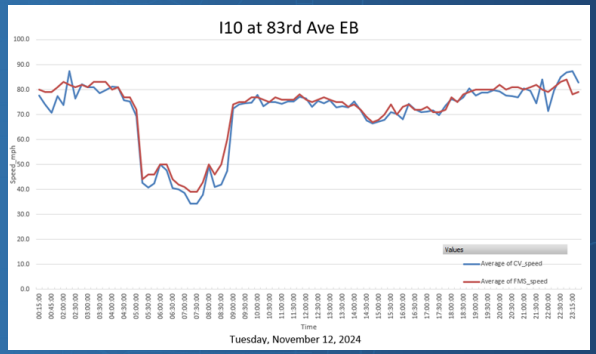
Use Case 1:
Virtual Detector: Measuring HOV Lane Speed Based On CVD

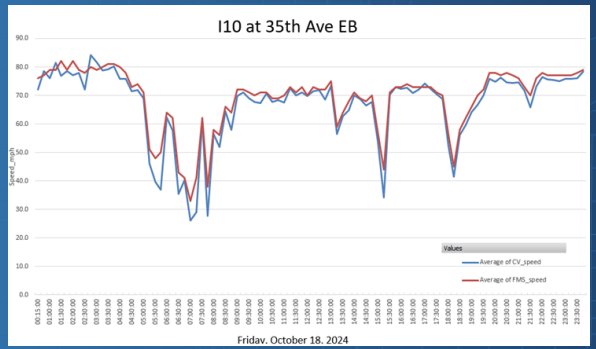
Remove Outliers(Z-score)



Det	Location	Route_Direction	date	time_bin	CV_speed	FMS_speed
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	00:00:00	80	80
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	00:15:00	79	78
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	00:30:00	73	79
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	00:45:00	79	80
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	01:00:00	80	80
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	01:15:00	78	80
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	01:30:00	77	83
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	01:45:00	78	80
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	02:00:00	76	81
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	02:15:00	76	82
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	02:30:00	78	82
2	I10 at 83rd Ave EB	I-10 EB	10/8/2024	02:45:00	80	81

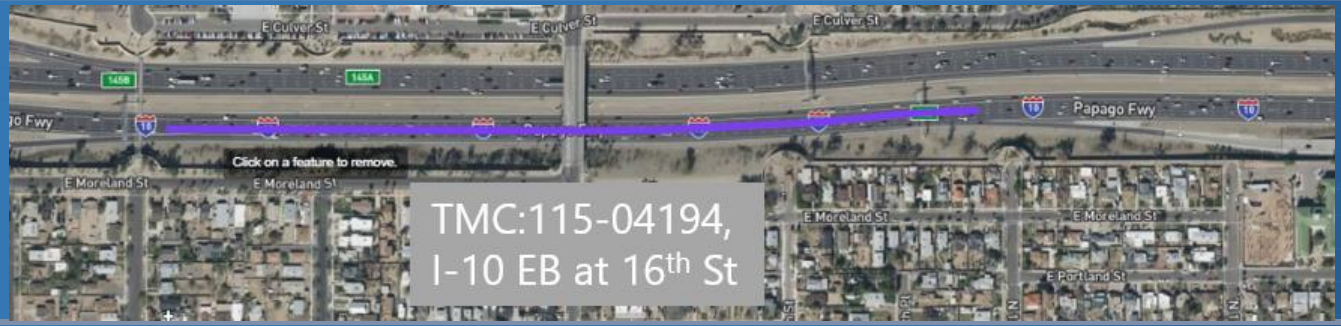
Consistent result to the ground truth





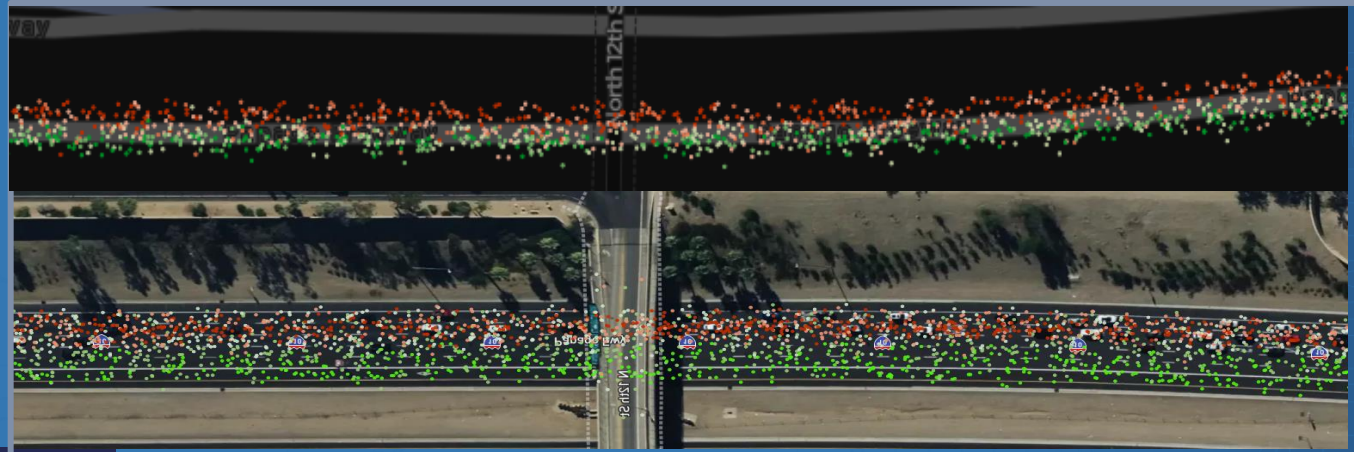
Use Case 2: Freeway Bottleneck Analysis

High frequency ,Speed Differential, Queue Jump based on CVD



Traditional

- Long segment
- Multiple lanes
- Aggregated speed



CVD

- Waypoint speed by every 3-second
- Lane specific speed measurement
- Queue jump analysis

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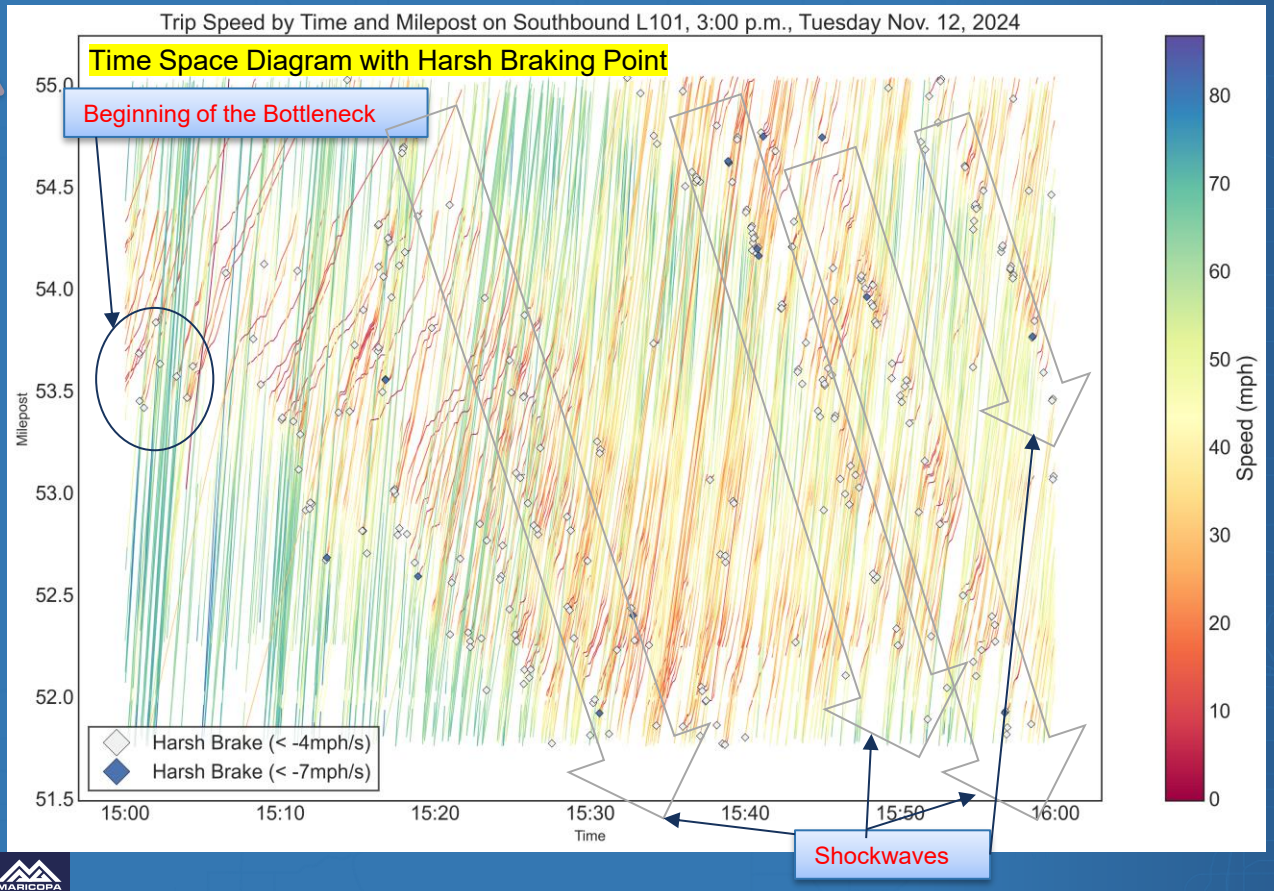
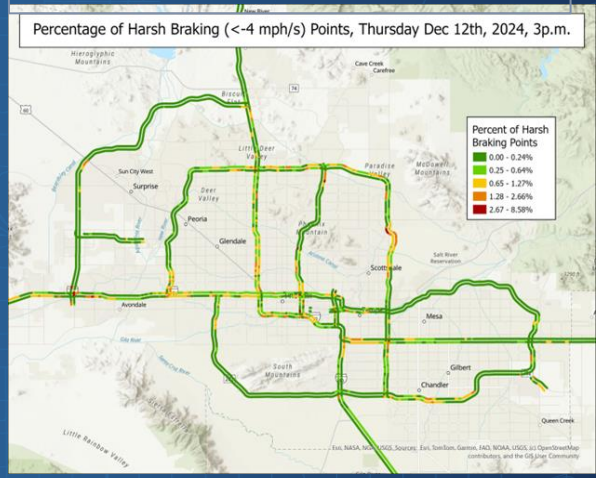
Use Case 2: Freeway Bottleneck Analysis



- Example #1 (left): Analyzing harsh braking patterns (extracted from CVD) to help pinpoint and identify congestion occurrence
- Example #2 (below): Scanning region-wide freeway network to detect dangerous driving zones measured by harsh braking events



Use Case 3: Arterial Analysis

New way to assess arterial operation/planning

traffic counts

speed

+

queue

harsh braking

aggressive acceleration /speeding/hard cornering

Queue analysis: Speed <=5mph

Harsh Braking Analysis

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THANK YOU

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