TRANSIMS Studies at the University at Buffalo

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TRANSIMS: Applications and Development Workshop

Argonne National Laboratory

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Presentation Outline

- Project 1:
  - Modeling the University at Buffalo North Campus in TRANSIMS
- Project 2:
  - Using TRANSIMS for On-line Transportation System Management during Emergencies
- Future Research

Introduction

- A University transportation system
  - Micro-scale of a regional system
  - Unique characteristics

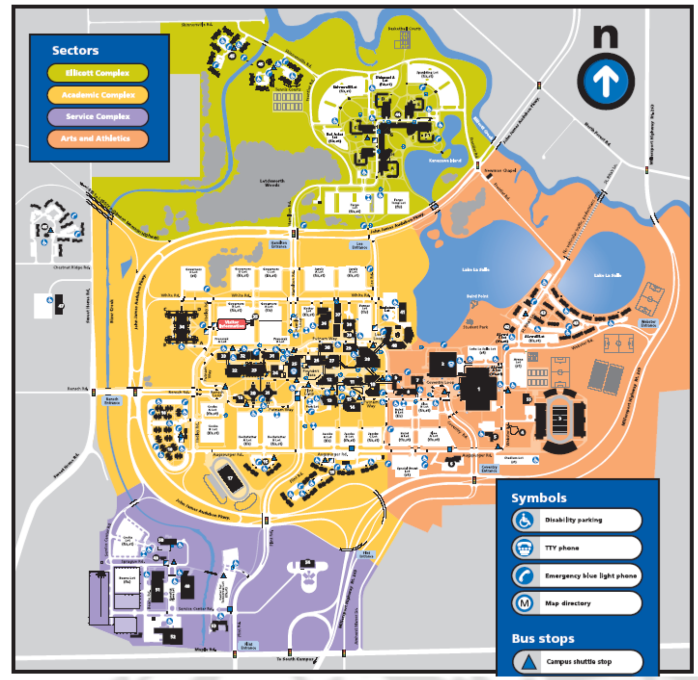
- Feasibility of TRANSIMS for model traveling on a university campus

- A case study of UB's north campus

UB North Campus

- Located in Amherst, NY, and occupies 1,192 acres and has more than 146 buildings.

- UB is currently in the middle of a strategic planning (UB2020) to grow by as much as 40%.



Project Outline

01 UB TRANSIMS Network Development

02 Demand Estimation & Parking Choice Model

03 Simulation Results and Analysis

04 Future Research

TRANSIMS Model Development

Input

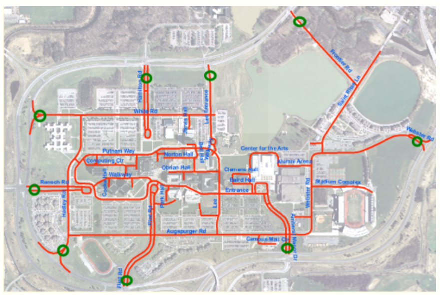
- Network Data
- Travel Demand Data

Output

- Second by second movement of every traveler in the system over a 24-hour period

UB TRANSIMS Model: Data Collection

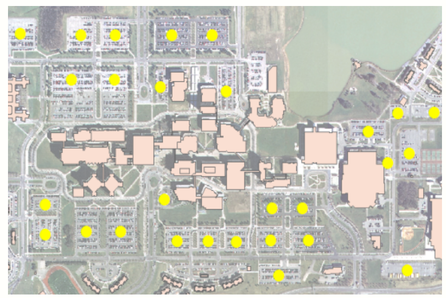
Digital Map



GIS Shape Files & Satellite Images

Center-lines of the road network
Polygons of Buildings
Centroids of Parking lots

Occupancy



Excel File from UBPD

9 AM, 10 AM, 11 AM, and 12 PM
Records of 28 parking lots out of a total number of 47 lots Parking lots

Counts

Counts by Radar & Tube

24-hour traffic counts at the entry and exit points to the north campus (a total of 9 key locations)

Network Coding

GISNet (Shapefile -> Text)

Get basic files for TRANSIMS (node, link, shape)

ArcNet(Text -> Shapefile)

Counting through lanes and pocket lanes

Setting road types and speed limits

GISNet (Shapefile -> Text)

TransimsNet

Creating intermediate tables, including activity locations and signal warrants files

IntControl

Creating signal tables

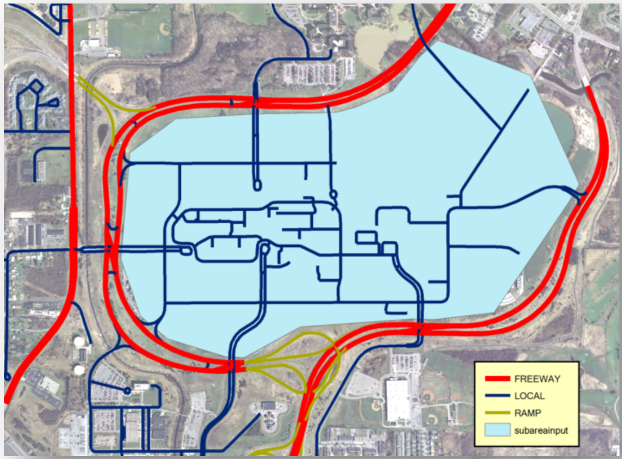
ArcNet(Text -> Shapefile)

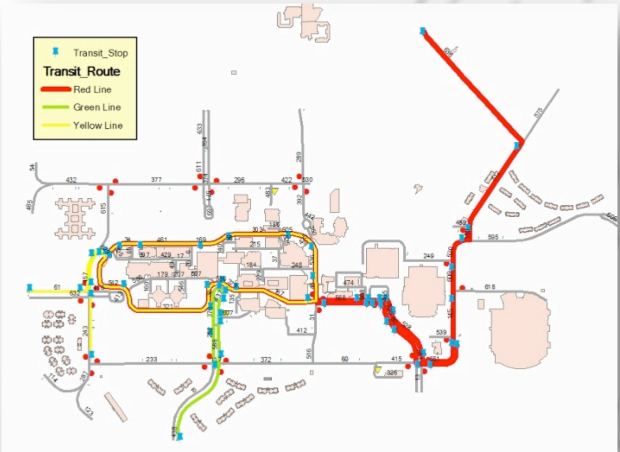
Specifying signs and signals (Location & Type)

GISNet (Shapefile -> Text)

TransitNet

Creating transit network files from route header and nodes files





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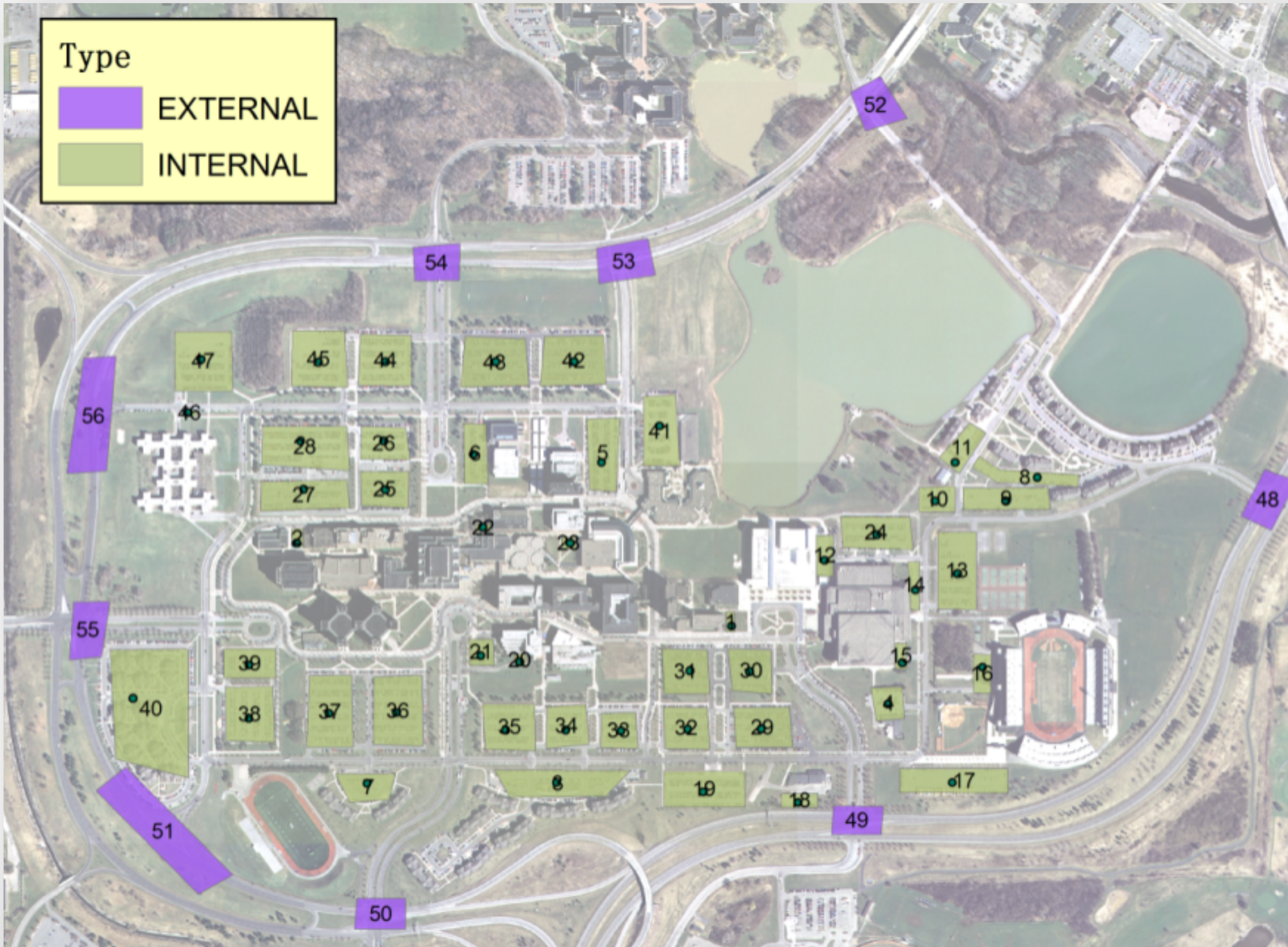
Travel Demand Estimation: Zoning



Demand Estimation: Gravity Model

- Trip Production

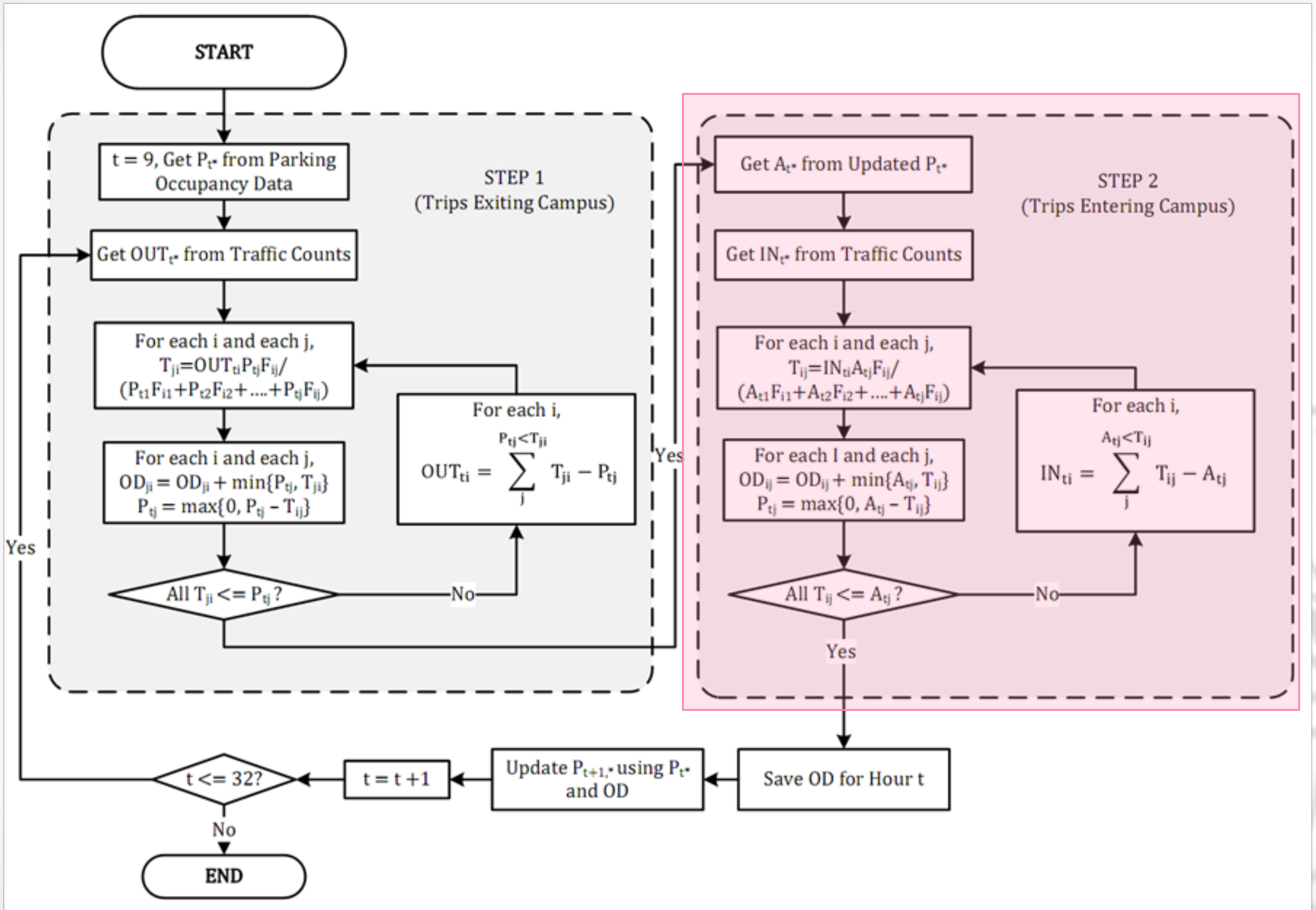
$$T_{ij} = \frac{Out_{ti}\, O_{tj} F_{ij}}{\sum_j O_{tj} F_{ij}}$$

Trip Attraction

$$T_{ij} = \frac{In_{ti}\, V_{tj} F_{ij}}{\sum_j V_{tj} F_{ij}}$$

F_{ij} =1 / (Free-flow travel time between zone i and zone j)^2

Travel Demand Estimation



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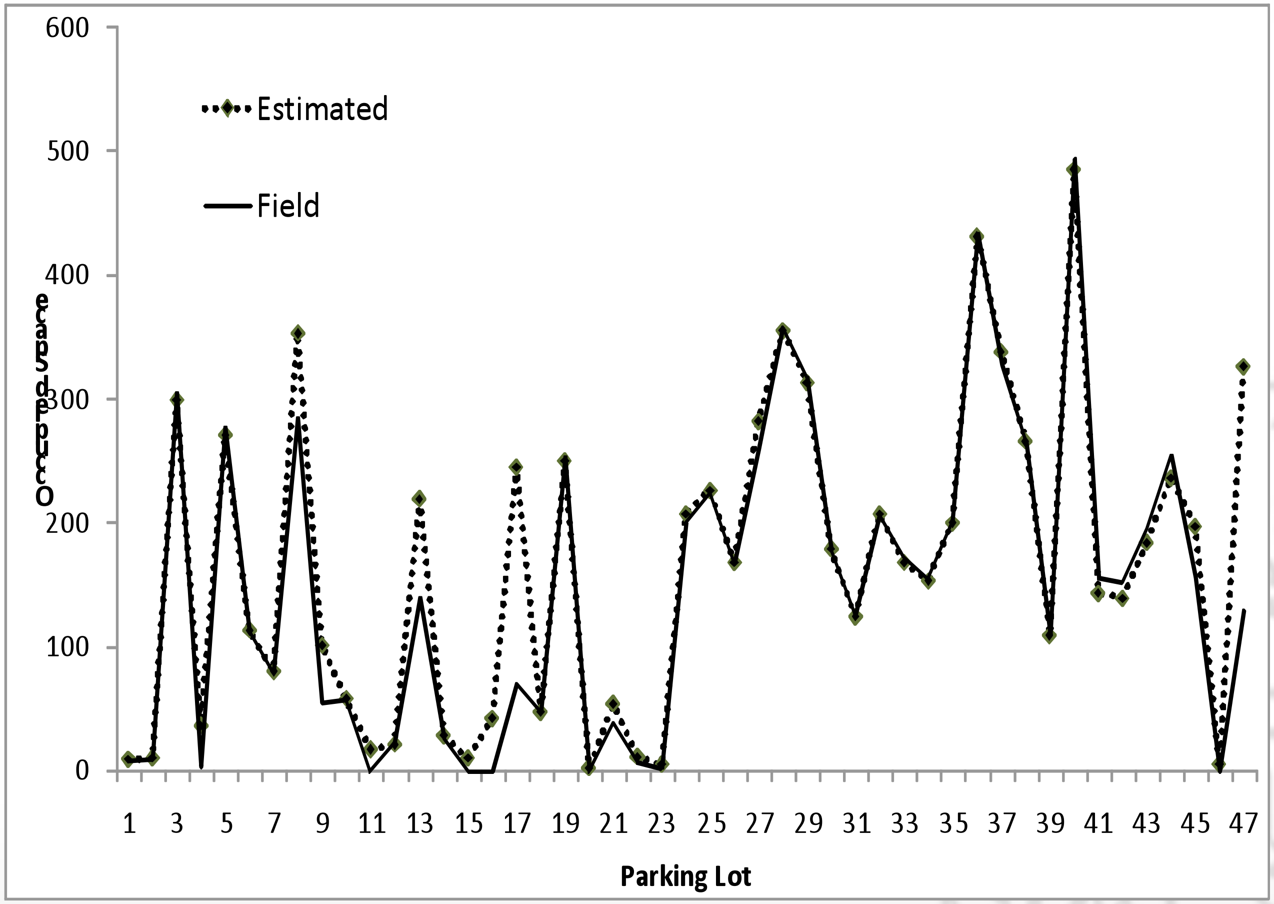
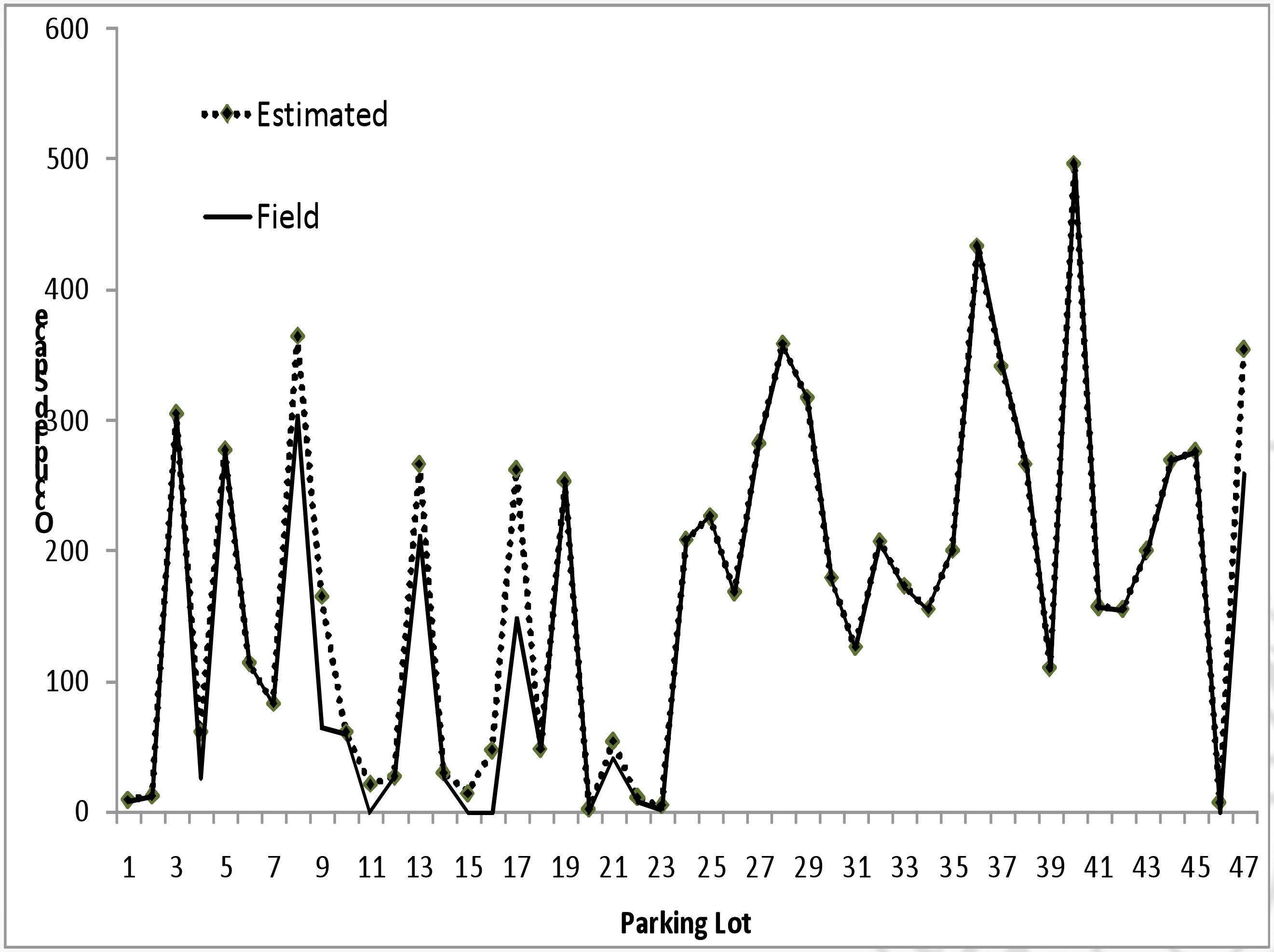
Results – Occupancies at 10 AM

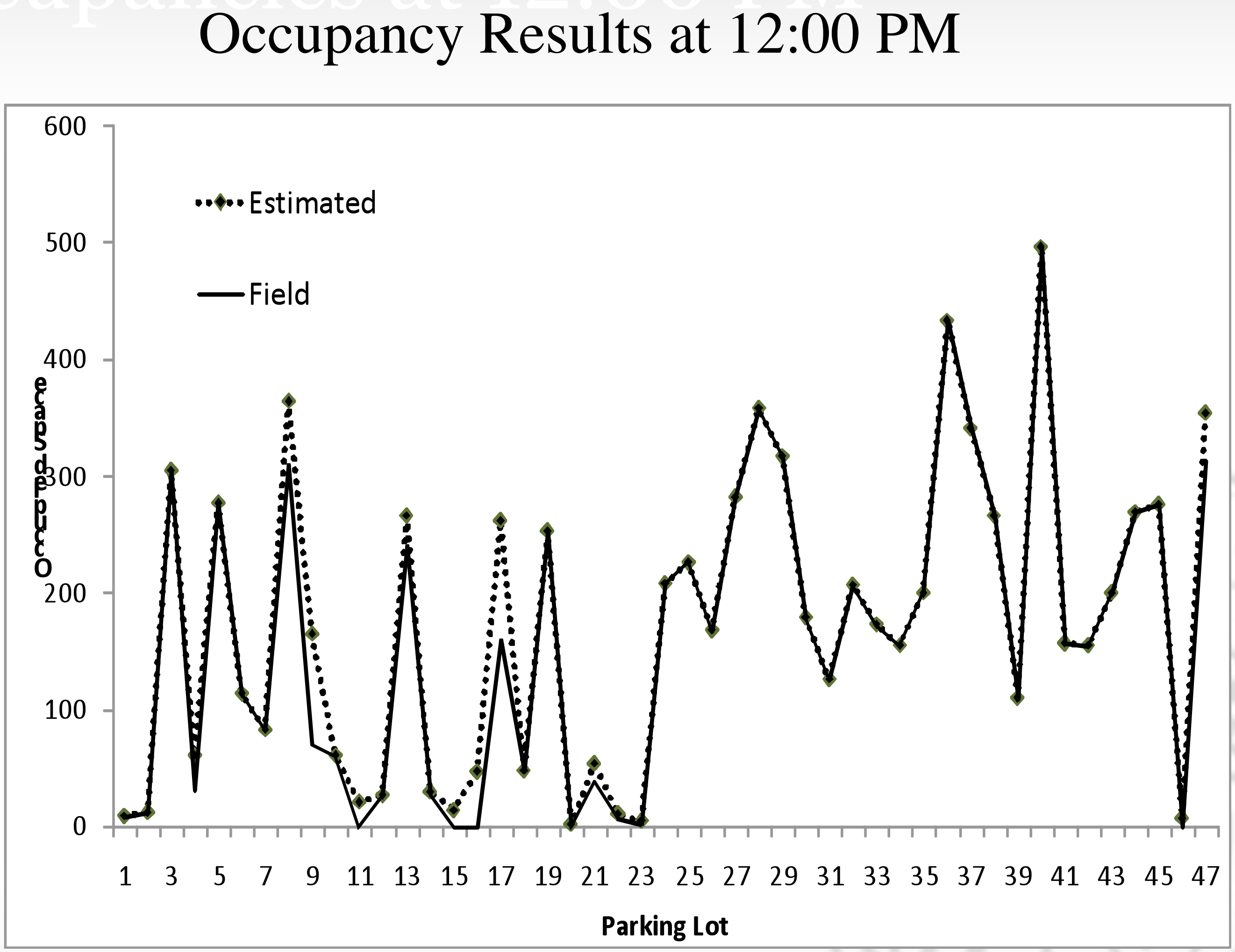
Occupancy Results for 10:00 AM



Occupancy Results for 11:00 AM

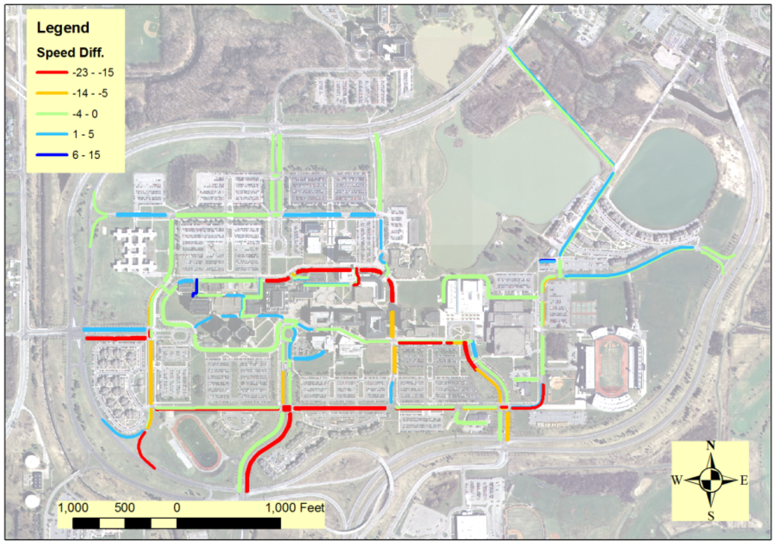


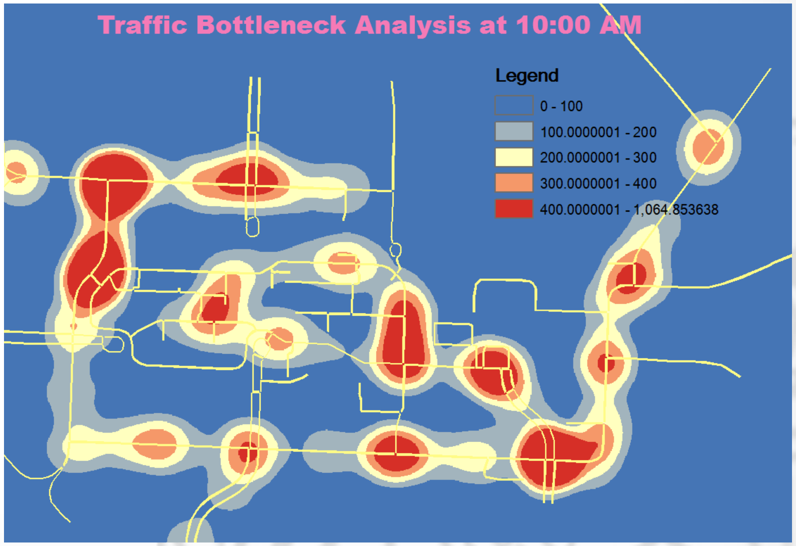
Occupancies at 12:00 PM



Simulation Result & Analysis: Animations

Congested Traffic Condition 19:00 – 20:00





Presentation Outline

Future Research

- With “Track 1” completed, work on a “Track 2” is planned for the next phase of the study
- Developing a Game-Theoretic Parking Choice Model
- Interest in innovative approaches to modeling students’ activities

Using TRANSIMS for On-line Transportation System Management during Emergencies

University at Buffalo
The State University of New York

GBNRTC
GREATER BUFFALO-NIAGARA
REGIONAL TRANSPORTATION COUNCIL

Calspan

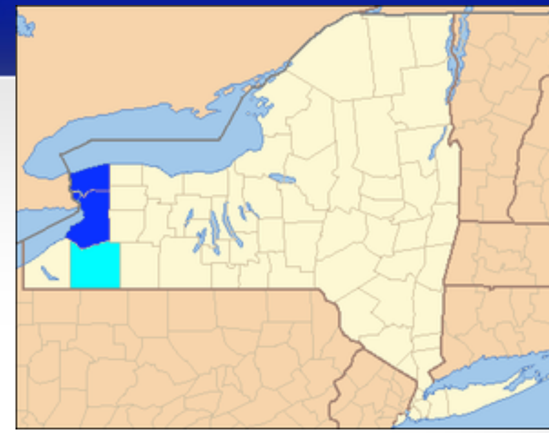
NITTEC
Niagara International Transportation Technology Coalition

CUBRC
Advantage Through Technology

www.buffalo.edu/reachingothers

Scope of Work

- Why Buffalo-Niagara?
  - One among a handful sites nationwide selected for TRANSIMS deployment
  - Well known for its winter weather and lake-effect snow events
  - Critical links – the three border crossings
  - Not too big and not too small



Scope of Work

- Project Objectives/Outcomes:
  - Further development of the Buffalo TRANSIMS model
  - Modifying TRANSIMS to allow for modeling impact of inclement weather
  - Simulating emergency scenarios in the Buffalo-Niagara area
  - Feasibility of using TRANSIMS for **online** transportation system management **during emergencies**
  - Use TRANSIMS as an aid for predicting border crossing delays

Research Tasks

- Task 1: Further Development of the Buffalo Model
- Tasks 2 & 3: Define traveler behavior during emergencies
- Task 4: Model the new behavior in TRANSIMS
- Task 5: Use TRANSIMS to evaluate likely emergency scenarios in the Buffalo-Niagara area
- Task 6: On-line transportation system management
- Task 7: Border crossing delay prediction
- Task 8: Peer-review and final report

Task 1: Further Development

- Build on Volpe's Work, and extend the micro-simulator
  - Initially - extend sub-network in the north-west direction to include Niagara Falls and the Rainbow bridge, and in the south-east direction to include I-290 and part of Amherst

Task 1: Further Development

- Specific area would depend upon the emergency scenarios of interest
- Additional Resources:
  - UB-NITTEC feed
  - Related studies (UB TRANSIMS study, NYSERDA Smart Growth study, GBNRTC's simulation, signal optimization and corridor studies)
  - Naturalistic Driving SHRP2 Study – CUBRC/Calspan
  - Integrating Education and Research

Tasks 2 & 3: Data Acquisition

- Two Primary Sources:
  - NITTEC's monitoring and surveillance network
    - Data archiving – working on building a prototype ITS data warehouse
  - Instrumented Vehicles
    - Calspan has already started to do that
    - Hope to be able to augment with data from the naturalistic driving experiment
- Some studies exist in the literature
- Data used to quantify changes in volume, speed & travel time during inclement weather conditions.

Task 4 – Modeling New Behavior in TRANSIMS

- Modifications for snow events:
  - Changes to TRANSIMS CA traffic model in terms of reduced speeds & longer headways during snow events
  - Activity generation pattern of travelers to reflect the lower-than-normal volumes
- Wide-area network disruption:
  - Activity generation pattern to reflect simultaneous initiation of new trips
  - Drivers' behavior to become more aggressive

Task 5: Evaluate likely emergencies

- Scenarios may include:
  - Inclement weather
  - Critical transportation link loss
  - Wide-scale network disruption scenarios

- Particular emphasis will be placed on simulating emergency or accident-related scenarios involved the border crossings.

Task 6: On-line Transportation System Management

- Real-time DTA Models
  - DynaMIT in Hampton Roads, VA and in LA
  - Use the model to interpolate in-between sensors and to evaluate impact of proposed control strategies

Task 6: On-line Transportation System Management

- Extensions
  - Ability to receive traffic-related information in real-time from sensors, probe vehicles, …etc.
  - On-line calibration
    - Updating activity patterns or trip tables
    - Calibrating CA model

Task 7: Border Crossing Delay Prediction

- Two-stage process
  - Short-term prediction of border crossing traffic using an on-line TRANSIMS model
  - Queuing models to estimate delay

- Currently working on another small study to develop predictive models for border crossing based on time-series forecasting methods

Acknowledgements

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