Signal Timing Optimization with Consideration of Environmental and Safety Impacts

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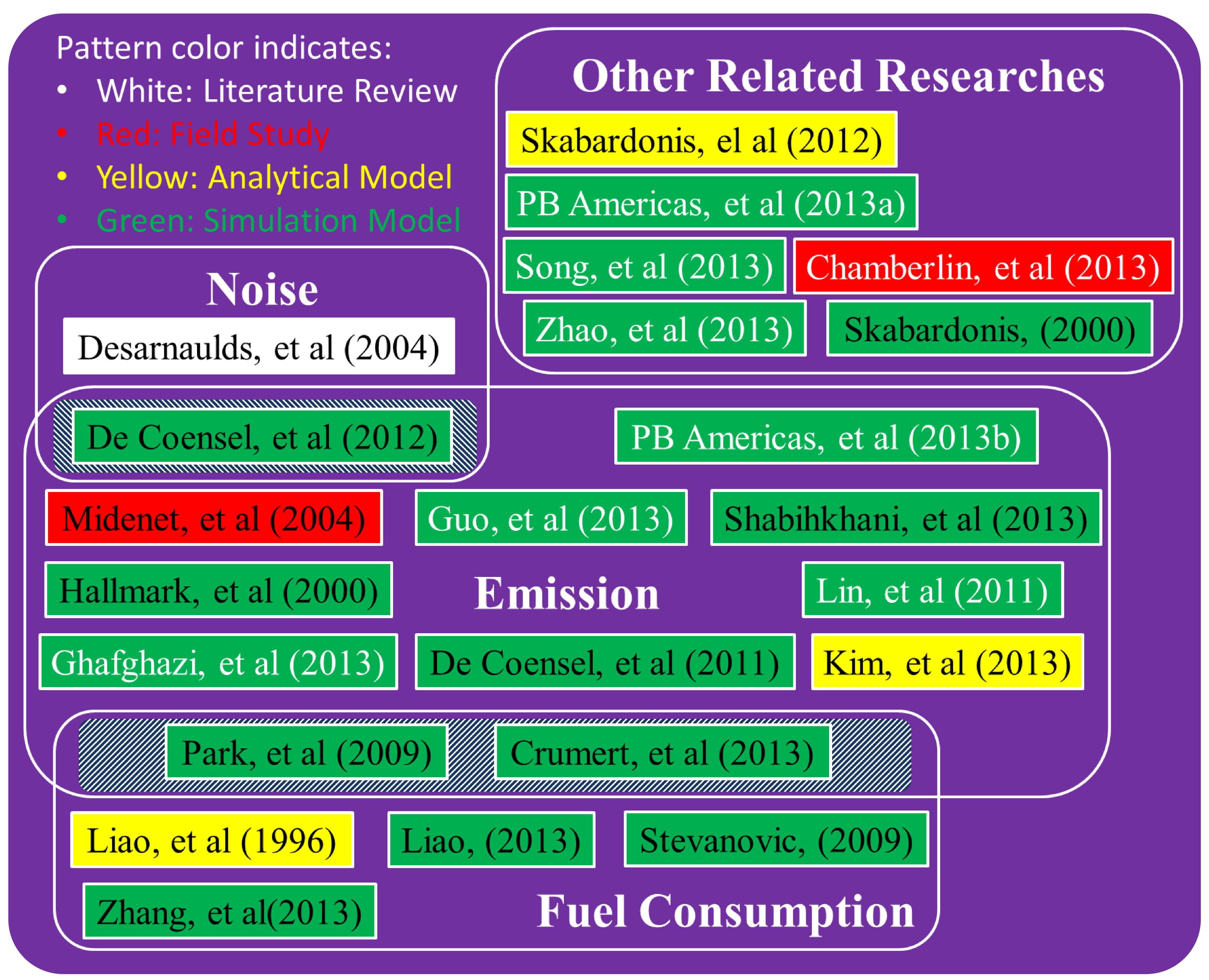
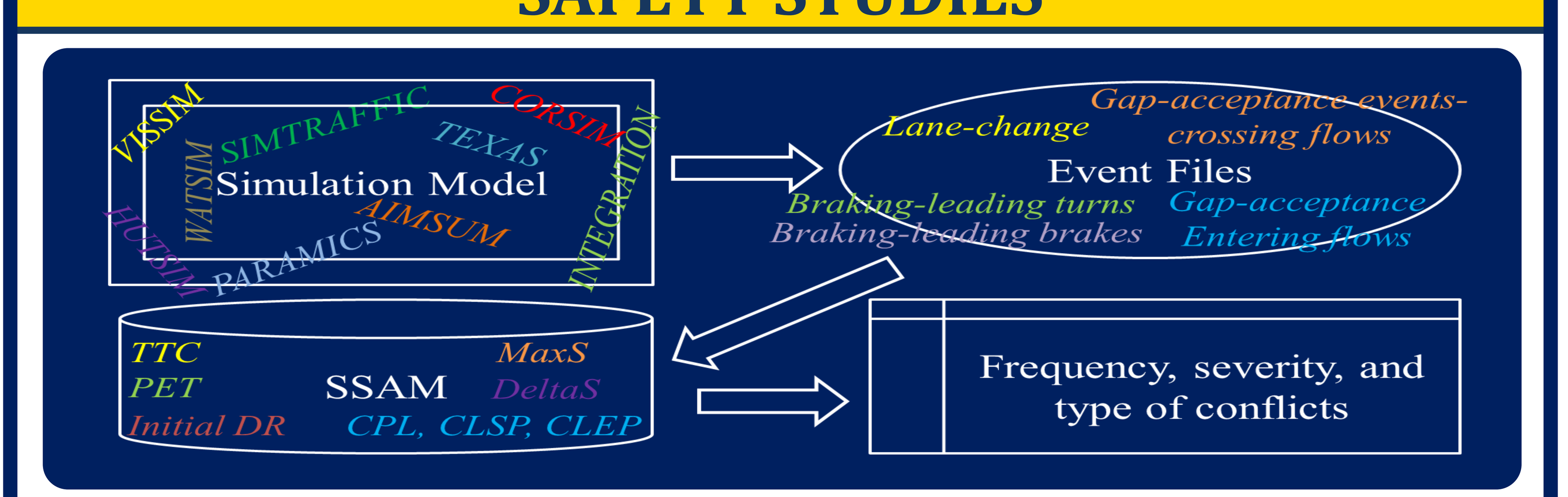
INTRODUCTION AND OBJECTIVE

- ❑ The main performance measures used in assessment an optimization of signal timing have been mobility measures (e.g. travel time, delays).
- ❑ Limited efforts have been conducted to incorporate environmental or safety impacts in signal optimization.
- ❑ Despite the availability of some studies on theses subjects, no guidelines or tools are.
- ❑ This STRIDE project investigates signal timing methods for assessment of environmental and safety impacts, in combination with mobility measures.

SUMMARY OF PREVIOUS STUDIES



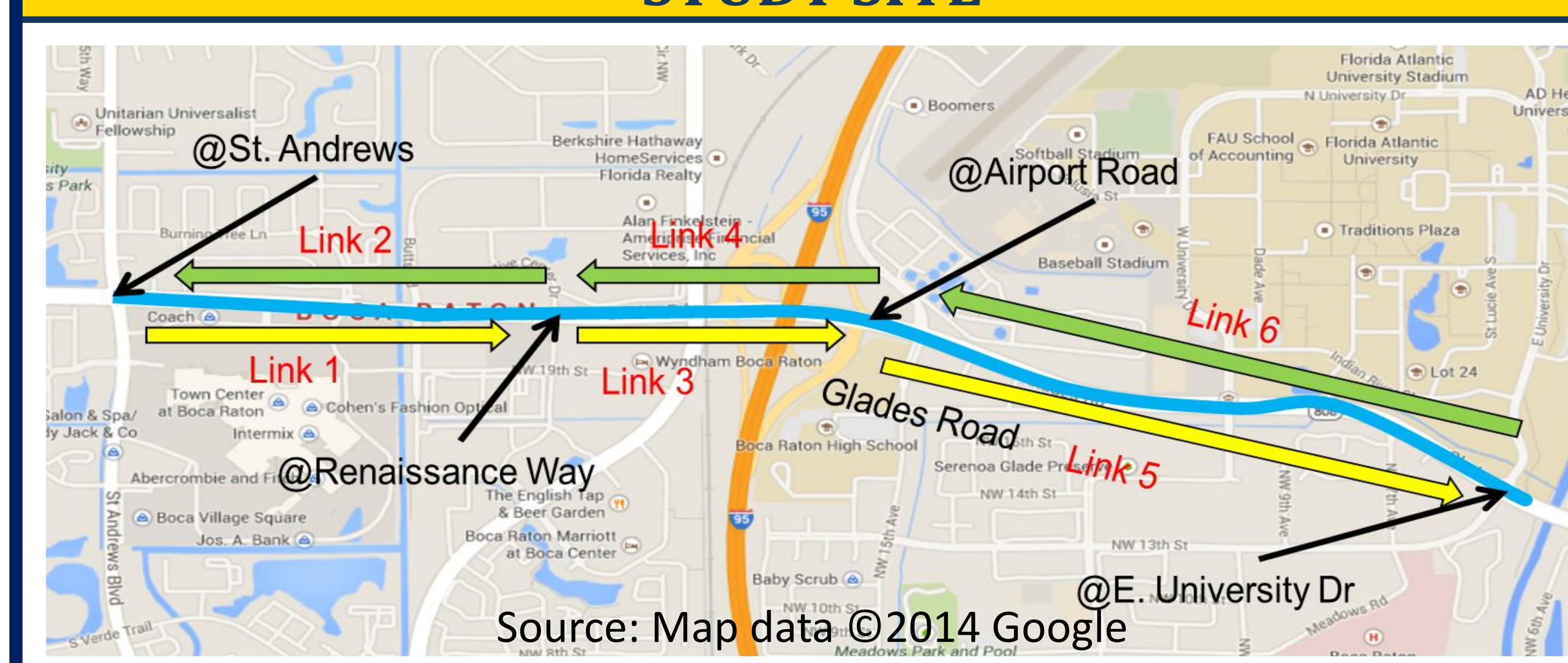
SAFETY STUDIES



ENVIRONMENTAL STUDIES

Authors	Software/Model/Control Device Used	Results (Types)
Midenet, et al (2004)	CRONOS Adaptive Control	-4% (CO_2) -14% (delay costs)
Chamberlin, et al (2013)	OMDG, TOTEMS	Inconsistences (CO, PM_{10})
Liao, et al (1996)	AFCM, Webster's Delay Model, TEXAS	Longer cycle time are needed for fuel consumption
Skabardonis, et al (2012)	CORSIM	Reduction (CO)
Kim, et al (2013)	Regression, CART	1.4708 m/s^2 and 2.2770 m/s^2 (aggressive, extreme aggressive)
Zhang, et al (2013)	CTM, Gaussian Plume Dispersion Model, GA	Up to -48% (CO) +93%
Skabardonis (2001)	TRANSYT-7F	-7.8% (fuel consumption) -7.7% (travel time) -13.8% (delay) -12.5% (stops)
Shabihkhani, et al (2013)	Aimsun, NGSIM, MOVES	Stops contributes the most for CO_2 emissions
Stevanovic, et al (2009)	VISSIM, CMEM, VISGAOST	-1% ~ -1.5% (fuel consumption)
Park, et al (2009)	GA, CORSIM, VT-Micro	-2.8% (fuel consumption) -3.0% (queue time)
De Coensel, et al (2012)	PARAMICS, VERSIT+	-10% ~ 40% (CO_2, NO_x, PM_{10})
Guo (2013)	SYNCHRO, VISSIM, MOVES	Positive relationship between delays and emission / fuel consumption
Song, et al (2013)	OVM, GFM, FVDM, Wiedemann, Fritzsche	Inaccuracies are found in the studied car-following models
Grumert, et al (2013)	SUMO, ARTEMIS/HEBEFA, CMEM	-2.66% ~ -3.95% (CO) -1.20% (NO_x) -1.52 ~ -2.78% (CO_2) -1.52% (fuel consumption)
Zhao, et al (2013)	TRANSIMS, PARAMICS, MOVES	1 vehicles + 2^+ runs > 2^+ vehicles + 1 run
Ghafghazi, et al (2013)	VISSIM, VISUM, MOVES	+1.50% (CO_2) +0.33% (CO) +1.45% (NO_x)
Hallmark, et al (2000)	MEASURE, CORSIM, MOBILE5a	CO Reduction in MEASURE is more significant than in MOBILE5a
Liao (2013)	AFCM, DyanTAIWAN, TRANSYT-7F, SYNCHRO	AFCM performs better to reduce CO_2 emission and fuel consumption
Lin, et al (2011)	MOVES, DynusT	Using MOVES default drive schedules estimate up to 37% higher CO_2 emissions than using the local specific operating mode distribution.

STUDY SITE



Source: Map data ©2014 Google

MOVES RESULTS AT CURRENT STAGE

- ❑ Operating Mode Distribution
  - ❑ Link Driver Schedules
    - ☑ Links with average speed & volume
- ☑ Time Mean Speed (Point Detector Speed)
- ☑ Space Mean Speed (Point Detector Travel Time)
- ☑ T7F Space Mean Speed (Travel Time)

Link ID	Measurement	Time Mean Speed Emission (grams) (Joules)	Space Mean Speed Emission (grams) (Joules)	T7F Space Mean Speed Emission (grams) (Joules)
1	CO	216%	100%	81%
1	NO_x	246%	100%	94%
1	CO_2	227%	100%	88%
1	Energy	227%	100%	88%
2	CO	250%	100%	96%
2	NO_x	267%	100%	97%
2	CO_2	229%	100%	92%
2	Energy	229%	100%	92%
3	CO	227%	100%	109%
3	NO_x	248%	100%	104%
3	CO_2	233%	100%	111%
3	Energy	233%	100%	111%
4	CO	250%	100%	83%
4	NO_x	263%	100%	89%
4	CO_2	215%	100%	70%
4	Energy	215%	100%	70%
5	CO	313%	100%	232%
5	NO_x	302%	100%	157%
5	CO_2	306%	100%	263%
5	Energy	306%	100%	263%
6	CO	176%	100%	542%
6	NO_x	226%	100%	380%
6	CO_2	193%	100%	874%
6	Energy	193%	100%	874%
Whole Segment	CO	236%	100%	188%
Whole Segment	NO_x	258%	100%	154%
Whole Segment	CO_2	229%	100%	242%
Whole Segment	Energy	229%	100%	242%

STRIDE Southeastern Transportation Research, Innovation, Development and Education Center
LCTR Lehman Center for Transportation Research at Florida International University