Spring is Coming – How to Cope with the Impact of Hurricanes and other Natural Disasters using Big Data

2019 ITS Tennessee Conference

April 10-12, 2019
Franklin, TN
Agenda

- INRIX Background
- Pre-Event
  - Real Time Data Applications
- During The Event
  - Real Time Data Applications
  - Real Time Tools
- After the Event
  - Post Event Evaluation using Archived Data and Analytics
- Conclusions
- Questions


Total billion-dollar natural disasters: 65

Cost of most expensive disaster: $160 billion (Hurricane Katrina)

(Source: National Centers for Environmental Information)
Technology is Fundamentally Reinventing Transportation

Motivating cities to reinvent transportation in their cities to improve urban life

INRIX is at the center of smarter transportation by positioning ourselves at the convergence of the connected car and smart cities.
USES FOR BIG DATA ANALYTICS:

- Identify and analyze traffic bottlenecks to meet demands of growing population.
- Identify congestion and incidents in real-time to effectively deploy emergency response units.
- INRIX GPS probe data provides real-time traffic information that covers more than what is possible with sensors.
- Provide freight-related congestion data to optimize routes for commercial vehicles.
Real Time Data Applications

Pre-Event

Image Courtesy NBC News
“Standard” Real Time Toolkit

• Advanced Traffic Management Systems (ATMS)
  • Regional or State Level Control
  • Field Sensor Based
  • Typically Loop/Radar Detectors and Cameras
• Changeable/Dynamic Message Signs (CMS/DMS)
  • Permanent or Temporary
• Highway Advisory Radio
  • Limited Usage
• Traffic Signal Systems
GPS Based Real Time Data

- Data from Numerous Sources
  - Smart Phones
  - AVL Fleet Systems
  - Connected Cars
- No Jurisdictional Boundaries
- Nearly Ubiquitous Coverage, 24x7x365
- Can Feed into Standard ATMS Systems
- Not Dependent on Local Power or Communications
- High Spatial Resolution (~3-5 meters)
- Actually Shows where People are Currently Driving
- Many Applications
Typical Traffic Sources

Flow
- Road sensor
- Traffic camera
- Commercial Vehicle GPS Probe
- Consumer Vehicle GPS Probe
- GPS-Enabled Smartphone Probe
- Cellular Network Probe

Incidents
- Driver Generated Report
- Accident
- Construction
- Event
Real Time Monitoring Site

- Traffic Flow
  - Congestion
  - Comparative Speed
  - Actual Speed
- Incidents
- Real Time End of Queue Warnings
Example Dash Boards - Indiana DOT’s Operations Depends on GPS Probe Data (produced by Purdue University)

- INDOT licenses Real-Time Traffic Data for statewide interstates
- ~5,000 segments, ~1 mile segment granularity, updated every minute
- Purdue University ingests live data in real-time, and builds/runs applications to support INDOT needs
- Purdue created “Mobility Dashboards” provide real-time and historical views by day/time, roads, INDOT Districts, etc.

http://its.ecn.purdue.edu/mobility/dashboards/
Hurricane Matthew October 2016

- Impacted the Southeastern US
- Caused Storm Surges of almost 10 Feet in Florida
- Created Mandatory Evacuations Impacting upwards of 1.5 Million Floridians
Thursday Oct 6, 2016, 12:27am – day prior to Hurricane Matthew
Thursday Oct 6, 2016, 6:09am – day prior to Hurricane Matthew
Thursday Oct 6, 2016, 12:05pm – day prior to Hurricane Matthew
Thursday Oct 6, 2016, 6:07pm – day prior to Hurricane Matthew
Thursday Oct 6, 2016, 9:05pm – day prior to Hurricane Matthew
Thursday Oct 6, 2016, 11:07pm – day prior to Hurricane Matthew
Real Time Data Applications

During an Event
Evaluation of Real-Time Conditions and Travel Patterns

“Bomb Cyclone” March 2019
Real Time System View

- Typically Provided/Consumed as either an API or Web Tile
- Can Provide Many Data Layers
  - Traffic Conditions
  - Incidents
  - Construction
  - Weather
  - User Generated Data
  - Events

Winter Storm Gia, January 2019, showing road weather and dynamic end of queue warnings reports
Hurricane Irma – September 2017

Showing I-95 Closure due to Truck Roll Over and Spill
Real-Time On-Demand Alerting Service to Travelers

Wireless emergency alerting service specifically focused on highway transportation

- Establishes 1-way or 2-way communications during closures or other emergencies
- No app needed – no preregistration needed
- Efficiently pushes official messages to geo-targeted customers
- Approved by the Federal Emergency Management Agency (FEMA) as an effective service for communicating with travelers in emergency situations
Agencies Can Manage Travelers in the Queue

- Web map shows congestion and queues in the area via Agency enters event name and description, & draws a shape around the area
- Agency selects questions to send to travelers, & views answers
- Agency views travelers’ locations pinned to map
Real Life Usage from PA

Usage Stats: December 2016 – Now

- In January 2017, days after deployment, the PA Turnpike activated the system three times in four days.
- More recently, during the nor’easter that hit Pennsylvania on March 2, 2018, the system was activated five times. Four of those activations occurred simultaneously. In that one day of activations, 1,889 vehicles registered as part of trapped queues, and they reported carrying 6,325 travelers.
- Overall, over 10,000 occupants have been reported in queues where the system has been activated.
Real Time Data Tools

Post Event

Hurricane Michael Image Courtesy Washington Post
Post Event Application of Real Time Data

• Real Time Data is being Archived as its Collected (allows for “after and before” studies)
• This Data Can be Mined in Many Ways
  • Analytics
  • Visualizations
  • Return to Normal Analyses
  • Loaded into Models for Future Applications
  • Etc.
• When Utilized with Other Data sets this Data Can be even more Powerful, e.g.:
  • 100 Year Flood Plain Mapping
  • Shelter Locations
  • Special Needs Population Mapping
  • Etc.
Hurricane Matthew Evacuation – NB Florida’s Turnpike, October 5, 2017 (one day before landfall)
Oroville Dam Mandatory Evacuation

- Approximately 70 miles north of Sacramento
- Approximately 190,000 people evacuated
- Impacted three counties Butte, Sutter and Yuba
- Mandatory evacuation lasted three days
NB CA 99/149 and SB CA 70
Exiting Oroville – Sunday, February 12, 2017

Mandatory evacuation order given at 4:58 pm 2/12/17
Evaluate Evacuation Patterns

• Did Evacuees follow Designated Routes?
• How did they Actually Leave the Event Area?
• Where did they End up?
• How can this Data be used in the Future to:
  • Better Plan Evacuations
  • Better Model What if Scenarios

Actual GPS waypoints from Oroville Dam Evacuation 2/12/17
Winter 2017 – California Mudslides

- California came out of a five year drought in the winter of 2016
- Snowfalls were well in excess of typical snowfall levels and resulted in avalanches and mudslides.
- Several roads throughout the state were closed as a result of these conditions.
- Both I-80 and SR 50 were temporarily closed between Sacramento and Lake Tahoe due to mudslides.
Introduction

• U.S. Highway 50 in El Dorado County was closed from Pollock Pines to Strawberry for about 20 miles due to multiple active mudslides

• The first slides occurred Feb. 10 in the late afternoon and were cleared, but several other slides occurred

• Crews opened U.S. Highway 50 late Feb 14
Affected area

Section of Route 50 affected by mudslides

Alternative journey on Route 88
Index of Trips per Day on Route 50

Mudslides cause closure on Route 50

Route 50 reopened
Index of Trips per Day on Route 88

Closure on route 50 causes Diverted traffic
Conclusions

Real Time Probe Data Has Many Before and After Event Uses

• Event Operations - Before:
  • Evaluate Current Conditions
    • Queues, Weather, Incidents, etc.
  • Calibrate Evacuation Models

• Event Operations - During:
  • Monitor Traffic Flows and Evacuation Patterns
  • Manage/Communicate with Trapped/Stranded Motorists

• Event Operations After:
  • Assess Actual Driver Behavior
  • Evaluate Actual Routes used
  • Efficiency of Operations
  • Develop Lessons Learned for Future Events and Plans
Questions?

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