CENTER FOR TRANSPORTATION RESEARCH

Understanding the impacts of freeway lane closures through data: a combined analysis of NPMRDS and fixed-sensor data

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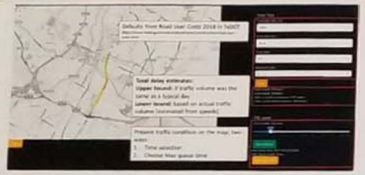
ASSESSING THE IMPACT OF CLOSURES

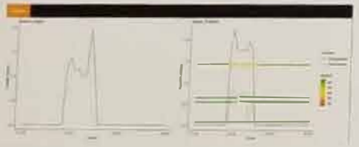
- User delay costs are often use by agencies to evaluate the impact of lane closures
- Current approaches to evaluate user delay cost involve ESTIMATION using simple deterministic queue models or simulations.
- **Probe-based speed data can support a direct evaluation of user delay costs.**
  - Benefits: direct measurement of queue length and position over time.
  - Limitations:
    - Location of start/end of queue is not precise, particularly for long segments.
    - Volume information must be obtained from separate sources.

Illustration of proposed method

APPROACH

- Estimate queue lengths and position over time based on NPMRDS speed data.
  - "Queued" links are identified using a speed threshold.
  - Simple method to better approximate queue start and end point for selected speed thresholds.
- Estimate volumes based on speed-flow curves calibrated using NPMRDS data and a limited number of traffic sensors.
- Estimate user delay cost by combining traffic volumes and delays.
- Implement using R-shiny package to facilitate use.





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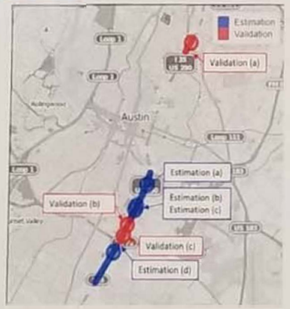
VOLUME ESTIMATION

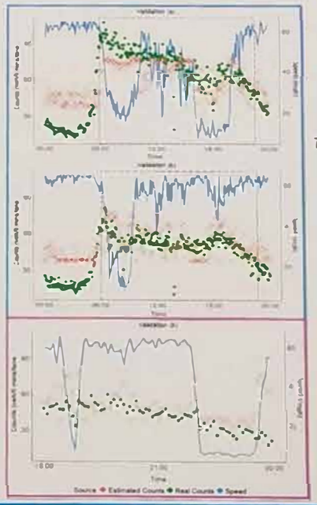
- **Data Collection**

Time	Speed from seg. 1	Counts from sensor A
2019/1/9 6:00	35	100
2019/1/9 6:05	40	90

- **Relationship between volume and segment speed**

- **Validation**





Typical day

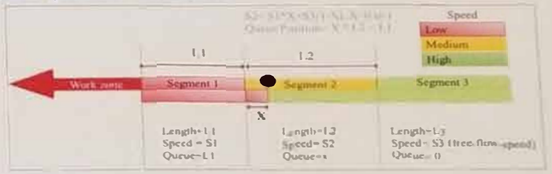
Closure day

Interval (minutes)	Mean (vehicles)	Standard Deviation (vehicles)	RMSE: Speed-flow diagram (vehicles)	RMSE: NPMRDS (vehicles)
5	68.62	17.64	15.22	99.846
10	122.51	42.97	26.10	159.35
15	169.70	71.92	35.95	222.709
30	290.02	162.13	61.50	393.594
60	480.76	333.51	103.77	643.403
120	779.07	649.75	171.99	1 174.33

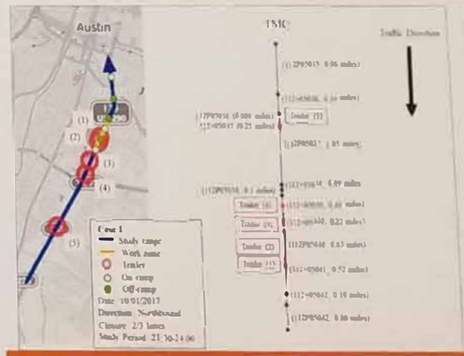
Comparison of flow estimates using proposed speed-flow diagram and generic NPMRDS method (NPMRDS User Delay Cost Analysis. https://npmrds.ritis.org/analytics/help/#udc-19 analysis/how-user-delay-cost-is-calculated)

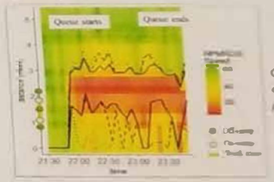
QUEUE ESTIMATION

- **Queue position refinement**

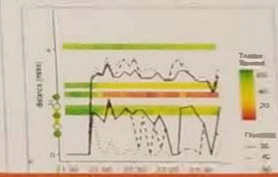


- **Case Study**
  - Data
    - Segment-level (TMC) speeds every 5 minutes used for queue position estimation.
    - Smart work-zone trailer speed data used to validate queue position





Queue position estimates and raw data



Validation using work zone trailer data

FINDINGS

- **Estimation of queue lengths and position over time based on NPMRDS speed dat**
  - **Speed thresholds of 30 mph or lower are likely to provide more stable results.**
- **Estimation of corridor-level speed-flow relationship based on data from a limited number of sensors.**
  - **The model performs well within most traffic conditions (6 am–10 pm), improvi upon the more generic method typically used for NPMRDS data.**
  - **The model tends to over-estimate traffic counts in low-volume/high-speed situ tions.**

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