An Integrated Data Fusion Framework for Signalized Arterial Performance Measures

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OVERVIEW

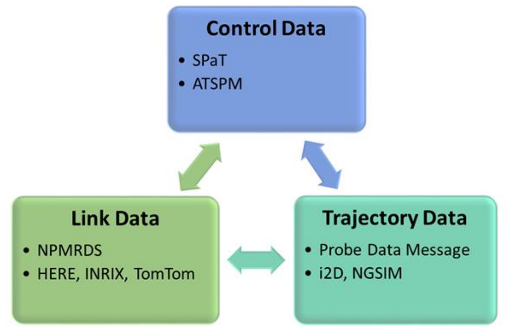
- There are around 350,000 traffic signals in the United States. 75% of these signals could be significantly improved by updating their timing plans.
- Bad traffic signal timing accounts for about 300 million vehicle-hours of delay on major roadways alone.
- Inefficient and ineffective methods are used for operations and maintenance of traffic signals. (local knowledge, driver complaints, long-range planning).
- As further data sources become available, there is uncertainty surrounding appropriate usage of each data source.
- Factors such as cost, availability, accuracy, reliability, and accessibility should be considered when deciding which data to use. Unfortunately, transportation managers are not usually informed of the most factors aside from a cost estimate during this process.
- We develop a data fusion framework to make use of different data sources for performance assessment of signalized arterials.

OBJECTIVES

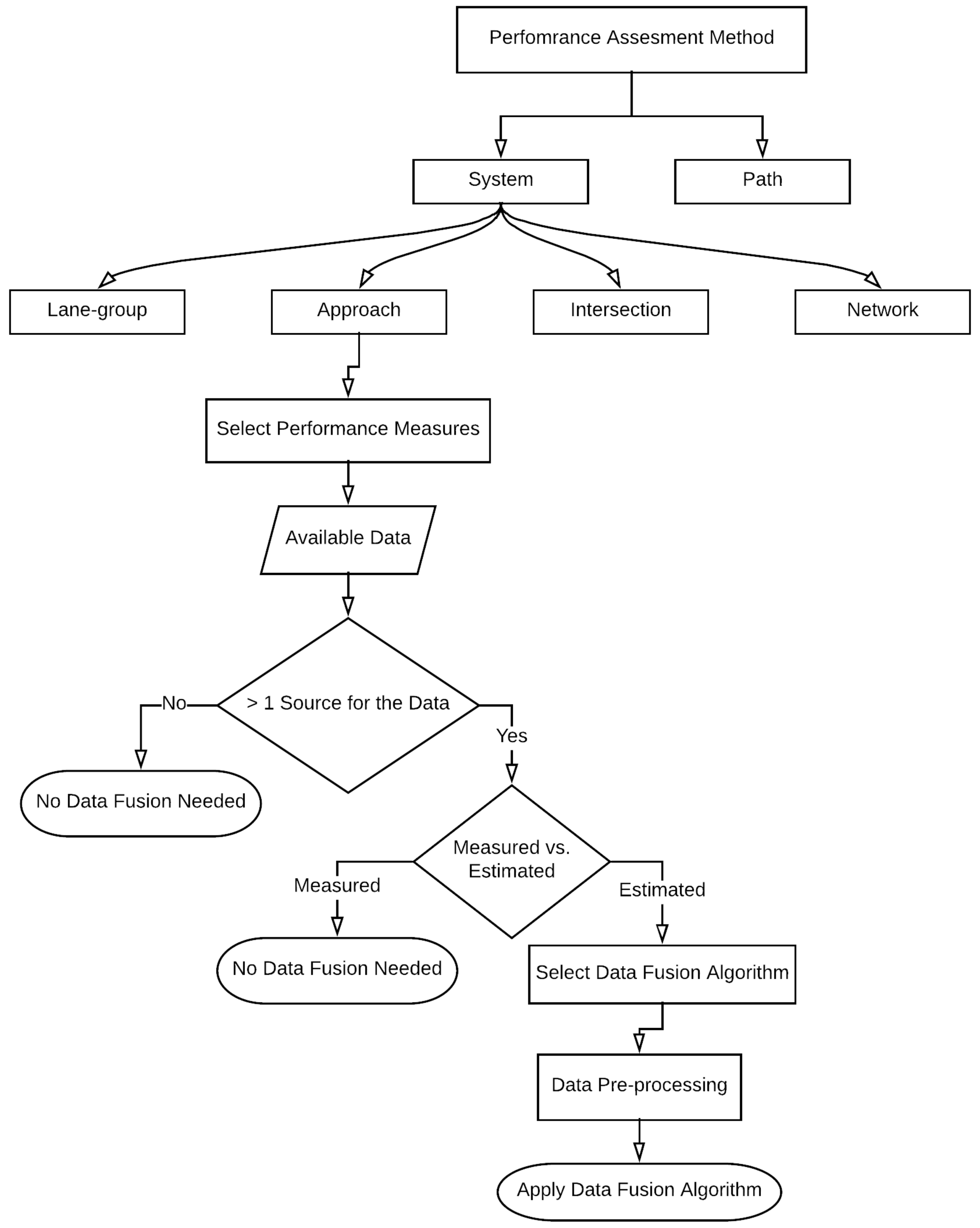
- Fusion of disparate data sources to better understand the operations of traffic signals and signalized arterials.
- Develop data fusion framework to incorporate data with different spatiotemporal resolutions including synthetic data sources.
- Evaluate the effectiveness of the developed framework

METHODOLOGY

- Available data sets

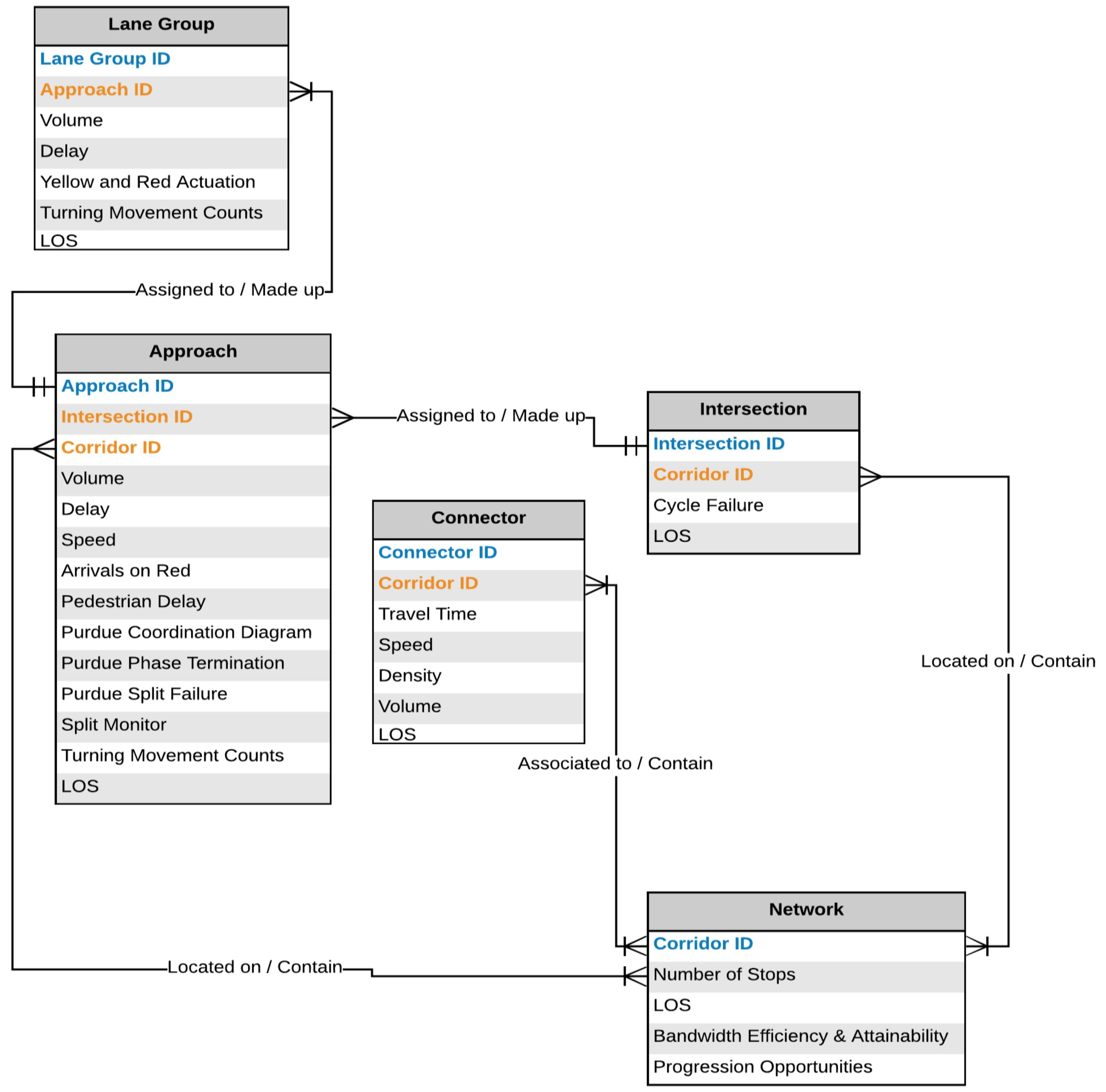


- Fusion Framework



METHODOLOGY (continued)

- System level spatial Entity Relationship diagram



- Candidate data fusion algorithms

Potential Data Fusion Algorithms

* Dempster-Shafer Theory
* Bayesian Inference
* Inference rules
* Weighted means
* Artificial Neural Networks
* Fuzzy Logic
* Fuzzy Neural Networks
* Kalman Filter
* K-means clustering
* Extended Kalman filter
* ...

METHODOLOGY (continued)

- Performance measures

Lane-group PM
* Delay
* Volume
* Yellow and Red Actuations
* Turning Movement Counts
* LOS

Approach PM
* Delay
* Volume
* Speed
* Arrivals on Red
* Pedestrian Delay
* Purdue Coordination Diagram
* Purdue Phase Termination
* Purdue Split Failure
* Split Monitor
* Turning Movement Counts
* Yellow and Red Actuations
* LOS

Intersection PM
* Delay
* Volume
* LOS

Network PM
* Travel time
* Speed
* Number of Stops
* Travel Time Reliability

Path level PM
* Number of stops
* LOS
* Bandwidth Efficiency
* Bandwidth Attainability
* Progression Opts.

CASE-STUDY

- Case study site is NGSIM's Lankershim Boulevard, an arterial running primarily north-south in Los Angeles.
- Four signalized intersections, 1600 feet in length, 35mph speed limit, and 3-4 arterial through lanes in each direction
- Available data: vehicle trajectory, link data, traffic signal control data, volume, origin-destination, travel time, speed and lane-changing.
- In the near future, the team intends to test the developed fusion framework to assess the performance of this arterial.
- Application of the framework to NC 55 and Western Boulevard in North Carolina is next.