MDOT-MSU Traffic State Monitoring System

Phase II: Traffic Signal Performance Monitoring based on high-resolution traffic signal event data

(Preliminary design)

3rd Project Progress Meeting
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Outline

• Introduction of high-resolution traffic signal event data

• Modification to Detectors (Wavetronix)

• System UI design

• Background database design

• Data visualization Algorithm

• Discussion for new projects
Some new findings of the Wi-Fi system

Thursday of Thanksgiving week

Weekend
Introduction

• System detectors (connected to traffic signal cabinet) have been used to collect traffic states on arterials
  • Traditionally, The reported data, such as counts, occupancies or green usages, are aggregated from individual traffic signal events every 5, 10, 15 min or hour
• Dr. D. Bullock and his research group at Purdue University first proposed the concept of “high-resolution” (i.e., individual) traffic signal events and design new traffic state methods with the type of data
  • They also developed the “de facto” standards for traffic signal event definitions
  • Most Linux controllers today generate such data, such as Siemens M60

References: https://docs.lib.purdue.edu/jtrpaффdocs/3/
Modification of traffic signal detectors

- Phase-related events (e.g., green start, overlap start, etc.) are collected by default
- Detector configuration must be modified to generate the traffic signal performance diagram
  - Advance detectors (pulse): to estimate arrivals during the green in conjunction with phase events
  - Stop-bar detectors (presence): to estimate cycle failure in conjunction with phase events
  - Detectors after stop bar (presence): to estimate red/yellow-light runners

http://10.131.12.68/
(Wavetronix Phase 2 and 6 for this intersection)
Active Phase Events
1. Phase Begin Green
2. Phase End Green
3. Phase End Red
4. Phase Gap Out
5. Phase Max Out
6. Phase Force Off
7. Phase Begin Green
8. Phase Begin Yellow Cl
9. Phase End Yellow Cl
10. Phase Begin Red Cl
11. Phase End Red Cl
12. Phase Inactive

Active Pedestrian Events
21. Ped Begin Walk
22. Ped Begin Clearance
23. Ped Begin Don’t Walk
24. Ped Dark

Ped Dark Barrier/Ring Events
31. Barrier Term
32. FYA Begin Perm
33. FYA End Perm

Phase Control Events
41. Phase Hold Active
42. Phase Hold Released
43. Phase Call Registered
44. Phase Call Dropped
45. Ped Call Registered
46. Phase Omit On
47. Phase Omit Off
48. Ped Omit On
49. Ped Omit Off

Notes:
* Barrier is identified by the number of the phase preceding it in the ring
* FYA is identified by the number of the corresponding protected phase.
* Event is not yet supported.

Overlap Events
61. Overlap Begin Green
62. Overlap Begin Trailing Green
63. Overlap Begin Yellow Cl
64. Overlap Begin Red Cl
65. Overlap Off
66. Overlap Dark
67. Ped Overlap Begin Walk
68. Ped Overlap Begin Clearance
69. Ped Overlap Begin Don’t Walk
70. Ped Overlap Dark

Detector Events
81. Detector Off
82. Detector On
83. Detector Restored
84. Detector Fault – Other
85. Detector Fault – Watchdog
86. Detector Fault – Open Loop
87. Detector Fault – Shorted Loop
88. Detector Fault – Excess Change
89. Ped Detector Off
90. Ped Detector On
91. Ped Detector Failed
92. Ped Detector Restored

Preemption Events
101. Preempt Adv Warning
102. Preempt Input On
103. Preempt Gate Down
104. Preempt Input Off
105. Preempt Entity Started
106. Preempt Begin Track Cl
107. Preempt Begin Dwell
108. Preempt Link Active On
109. Preempt Link Active Off
110. Preempt Max Pres. Exceeded
111. Preempt Begin Exit
112. TSP Check In
113. TSP Adjust Early
114. TSP Adjust Late
115. TSP Check Out
System Architecture (with modified sensor)
Background database design

• Two new database tables are generated:
  • Intersection List:
    ![Intersection List Table]
  • PCD segment List:
    ![PCD segment List Table]
A snapshot of raw and “enhanced raw” signal event data and interpretations

Enhanced raw data

Intersection layout

Raw data

Definitions
Algorithms to generate Purdue Diagram(s)

- Diagram: Arrivals During Green
  - Green starts, ends and durations of each cycle
    - Step 1: Check Event type 1 (phase start) and 7 (phase end) for the subject phase (e.g., 2)
      - Cycle length is calculated as the time elapsed between two phase-ends event.
    - Step 2: For each cycle, scan all the event type 82 for the corresponding advance pulse det (e.g., 25)
      - Plot according time (x) and the time difference to the phase end event (y)
New research ideas?

• Installation at new locations?
  • We have deployed the system on the MDOT server
  • It’s ready to deploy at new locations

• Safety related?
  • Red-light-running?
  • FLA impact on the safety?
  • Dilemma zone and dilemma zone protection?
  • Continuous turning movement counts?