Topic 4
(Chapter 20)
Actuated Signal Control
Types of Signal Operation

- **Types of signal control**
  - Fixed or pre-timed
  - Fully actuated
  - Semi-actuated

- **Fully actuated signal**
  - Based on vehicle detection
  - Varied green and cycle

- **Types of detectors**
  - Inductive loop
  - Video image
Actuated Signal Operation

- Types of detection
  - Passage or point detection
  - Presence or area detection
Terms for Actuated Operation

- Controller terms
  - Minimum green (5~10 sec)
  - Minimum initial (min. initial + Unit Extension = Min Green)
  - Unit or vehicle extension or passage gap (0.0~4.0 sec)
  - Maximum green
  - Min Recall and Max Recall
Vehicle Extension/Passage Gap, $p$

- When the time gap between detector activations exceeds $p$, the phase terminates (gaps out)
Passage Gap and Maximum Allowable Headway

- Maximum allowable headway is the headway above which the signal phase will gap out.

\[ h = \frac{L_d + L_v}{1.47S} + P \]
Example

Vehicles traveling on a signalized approach at the speed of 50 mph. Assume the detector length on the approach is 6 feet, and the vehicle length is 15 ft. If the signal operation is designed to gap out the phase when a vehicle headway is greater than 4.0 sec. What passage gap value (unit extension) should be set in the signal controller?
Effect of Detector Location – Stop Line

- When the phase gaps out and yellow starts, the car has already passed the intersection. The green time after the last vehicle is wasted.

\[ t_1 \text{ – time the last vehicle left the detector} \]
\[ t_2 \text{ – phase gaps out, yellow starts} \]

During \((t_2 - t_1)\), the phase is green, but not used.
Effect of Detector Location – Advance

- When the phase gaps out and yellow starts, the car is at the intersection. The green time is used to serve the last vehicle.

- \( t_1 \) – time the last vehicle left the detector

- \( t_2 \) – phase gaps out, yellow starts

During \( (t_2 - t_1) \), the phase is green.
The best location for advance detector is when the phase gaps out and yellow starts, the last vehicle can either stop or pass through the intersection.
Current practice for multi-lane approach is to have the detectors on both lanes connected to the same detector (phase).
Single Detection vs. Lane-by-lane Detection

- $h = 4$
- $h' = 2$

CEE 463/663 – Fall 2006
Vehicle Recall

- **Min Recall** – place a call to the phase automatically, even without vehicles on the detector. The phase will run the minimum and then extend based on activations.

- **Max Recall** – place a call to the phase automatically, even without vehicles on the detector. The phase will always run to the maximum.

- For fully-actuated operation, a phase will terminate only if it either gaps out or max out, and there is a call on the conflicting phase(s)

- **Pedestrian Phase and Pedestrian Recall**
  - When there is a pedestrian, the phase will run WALK + FDW
  - When set Ped Recall, the phase always runs WALK + FDW
Single Detection vs. Lane-by-lane Detection
This exercise is designed to use Synchro/SimTraffic to demonstrate the actuated signal operations. You need to set up a signalized intersection based on the following information:

- A signalized intersection with two one-way streets: westbound is controlled by phase 2, and northbound is controlled by phase 4. Northbound has a pedestrian phase, 6 sec for WALK, and 20 sec for FDW. Set min initial 4 sec, passage gap 3.0 sec, yellow 3.0 sec, and all-red 1.0 sec.
- Both approaches have a stopline calling-only detector of 30 ft long and a 6-ft advanced detector, located 120 ft from the stopline (refer to SimTraffic help for coding detectors).
- The westbound is the main street, so green resides on the westbound direction when there is no vehicle call on the northbound direction (i.e., min recall on westbound).
- Traffic demand: westbound – 400 vph; northbound – 200 vph; PHF=1.0; No trucks.
- Set cycle length to 60 sec, actuated-uncoordinated (fully-actuated), and even phase splits for both approaches.

Observe the signal animation in SimTraffic, and answer the following questions:

1. Does phase 4 always get the split inputted in Synchro? When is it shorter than the inputted phase length?
2. When does the gap counter reset, and when does the phase terminate?
3. Under what conditions that phase 2 gaps out (gap counter is zero), but it remains green?
4. Add pedestrian flow of 40 ped/hr for the northbound. When does phase 4 get the inputted split? Comment on the pedestrian impact on signal operations.
5. Comment on any other observations of the operations.
Phase Extension

- Some theoretical work done by Akcick, Wu and Tian on calculating phase extension.