



Gray Areas in Isolated Intersection Control-Type Selection

A Complementary Decision-Support Tool

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Overview

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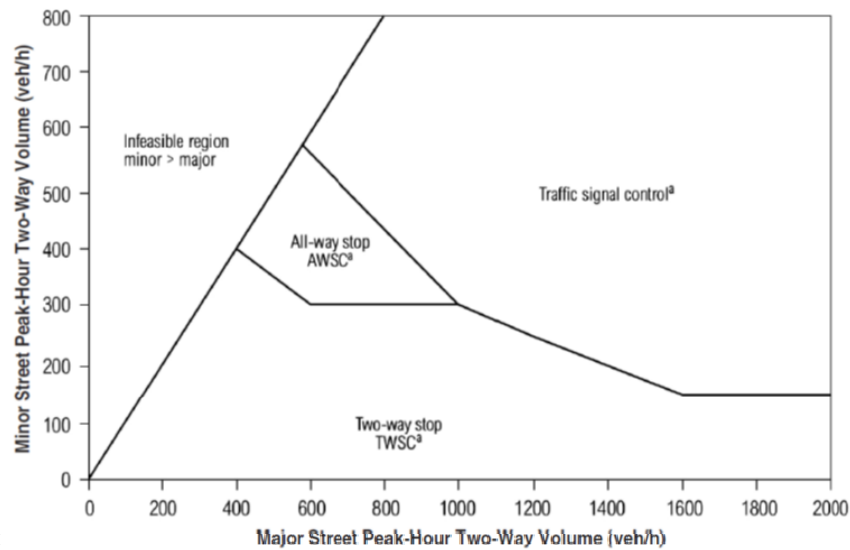
About me

- BS in Transportation System Engineering, Ajou University, South Korea
- MS in City Planning, Seoul National University, South Korea
- Worked as a Traffic Engineer/Traffic Signal Operator in Seoul, South Korea
- PhD Candidate in Civil Engineering/MS Candidate in Statistics, University of Tennessee

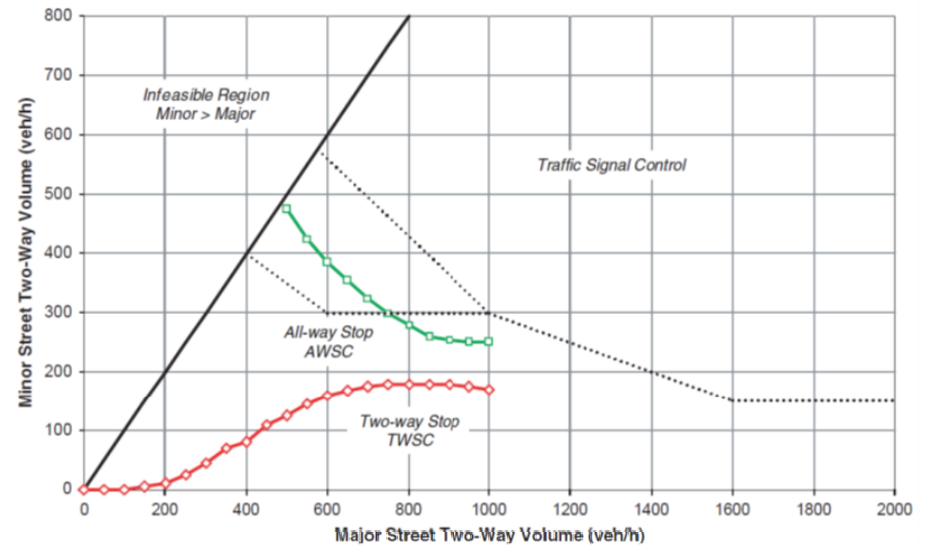


Motivation

- Previous works for intersection control type comparison



(a) Highway Capacity Manual 2000



(b) Han et al. (2008)

Motivation (Cont'd)

- How to deal with uncertainties in a modeling process?

- Control Delay (HCM 2010)

- Signalized Intersections:
$$d = \frac{0.5C(1-g/C)^2}{1-[\min(1,X)g/C]} + 900T \left[(X - 1) + \sqrt{(X - 1)^2 + \frac{8kIX}{clgT}} \right]$$
- Two Way Stop Control (TWSC):
$$d = \frac{3,600}{c_{m,x}} + 900T \left[\frac{v_x}{c_{m,x}} - 1 + \sqrt{\left(\frac{v_x}{c_{m,x}} - 1\right)^2 + \frac{\left(\frac{3,600}{c_{m,x}}\right)\left(\frac{v_x}{c_{m,x}}\right)}{450T}} \right] + 5$$
- All Was Stop Control (AWSC):
$$d = t_s + 900T \left[(x - 1) + \sqrt{(x - 1)^2 + \frac{h_d x}{450T}} \right] + 5$$
- Roundabout:
$$d = \frac{3,600}{c} + 900T \left[(x - 1) + \sqrt{(x - 1)^2 + \frac{\left(\frac{3,600}{c}\right)x_{vc}}{450T}} \right] + 5 \times \min[x_{vc}, 1]$$

Motivation (Cont'd)

- Does a human driver perceive one or two seconds of delay difference at an intersection?
 - “User-perceived service quality ratings do not correspond to the level of service evaluated using the HCM methods”

- Lee et al. (2007)
 - “... weak linear association between user perceptions (LOS ratings) and capacities (or volume-to-capacity ratios).”

- Chen et al. (2009)
 - “Trip purpose, socioeconomic-, road-related characteristics, and weather conditions are all significant influential factors ... ”

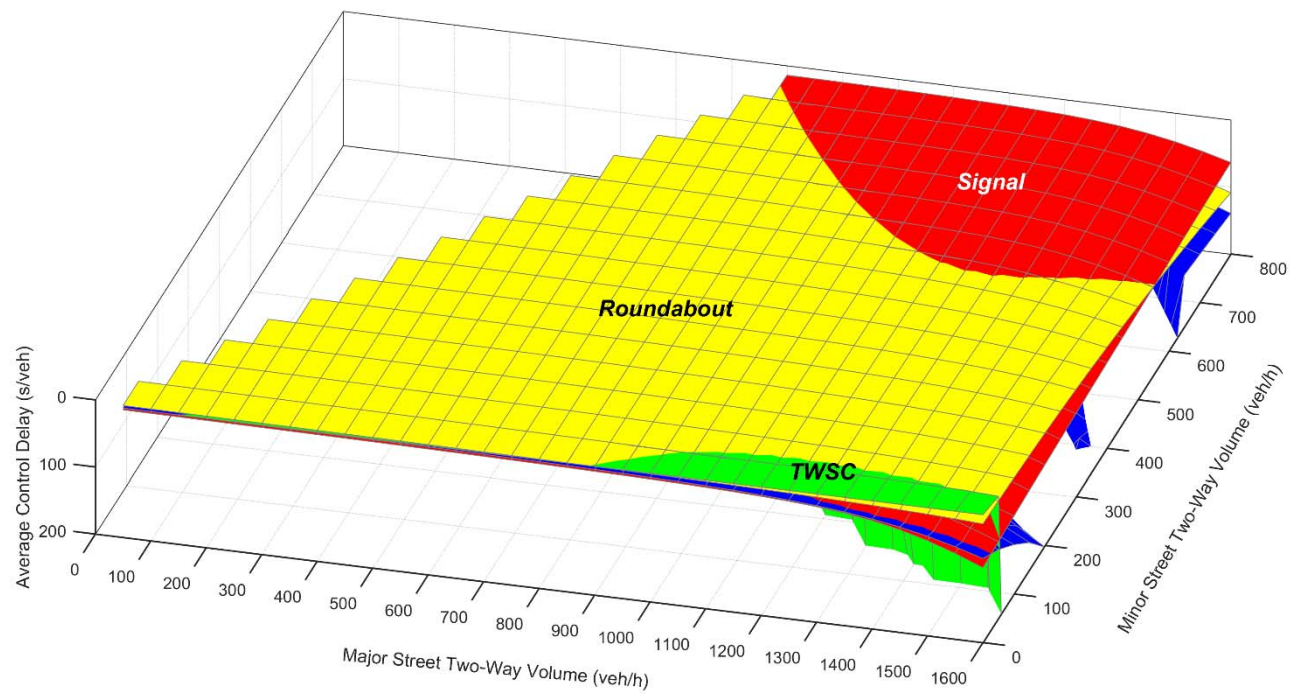
- Jou et al. (2013)

Scenario design for analysis

- Control delay comparison for the intersection control types:
 - TWSC, AWSC, Signal Control, and Roundabout
- Average control delay models of *HCM* 2010 (FHWA)
- Total 21,525 scenarios were analyzed in terms of the following factors.
 - 4-legged single-lane intersection
 - Major and minor streets volume of 0-2,000 veh/h in 50 veh/h increments
 - Left-turn volume percentage of 0-20%

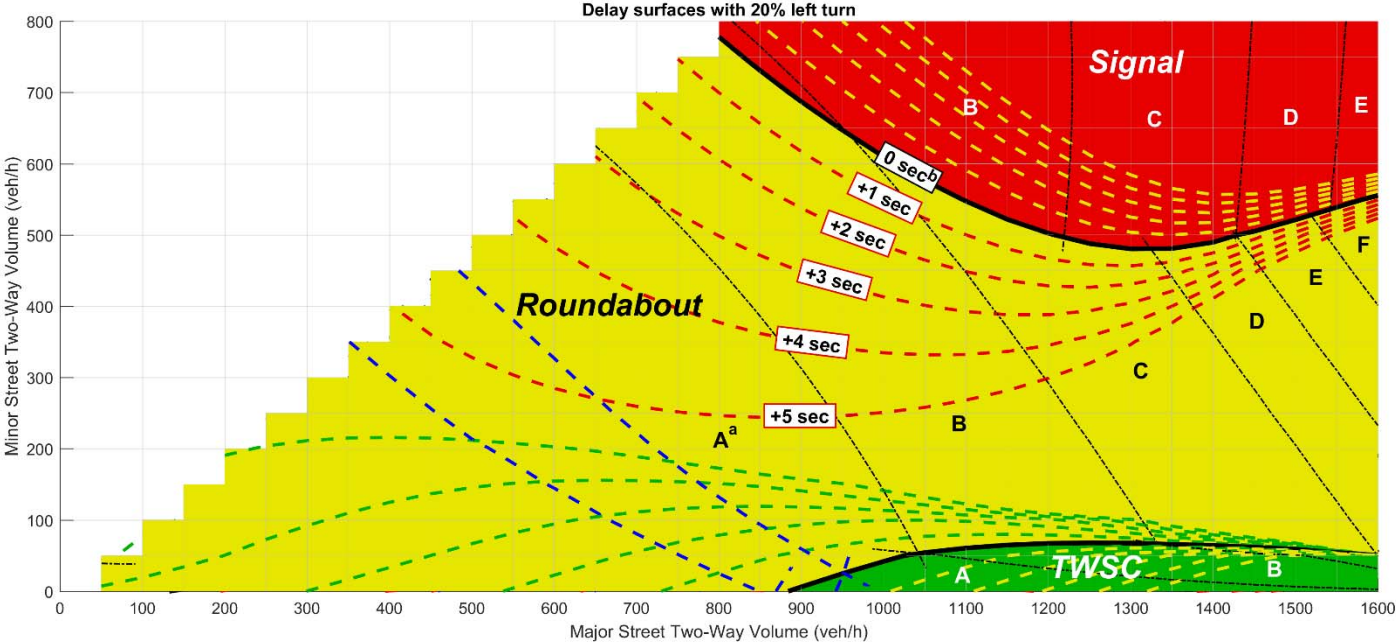
Analysis results

- 20% Left Turn Volume



Analysis results

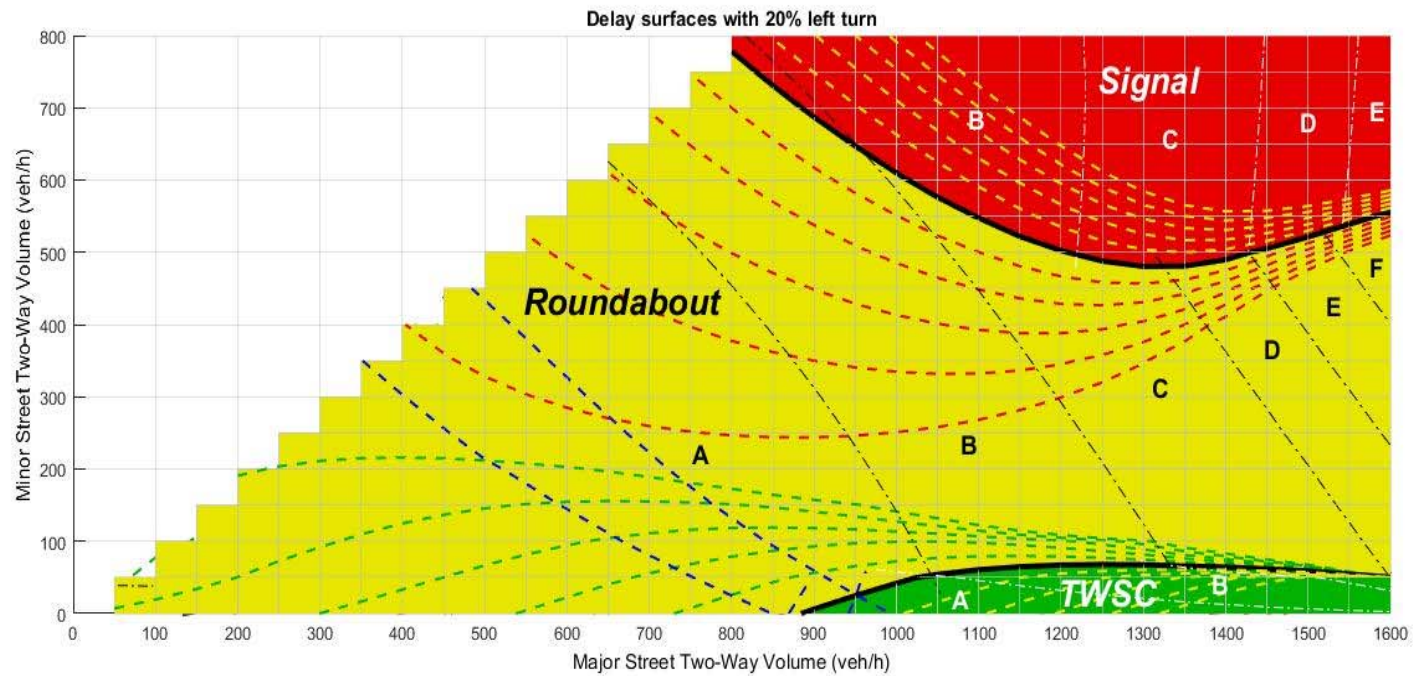
- 20% Left Turn Volume



^a Upper case letter indicates the level of service for each control type;
^b Each solid and dotted contour line represents 0-5 second difference in delay between two control types.

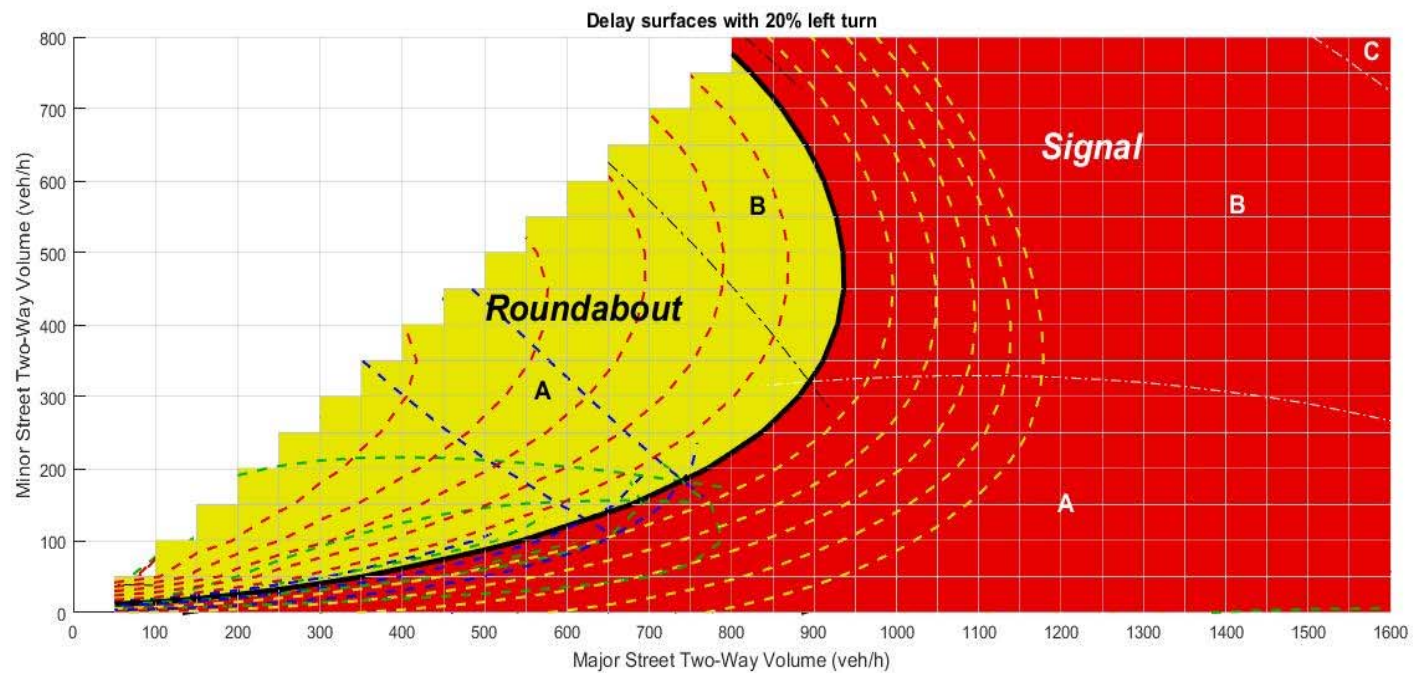
Analysis results

- No signal optimization



Analysis results

- Signal optimization (Cycle length and splits)



Conclusions

- The gray area concept can help engineers and practitioners make an engineering judgement.
- The gray areas can be used for a benefit-costs analysis for converting intersection control type from one to another in the future.
- This conceptual tool can be applied many other decision making situations based on quantitative metrics.