

High-Capacity Roundabout Intersection Analysis: Going Around in Circles

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TRB National Roundabout Conference

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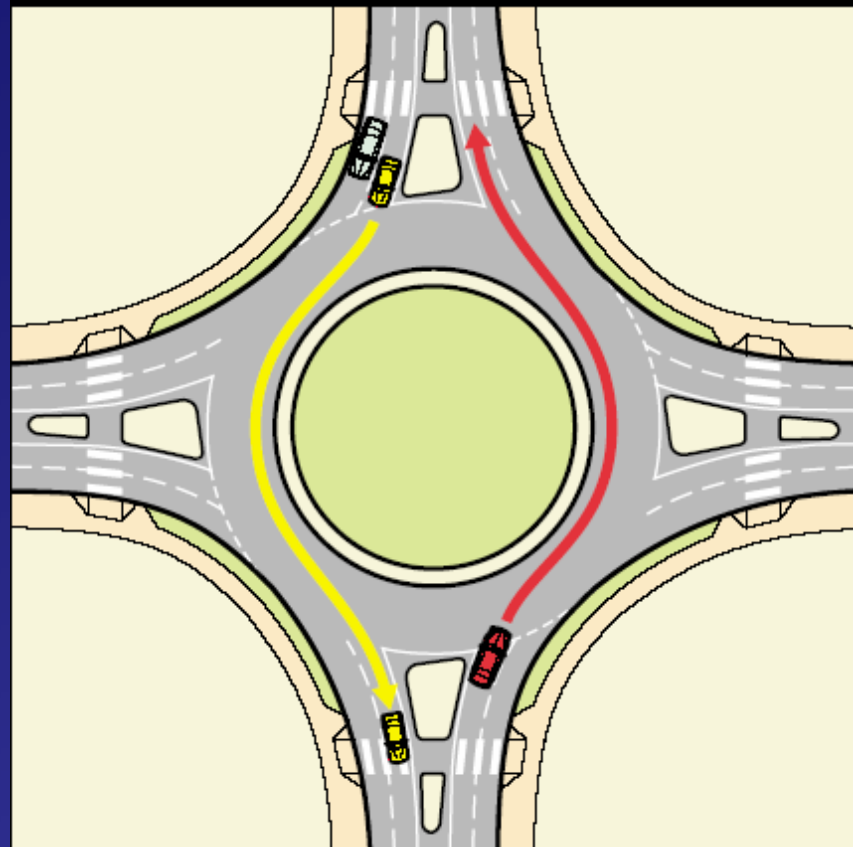
Vail, CO

Presentation Overview

- What is a high-capacity roundabout?
- What methods are used to analyze traffic operations?
- How are these methods applied to real-world problems?
- What are the differences in analysis results between methods?
- Which method should be used for a given set of conditions?

High-Capacity Roundabout

- Modern roundabout with yield entry
- Approaches with 2 or more lanes
- An alternative to traffic signals for high-volume locations



Roundabout Analysis Methods

- **Highway Capacity Manual (TRB, 2000)**
 - Only one-lane roundabouts
 - LOS thresholds are undefined
- **Roundabouts: An Informational Guide (FHWA, 2000)**
 - Equations for two-lane roundabouts
 - Design to v/c of 0.85
 - List of analysis software

Roundabout Analysis Methods

- **Macroscopic Models (Isolated)**
 - Analyze vehicle flows
 - Methods: RODEL & SIDRA
- **Microscopic Models (System)**
 - Analyze individual vehicles & drivers
 - Methods: SimTraffic, Paramics, & VISSIM

RODEL

- **Barry Crown, UK**
- **Regression equations based on observations of UK intersections**
- **Design elements determine approach capacity (diameter, entry width, etc.)**
- **Interactive design / operations analysis**

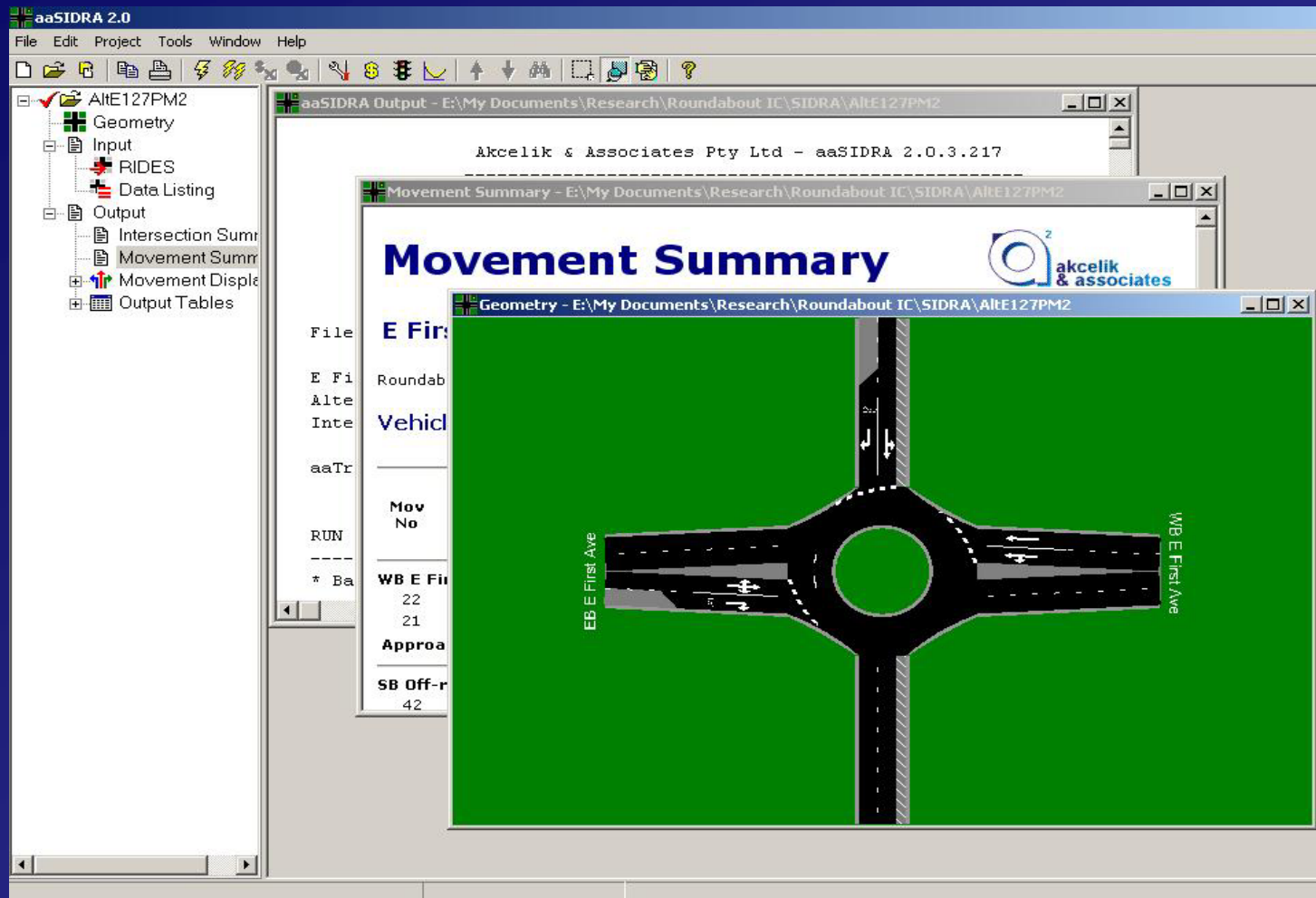
RODEL

12:00:03												NB SR-99/EAST FIRST AVE												1	
E	(m)	5.00	10.00	10.00	10.00											TIME PERIOD		min	90						
L'	(m)	10.00	10.00	10.00	10.00											TIME SLICE		min	15						
U	(m)	3.00	7.00	7.00	7.00											RESULTS PERIOD		min	0 60						
RAD	(m)	30.00	30.00	30.00	30.00											TIME COST		\$/hr	15.00						
PHI	(d)	40.00	40.00	40.00	40.00											FLOW PERIOD		min	0 60						
DIA	(m)	45.00	45.00	45.00	45.00											FLOW TYPE		pcu/veh	VEH						
GRAB SEP		0	0	0	0											FLOW PEAK		am/op/pm	PM						
LEG NAME		PCU	FLOWS (1st exit 2nd etc...0)				FLOF	CL	FLOW RATIO				FLOW TIME												
NB 99 ON		1.02	0	0	0	0	1.11	50	1.11	1.111	1.11	0	30	60											
WB E 1ST		1.02	185	745	0	20	1.11	50	1.11	1.111	1.11	0	30	60											
NB 99 OFF		1.02	0	5	950	0	1.11	50	1.11	1.111	1.11	0	30	60											
EB E 1ST		1.02	0	625	215	0	1.11	50	1.11	1.111	1.11	0	30	60											
MODE 2																									
FLOW		veh	0	1055	1060	932							AVDEL		s	3.7									
CAPACITY		veh	156	2300	1821	1638							L O S		A										
AVE DELAY		mins	0.00	0.04	0.07	0.07							VEH HAS		3.1										
MAX DELAY		mins	0.00	0.05	0.08	0.08							COST		\$	46.4									
AVE QUEUE		veh	0	1	1	1																			
MAX QUEUE		veh	0	1	1	1																			
F1mode F2direct F3peak G1F3rev F4fact F6stats F8econ F9prnt F10run Esc																									

SIDRA

- **Akcelik & Associates, Australia**
- **Intersection analysis similar to HCM**
- **Uses gap acceptance and lane utilization to determine capacity**
- **Can change headway values to calibrate to local conditions**

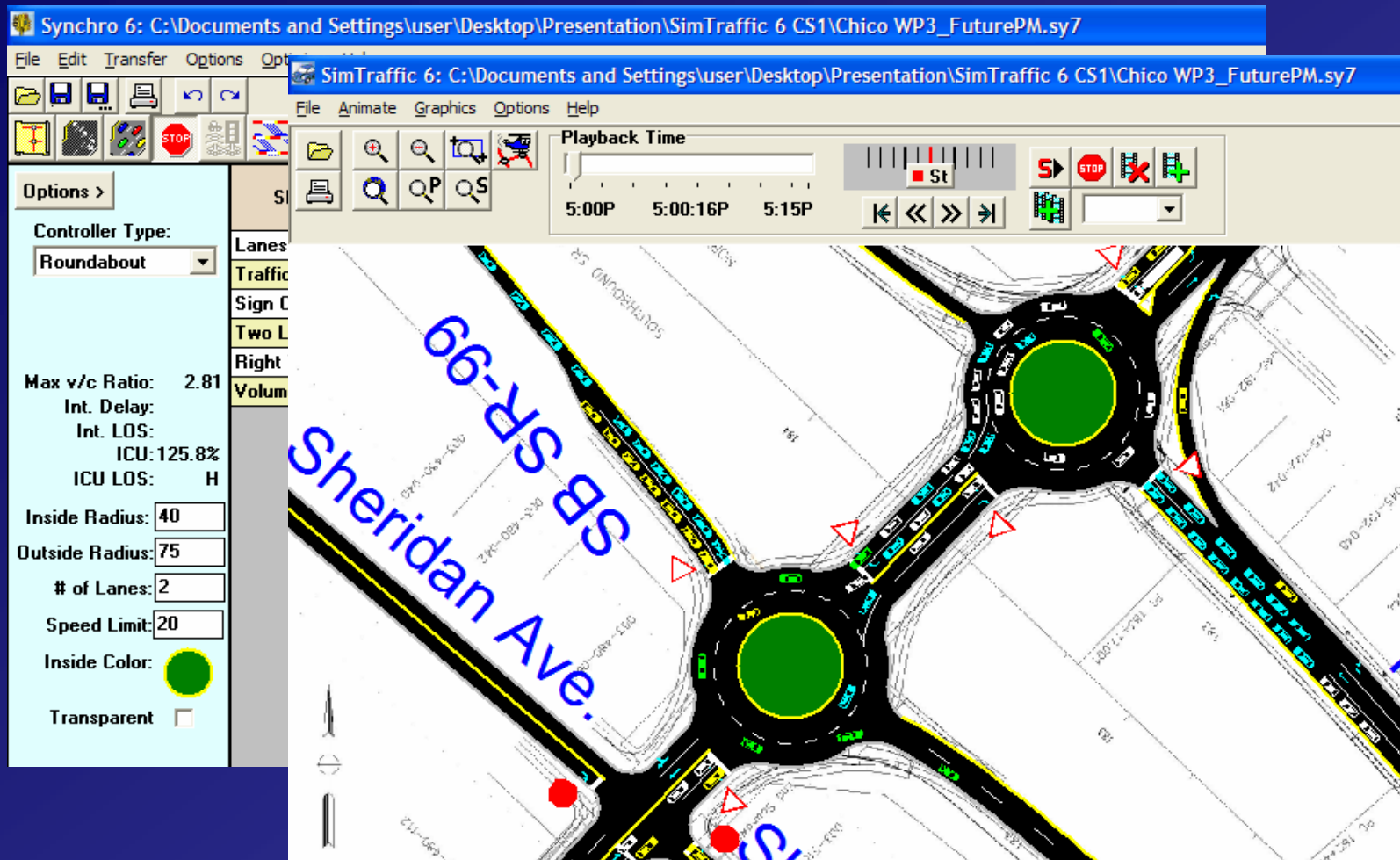
SIDRA



SimTraffic

- **Trafficware, USA**
- **Stochastic simulation model**
- **Uses Synchro for data input**
- **Driver behavior and vehicle characteristics**
- **Can change headway factors to calibrate to local conditions**

SimTraffic



Paramics

- Quadstone, UK
- Stochastic simulation model
- Driver behavior and vehicle characteristics
- Link/node network structure
- Automatically creates roundabout

Paramics



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VISSIM

- **PTV, Germany**
- **Stochastic simulation model**
- **3D animation features**
- **Link/connector network structure**
- **Specify gap acceptance parameters by lane for each approach**

VISSIM



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Review of Methods

- **FHWA & RODEL**
 - Based on British regression equations
 - Gap acceptance & lane configuration are not factors
- **SIDRA & SimTraffic**
 - Allow calibration of gap acceptance parameters to local conditions
- **Paramics & VISSIM**
 - Most flexible in modeling behavior

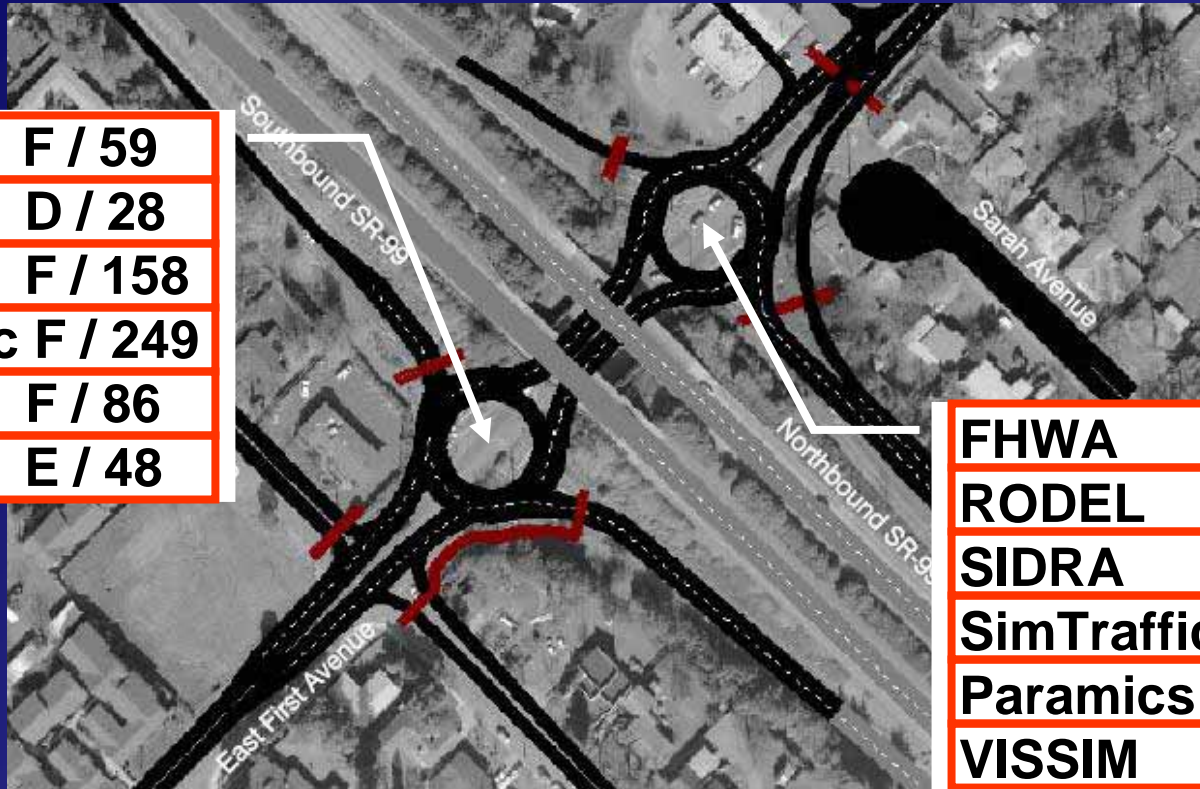
Case Study #1 - Description

- **SR-99/East First Avenue in Chico, CA**
- **Design Year (2027) PM Peak Hour**
- **Other alternatives with signals analyzed with CORSIM**
- **Diamond interchange with roundabout ramp terminal intersections**

Case Study #1 - Description



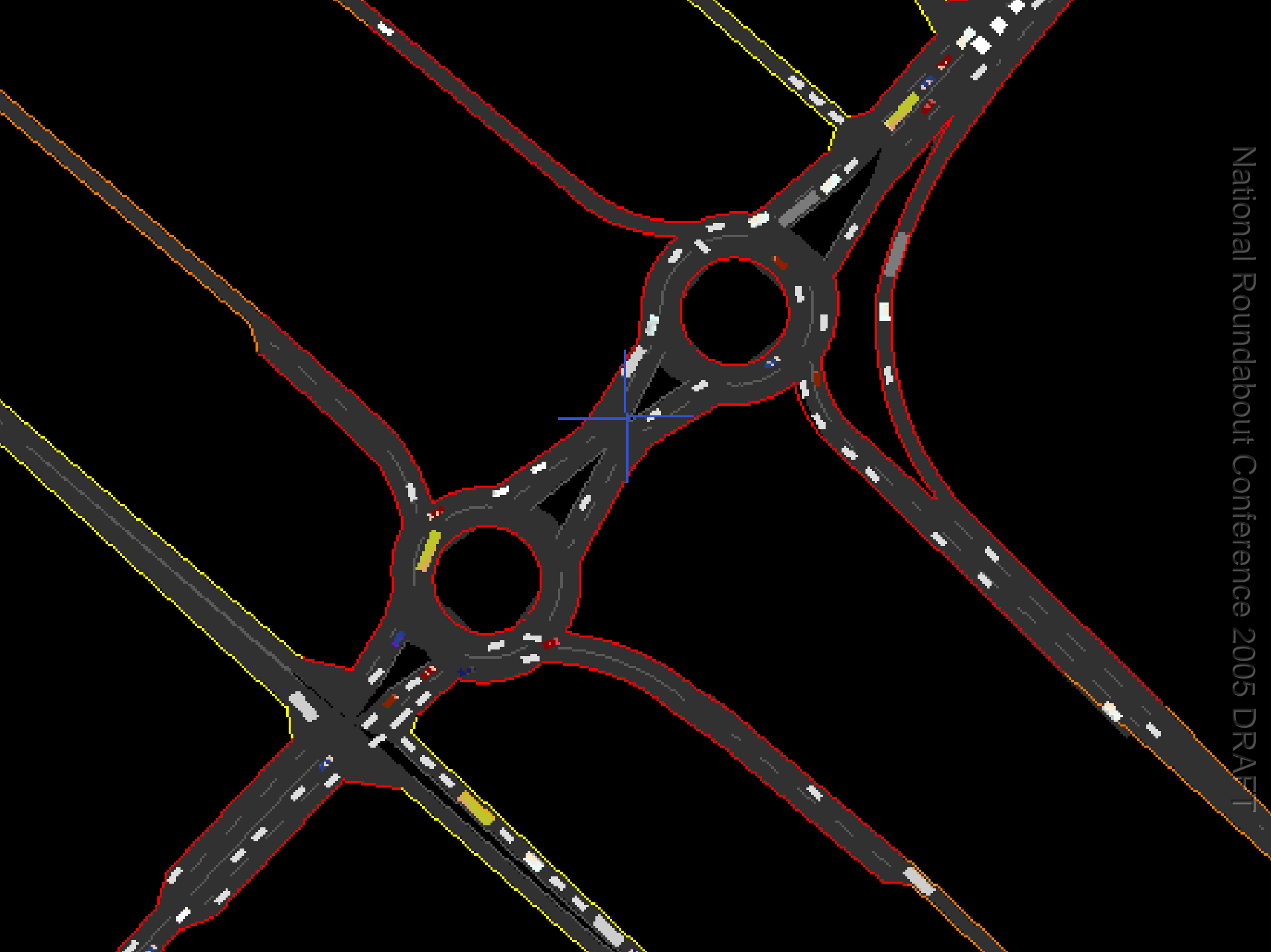
Case Study #1 - Results



FHWA	F / 59
RODEL	D / 28
SIDRA	F / 158
SimTraffic	F / 249
Paramics	F / 86
VISSIM	E / 48

FHWA	A / 5
RODEL	A / 4
SIDRA	D / 28
SimTraffic	F / 353
Paramics	C / 24
VISSIM	B / 11

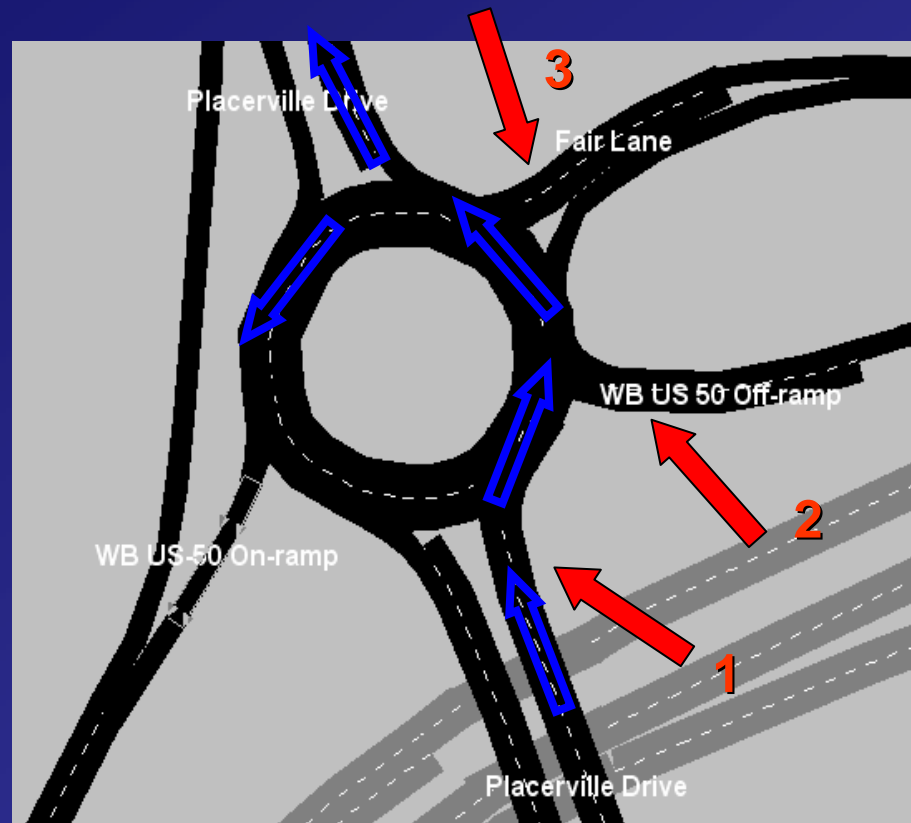
- **SimTraffic** predicted a 14% delay for the roundabout, which is about 10% higher than the delay predicted by the other models. The delay predicted by the other models is about 10% lower than the delay predicted by the other models.





Case Study #2 - Description

- **US-50/Placerville Dr. in Placerville, CA**
- **Design Year (2030) PM Peak Hour**
- **5-leg roundabout at westbound ramp terminal intersection**



Case Study #2 - Results

- **RODEL & SIDRA report good LOS**
- **Difficult to model the geometry accurately**

Method	LOS / Delay
RODEL	B / 11
SIDRA	B / 15
VISSIM	F / 99

- **VISSIM can model one-lane exits, lane restrictions, & gap acceptance factors**
- **Shows insufficient gaps for 3rd approach**



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Recommendations

- **FHWA, RODEL, & SIDRA**
 - For uncongested conditions
 - For isolated locations
- **SimTraffic**
 - For congested conditions
 - For system-wide analysis
 - For restricted geometry (one-lane exits or forced right two-lane exits)

Recommendations

- **Paramics & VISSIM**
 - For congestion conditions
 - For system-wide analysis
 - For complex geometry, such as:
 - Weaving within the roundabout
 - Signalized intersections
 - Right-of-way constraints
 - Freeway ramps
 - Driveways

Questions?

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