A Data-Driven Methodology for Prioritizing Traffic Signal Retiming Operations

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Motivation

Signal retiming is one of the chief responsibilities of municipal transportation agencies, and is an important means for reducing congestion and improving transportation quality and reliability. **Leveraging a data-driven approach to prioritizing signal retiming operations could better optimize use of agency resources.** This study presents a methodology for utilizing probe-based speed data to rank the performance of traffic signal corridors for retiming purposes. This methodology is then demonstrated in an analysis of 79 traffic signal corridors maintained by the City of Austin, Texas.

Background

Scale
- City of Austin (CoA) maintains ~1,000 signals over 300 mi²
- Signals are grouped into 90 corridors

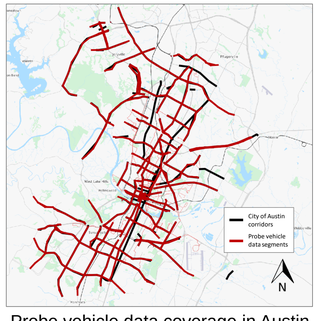
Selection
- 1/3 of signals are retimed every year
- Creates three-year, schedule-based system

Evaluation
- Floating car travel time runs
- Percent travel time reduction per corridor

GOAL: Improve the system-level benefits of signal retiming by developing a data-driven approach for corridor selection/prioritization

Data

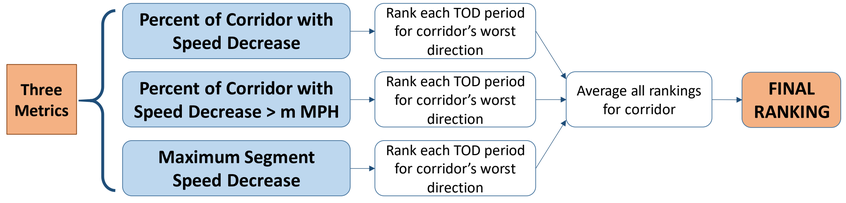
- CoA purchased **probe vehicle traffic dataset** from third-party vendor
- Chosen for extensive coverage of study area (87% of CoA corridors)
- Speed data collected through network of participating users' cell phones
- Data delivered in segment-level records
- Available in data granularity ranging from 1 min to 1 hour
- Limitations: no information on vehicle volumes or data penetration rates



Probe vehicle data coverage in Austin

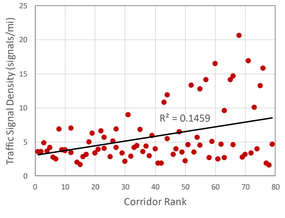
Methodology

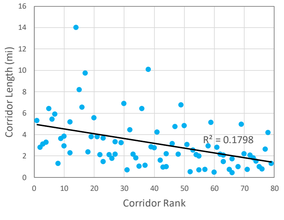
- **Challenges: (1) aggregating data without "washing out" variation and (2) comparing corridors of differing length and functional classification**
- Created three corridor-level metrics to capture performance deterioration between two "comparison periods"
- Compared corridors at different time-of-day (TOD) periods
- Combined metrics to produce a ranking of corridors based on their potential for improvement



Results

Rank	Corridor	Percent Experiencing Speed Decrease AM	Percent Experiencing Speed Decrease PM	Percent Experiencing Speed Decrease > 3 MPH AM	Percent Experiencing Speed Decrease > 3 MPH PM	Maximum Speed Decrease AM	Maximum Speed Decrease PM	Total Length (mi)	Number of Signals
1	US 290 - East	95.93	96.85	21.30	25.62	-28.38	-28.25	5.30	19
2	US 183 - Central	86.29	86.14	48.51	30.02	-19.61	-5.17	2.79	10
3	US 183 - South	48.37	65.08	47.65	48.68	-11.35	-11.23	3.08	15
4	51st	70.75	94.57	24.87	24.87	-3.82	-5.79	3.26	12
5	Airport	63.07	80.88	14.66	21.64	-3.82	-7.30	6.41	27
6	MLK - East	60.12	89.35	19.54	13.38	-3.55	-6.04	5.42	15
7	Lamar - North	75.65	86.24	7.93	7.93	-3.69	-5.45	5.88	15
8	Enfield	56.49	100.00	8.28	21.47	-3.21	-4.09	1.30	9
9	Ben White - East	91.28	52.72	37.55	28.08	-5.43	-9.35	3.61	14
10	Manor	79.88	67.69	3.55	3.55	-4.96	-6.47	3.83	15
10	Pleasant Valley	80.22	99.05	0.00	42.95	-2.16	-8.38	2.93	11
12	IH 35 SRVC RDS	46.65	67.96	16.66	55.77	-6.09	-6.40	2.27	16
12	Southwest Parkway	46.57	71.24	21.57	21.57	-5.99	-6.96	5.16	18
14	Parmer - West	44.31	74.05	11.13	14.86	-10.02	-8.85	13.99	29
15	Loop 360 - North	26.26	49.05	3.60	31.89	-8.31	-13.48	8.17	14
16	Brodie	100.00	70.96	0.17	8.28	-4.09	-4.37	6.55	19
17	Slaughter	49.52	67.71	17.30	20.29	-5.20	-5.37	9.75	31
18	7th - East	66.31	89.97	0.96	20.79	-3.28	-3.90	2.38	12
19	Riverside	63.00	83.07	0.77	13.76	-3.35	-5.37	3.79	24
20	Braker	59.18	63.70	0.36	0.00	-4.03	-2.48	5.56	19
21	Lamar - Central	90.14	63.44	0.00	0.95	-2.51	-3.35	3.78	15
22	Cameron - South	61.16	59.75	6.67	0.00	-3.98	-2.72	2.10	14





Findings and Conclusions

- Top three corridors are all major frontage roads for area freeways (likely due to construction on freeways)
- Corridors were not favored based on length or traffic signal density
- Ranking methodology presented greater potential for improvement than schedule-based system
- **This systematic prioritization of corridors for retiming is likely to lead to larger improvements in system performance than the schedule-based system, increasing the agency's ability to provide the best possible transportation services to the public.**

Future Work

Augment with new data sources	• Vehicle volume data • High-resolution detector data
Expand study period	• Current study used two months • Explore possible effects of seasonal variation
Develop reliability metrics	• Assess speed/travel time variation • Impact on decision-making for adaptive signal control
Explore data relationships further	• Underlying relationships between corridor length, signal density, and performance
Explore area-based metrics	• As opposed to corridor-based signal organization • Specifically, in dense urban setting (downtown grid)

Acknowledgements

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