Project Overview

• Interstate 95 Corridor Planning Study from US-1/SR 5/South Dixie Highway to the Broward County Line

• Planning study will lead into multiple future Project Development and Environment (PD&E) Studies along the corridor to further evaluate improvements/alternatives

• Study will develop future traffic forecasts and a detailed operational model for use in future PD&E Studies

• Determine the mainline (GPL/EL) cross section of corridor
Project Limits

US-1/SR 5/South Dixie Highway

Broward County Line
Managed Lane Simulation Analysis Project

• High Volume, Congested freeway-facility (I-95) with a “Dynamic-Tolling” managed lane facility with sensor collection (“Express Lanes”)

• **SunGuide** sensor data (speed, volume, density, etc.) available in 5-minute slices for real-time analysis

• Desire to produce a dynamic simulation model that can accurately replicate the existing logic in the dynamic-tolling managed lanes and the resulting change in vehicle behavior due to facility

• Model will need to be **advanced** and **flexible** to handle future changes in tolling logic and data collection techniques
Managed Lanes Analysis Toolkit – What Options?

• Hand Calculations

• Operational Analysis Packages

• Static Simulation Packages

• Dynamic Simulation Packages
VISSIM Managed Lanes Model Overview

• VISSIM utilizes a built in managed lane Logit Model to calculate the “pay-no-pay” decision in real-time
• Vehicles are given toll cost information as they approach facility and decide whether it is “worth the money”
• The Logit Model utilizes:
  • LogitA Coefficient: global value applied to all vehicle classes
  • Cost Coefficient: value of money applicable to each class/user
  • Time Coefficient: value of time applicable to each class/user
  • Base Utility: optional smoothing factor for decreasing/increasing probability of toll choice based on vehicle type or other precipitating factors
VISSIM Managed Lanes Model Overview

• When approaching facility, each vehicle is assigned a “toll utility” as $U(toll)$ based on the vehicle type and/or other characteristics:

\[ U(Toll) = \text{Cost coefficient} \cdot \text{Current Toll Amount} + \text{Time coefficient} \cdot \text{Time gain} + \text{Base utility} \]

• Then the utility $U(toll)$ is used to calculate the probability of each vehicle:

\[ P(Toll) = 1 - \frac{e^{\alpha U_{toll-free}}}{e^{\alpha U_{toll-free}} + e^{\alpha U_{toll}}} = 1 - \frac{1}{1 + e^{\alpha U_{toll}}} \]

*The utility of the toll-free lane ($U_{toll-free}$) is always zero, since there is neither a toll, nor time gain comparing to itself*
Useful Features of VISSIM for Managed Lanes

• Dynamic “agent-based” microsimulation models accurately portray congestion/bottlenecks/speeds in order to appropriately replicate managed lane logic and vehicle response

• “Managed Lanes Module” takes care of the logic and behavioral response to dynamic ITS facilities

• “Managed Lanes Routing” set within the model allows an analysis of savings for any number of alternative routes (travel time vs. cost) as well as look ahead distance for ITS signage replication

• “Data Collection Points” allow very customizable and reliable dynamic data collection and aggregation by lane and direction
Corridor Planning Study

SunGuide Data Locations

SunGuide in VISSIM Model
Expanding VISSIM for Better ITS

• One **shortcoming** of “managed lane modules” in all dynamic sim packages is lack of toll customization and real-time pricing response

• In addition, tolling algorithms are different based on **location and facility**, including for the I-95 “Express Lanes”

• Luckily, VISSIM allows for coding modification/extension through the **API/Scripting suite**

• Through this, the VISSIM model can be modified to collect and aggregate data like the SunGuide system, and then run the algorithms to determine/implement the tolls based on **real-time conditions**
VISSIM Managed Lane API Logic

- **Update/Override Toll in VISSIM Managed Lane Module**
- **VISSIM Simulation**
- **t = 15 min?**
  - NO
  - YES
  - API Request for SunGuide Data
- **Collect SunGuide Sensor Data**
- **Toll = T_{new}**
  - YES
  - NO
  - Calculate:
    - Max/Min Toll
    - Change in Toll (ΔT)
    - New Toll (ΔT + T_c)
- **T_{min} < T_{new} < T_{max} ?**
  - YES
  - NO
- **Calculate:**
  - Level of Service (LOS)
  - Current Density
  - Change in Density
Closing Thoughts on Dynamic Simulation

• Use of simulation suites such as VISSIM (and others) are useful for many reasons (but not limited to):
  • Second-by-second real-time realistic response to conditions by both vehicles and infrastructure
  • Many useful features for ITS replication, data collection, and analysis
  • Modification of base code to suit any possible facility-type, law or logic, physical location, or desired future alternative analyses

• The logic of these simulation packages can also be expanded for use in other next-generation ITS technologies and facilities
Modeled vs. Actual Toll Calculation

Calibrated Period

Northbound

Calibrated Period

Southbound

Actual SunGuide Toll
VISSIM Modeled Toll
Questions?

PUT IT DOWN
IT CAN WAIT

DRIVING DOWN
FATALITIES

MIA MI - D ADE C O U N T Y