Reliability, Flexibility, And Environmental Impact Of Alternative Arterial Offset Optimization Objective Functions

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Motivation
There are a number of different opinions on which optimization objective function is best. It is desirable to use high resolution controller data and probe vehicle travel times to compare multiple objective functions to determine which function performs best on a coordinated arterial?

Approach
- Establish a baseline measurement of travel time along an arterial.
- Optimize offset times using four alternative objective functions:
  - Minimize delay
  - Minimize delay and stops
  - Maximize vehicle arrivals on green
  - Maximize vehicle arrivals on green without startup time
- Implement four optimized offsets at eight intersections
- Measure travel times of probe vehicles to assess travel time associated with each objective.
- Calculate the potential driver benefits for changing offset times to accommodate optimal travel time and platoon dispersion.

Effect Of Adjusting Local Offset To Shift Vehicle Arrivals With Respect To Green Time

Offset Objective Function Concept
- Objective I: Minimize delay (d)
  \[ d = w \sum q_i \]
- Objective II: Minimize delay and stops in a performance index (PI).
  \[ PI = d + k \sum S_i \]
- Objective III: Maximize arrivals on green (N_g) [From Pro-Tracts & ACS/lite]
  \[ N_g = \sum G_i N_i \]
- Objective IV: Maximize arrivals on green with queue clearance time set at 10 seconds

Vehicle Arrivals Per Cycle Per Bin

Performance Index (veh-h/h)

Offset Adjustment

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

Offset Objective Function Example

Objective I: Minimize Delay

Objective II: Minimize Delay & Stops

Objective III: Maximize Arrivals On Green

Objective IV: Maximize Arrivals On Green With 10s Queue Clearance

Calculated Optimal Offsets Tested On Weekend Plans Along Study Corridor

- FIVE SATURDAY DATA COLLECTION PERIODS
- AVERAGE SATURDAY VEHICLE VOLUME: ~ 50,000
- TIME OF DAY PLAN: 0600 – 2200
- INTERSECTIONS: 8
- CYCLE LENGTH: 114 Seconds