

## Modeling Methodology and Simulation of Port-of-Entry Systems

# Project Team Profile

- PI(s) Name(s), University:
  - Benjamin Melamed (PI), Rutgers University
  - Weiwei Chen (Co-PI), Rutgers University
- Project Start Date: January, 2016
- Anticipated End Date: January, 2021
- Project personnel:
  - Mingfei Teng, graduate student

# Problem Statement

- **Background**

- Fast and sustained secure flows of people and freight through a Port-of-Entry (POE) are essential to the U.S. economy
- Excessive POE delays translate into burdens and costs
  - Increased supply chain lead times and attendant disruptive effects
  - Inconvenience to travelers in terms of time and missed connections
  - Elevated transportation carbon footprint

- **Capability Gap**

- CBP-OFO needs decision support tools for POE planning for both optimizing operations and guiding long-term evolution
  - CBP needs to optimize the tradeoff between performance and cost
  - To this end, it needs flexible and high-fidelity simulation models that compute performance metrics, primarily waiting time statistics

# Beneficiary / End User Profile: Jobs

- Who are the beneficiaries / end-users of this research (the “jobs”)?
  - End users
    - Analyst group at U.S. Customs and Border Protection – Office of Field Operations (CBP-OFO)
    - Planners at preparedness and response organizations, such as FEMA
  - Beneficiaries
    - Drivers passing through POEs
    - POE directors and other POE personnel
    - DHS planning personnel, including IT and procurement

# Beneficiary / End User Profile: Desired Gains

- What are the main outcomes and benefits that the end user desires (the “gains”)?
  - A POE modeling platform, serving as an easy-to-use and easy-to-understand in-vitro lab for flexible experimentation with POE scenarios
    - Dynamic editor
    - Animation of traffic flows and statistics
  - A suite of detailed POE simulation models
  - User guide and technical reports documentation for each POE

# Beneficiary / End User Profile: Desired Gains (Cont. 1)

- What are the main outcomes and benefits that the end user desires (the “gains”)?
  - Upstream benefits (analyst end-user group)
    - Ability to evaluate design tradeoffs efficiently and quickly using POESS as a flexible in-vitro laboratory for experimenting and answering “what-if” questions
    - Ability to improve/optimize POE designs
    - Ability to improve/optimize POE resource planning
  - Downstream benefits (POEs)
    - Reduced congestion at POEs leading to
      - Shorter waiting times and savings on gas for drivers
      - Less stress for inspection personnel
      - Lessened exposure to noxious gases for all
    - Better utilization of inspection personnel

# Beneficiary / End User Profile: Pain Points

- What are the main issues the capability / knowledge gap is causing (end user “pains”)?
  - Inability to flexibly gauge the impact of impending congestion by experimenting with mitigations
  - Inability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
  - Inability to better schedule inspection resources to reduce waiting times

# Products & Services

- What products & services are the outcomes of this research project?
  - Suite of detailed POE simulation models, dubbed ***Port-of-Entry Simulation System (POESS)***
  - Accompanying documentation consisting of user guide and technical reports for each POE modeled



# Gains Created

- What are the gains achieved and how are they measured?
  - Short term (evaluated by end-user satisfaction survey)
    - Ability to flexibly gauge the impact of impending congestion and experiment with mitigations
    - Ability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
    - Ability to better schedule inspection resources to reduce waiting times
  - Long term (evaluated by field measurements)
    - Shorter average waiting times
    - Increased inspection personnel utilization

# Pains Alleviated

- What are the pains alleviated and how are they measured?
  - Near term (evaluated by end-user satisfaction survey)
    - Inability to flexibly gauge the impact of impending congestion and experiment with mitigations
    - Inability to flexibly gauge the impact of disruptions and experiment with mitigating ensuing congestion
    - Inability to better schedule inspection resources to reduce waiting times
  - Long term (evaluated by field measurements)
    - Long average waiting times
    - Inefficient inspection personnel utilization

# Key accomplishments

- Developed a modeling and simulation methodology was for POESS and documented it (on track)
- Implemented, validated and delivered to our end-user analyst group at CBP-OFO a POESS simulation model and user guide of the Bridge of the Americas (BOTA) POE in El Paso, Texas (on track)
- Conducted a usability survey of end users for the BOTA model, yielding overall end-user satisfaction rate of 83.3%, well over the requisite minimum of 75% (delayed by 6 weeks, but now completed)
- Work is in progress on modeling the Peace Arch POE at Blaine, Washington (on track)

# Key accomplishments: POESS Welcome Screen

**Port-of-Entry Simulation System (POESS)**

Select POE: Bridge of the Americas (BOTA), El Paso, Texas

Select Input File: Browse File... D:\Projects\POESS\El Paso Bridge of the Americas (BOTA)\El-Paso\_BOTA\_input.xlsx

Select Output Directory: Browse Directory... D:\Projects\POESS\El Paso Bridge of the Americas (BOTA)

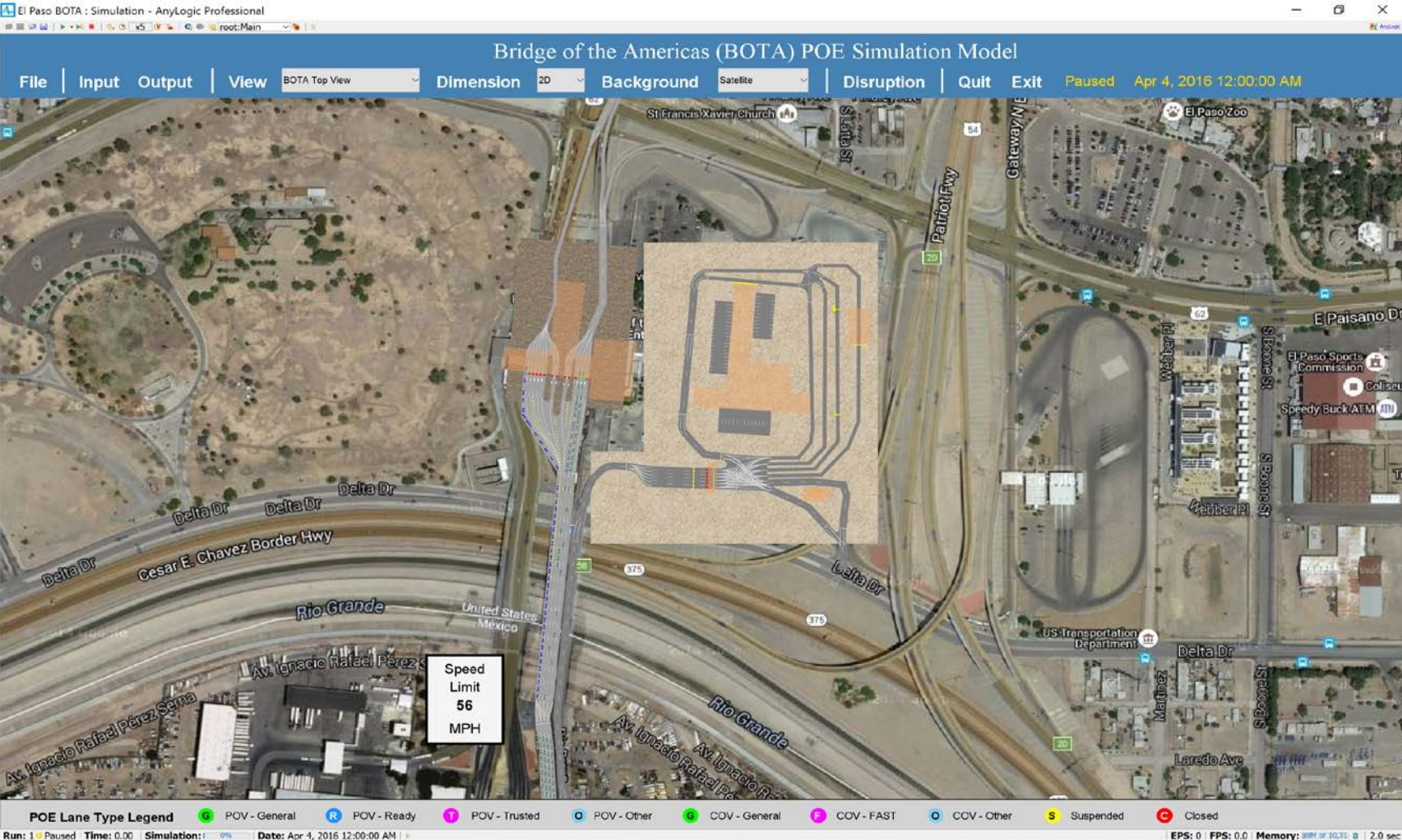
Type Output File Name: El-Paso\_BOTA\_input\_output.xlsx

Go To Animation Mode Go To Batch Mode

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# Key accomplishments: POESS BOTA Model Satellite View



# Transition Pathways

- How will the work reach the end-user? What is the proposed transition pathway?
  - The end-user group of our project champion and his analyst group at CBP-OFO will receive the POESS software as a distribution folder, with executables and documentation (user guides and technical reports) as well as training
    - **Already done for the Bridge of the Americas POE model**
  - POE directors and other decision makers will receive analysis results from the analyst group aiming to improve POE metrics
    - Vehicle waiting times and inspection personnel utilization
  - We will work with our project champion to identify other potential users at preparedness and response organizations, such as FEMA
    - For example, POESS can be used to gauge evacuation times

# Transition Engagement

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - The design and implementation of POESS has been carried out in close collaboration with our primary champion and his end-user analyst group at CBP-OFO
  - Our primary champion is serving as the POC to all POEs, and provides us with the bulk of the information on POE structure and data on POE operations
  - The POESS software and user guide have been securely distributed via the projects HSUP site, followed by a tutorial of POESS
  - The end-user group then exercised POESS and responded to a usability survey

# Transition Engagement (Cont. 1)

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - The PI and co-PI organized a tripartite transition meeting on 8/25/17 with representatives from Rutgers and UH, as follows:
    - Primary champion and customer/end-user, CBP-OFO
    - BTI personnel, including the director
    - Assistant Director of Information Technology, Rutgers Office of Research Commercialization (ORC)
    - BTI Transition POC
    - Executive Director, BTI Strategic Partnerships
    - Executive Director, UH Office of Intellectual Property



# Transition Engagement (Cont. 2)

- What mechanisms has project staff used for engaging with the potential customer(s)?
  - A Notice of Software Development) has been submitted to the Rutgers Office of Research and Economic Development which administers Intellectual Property at Rutgers University
  - The PI and co-PI have discussed post-project transition plans with the ORC representative, as follows:
    - Searching for a company to take over software support and upgrades of POESS
    - possible commercialization of POESS through the new Rutgers SoCrates program for software licensing

# Transition Challenges (if applicable)

- What does the project team perceive to be the challenges they will face in the near and long term going forward?
  - Near term
    - Good field measurements (empirical data) are needed for model validation, but may not always be available or in “clean” condition, requiring some processing
  - Long term
    - Difficulty finding a company to take over POESS upgrades and maintenance

# Conclusions

- Having developed a modeling and simulation methodology for POEs, the project delivered the first POESS model of the BOTA POE to our end-user group at CBP-OFO
  - The model was tested for its usability and end-user satisfaction
  - All technical problems involved in modeling this complex POE were solved, which would facilitate the modeling of other POEs
- POESS modeling of additional POEs is now on track (on time and within budget)

# Disclaimer

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