Commercial Remote Sensing and Spatial Information (CRS & SI) Technologies for Reliable Transportation Systems Planning

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Project Kick-off Meeting Presentation
October 25, 2012
Partners & Collaborators

- Department of Civil & Environmental Engineering, UNC Charlotte
- Center for Transportation Policy Studies, UNC Charlotte
- North Carolina Department of Transportation (NCDOT)
- City of Charlotte Department of Transportation (CDOT)
- Mecklenburg-Union Metropolitan Planning Organization (MUMPO)
- Charlotte Area Transit Systems (CATS)
Reliability

• **Definition**
  - Consistency or dependability on travel time
  - Inversely proportional to duration / extent of congestion?

• **Why is it an important attribute for system users?**
  - Vital in making route & mode choice, and departure time decisions
  - Valued more than travel time savings by users

• **How does it help practitioners?**
  - Understand the role of recurring (traffic; peak hours) and non-recurring (incidents related) congestion components
  - Incorporating safety into planning process
  - Better quantify duration and extent of congestion for developing congestion management plans
Research / Project Challenges

• How reliable are off-the-shelf travel time data sources for use in calibrating regional transportation planning models?
  – Travel impedance or friction factors
• Link-level reliability for transportation planning?
  – Definition?
    • Intensity? Duration?
  – Can we effectively capture temporal and spatial variations?
  – How is it correlated to V/C ratio?
    • LOS thresholds based on reliability?
  – How can it be used to develop congestion management plans?
    • Say, identify top “N” congested segments
  – Can corridor, area or regional level reliability be quantified using link-level reliability?
Research / Project Challenges (Cont.)

• Can transit buses be used as probe vehicles to extract data and estimate link-level reliability for transportation planning?
  – Or, is this data limited to transit planning applications?
• What is the effect on travel time / delay due to incident on a link?
  – How far and how long?
    • Upstream and downstream links
  – How can this info be used for improved traffic incident management (re-routing traffic)?
Project Objectives

- Research, validate and recommend the best SI technology or the best combination of technologies to capture travel time (or its variation) and to develop congestion management plans
- Develop a space-based framework for travel time data capture, storage, retrieval and analysis to reduce congestion and improve safety
- Research and integrate recurring and non-recurring congestion components to measure link-level reliability by time of the day
  - Delay to traffic due to crashes and other incidents
  - Incorporate safety into planning process
• Process bus travel time data (from AVLs) for better transit planning
  – Bus travel time and arrival time prediction
  – Transit system reliability
• Develop interactive DSS tools with analytical and visual capabilities to assess and report the condition of transportation network, and facilitate stakeholder’s need in identifying, prioritizing and planning transportation projects
• Effectively inform and disseminate tools/products and outcomes to relevant transportation user-communities (public/private sector and academia)
System Concept & Framework

- GPS in vehicles / Bluetooth
- Capacity
- Integration of CRS & SI with Planning Process
- Incident location / time
- Data processing, integration and visualization tools
- Buses with GPS
- Reliability by hour and day
Research / Project Tasks

- Task 1: Project administration and management
- Task 2: Develop and maintain website
- Task 3: Form a Technical Advisory Committee (TAC) and team meetings
- Task 4: Literature review
- Task 5: Collect travel time and spatial data
- Task 6: Data tools and query applications
- Task 7: Assess reliability by time of the day
- Task 8: Model the effect of incidents on reliability
- Task 9: Develop DSS tools using visualization tools
- Task 10: Prepare reports and disseminate outcomes
Task 4: Literature Review

- Review the following topics (but not limited to):
  - CRS & SI for transportation planning (in particular, travel time studies)
  - Use of GPS and Bluetooth detectors for travel time / delay studies
  - Transit buses as probe vehicles
  - Reliability as a function of recurring and non-recurring congestion components

- Output/Deliverables
  - Synthesis report with findings from literature review on SI technologies, travel time studies, effect of incidents on travel delay and reliability
Task 5: Collect Travel Time & Spatial Data

- Study area: Charlotte / Mecklenburg County, NC
- Gather existing data
  - Travel time data
  - Crash / incidents data
  - Other
Task 5: … Time & Spatial Data (Cont.)

- A) Sources of available travel time data for consideration
  - Remotely collected data or data from GPS
    - Example, Inrix data
      - Non-connected devices, traffic cameras
    - GPS data from transit buses
      - Collected by Charlotte Area Transit System (CATS)
      - 74 routes
Task 5: ... Time & Spatial Data (Cont.)

• B) Collect **new travel time data**
  – Using **Bluetooth detectors**
    • Along 6 selected corridors; each ~5 miles in length
      – 2 each along freeway/expressway, major and minor thoroughfares
Task 5: ... Time & Spatial Data (Cont.)

- **Output/Deliverables**
  - Travel time data collection strategy based on comparison and validation of collected data
  - Inrix travel time data, bus travel time data and other spatial datasets from local agencies
Task 6: Develop Tools and Query Applications

• **Queries to extract** required information (date and/or day, from-to, travel time, number of samples, time duration, etc.) from Inrix and AVL datasets

• **Tools to integrate** (incident data with travel time database) and **segregate data** for modeling and assessment

• **Output/Deliverables**
  – Tools and query applications to process and integrate/segregate datasets
  – Complete computing link travel times
Task 6: ... Query Applications (Cont.)

Data processing, integration and visualization tools → ... data on dates without incidents

... data on dates with crashes, ...

Reliability by hour and day
Task 7: Assess Reliability by Time of the Day

- Identify **best SI technology** to capture travel time
- **Effect of recurring congestion component on reliability**
  - Process and analyze data on days without incidents
  - Develop methods to assess travel time or reliability at link level by
    - time of the day, day of the week, and month / season of the year
    - Evaluate use of 5-, 15- and 30-minute interval data and recommend duration to process data for future analysis
  - Compute duration and compare to define peak and off-peak periods
    - For transportation planning / modeling
      - Example, Charlotte (4 time periods) vs. Las Vegas (7 time periods)
- **Bus travel time**
Task 7: Assess Reliability … (Cont.)

- Output/Deliverables
  - Recommend the optimal SI technology for travel time data collection
  - Compute and assess reliability of links in the regional model by the time of day and day of week
    - Examine its correlation with V/C ratio
    - Develop level-of-service criteria
  - Compute bus travel time reliability by time of day
Task 8: Model the Effect of Incidents on Reliability

- Process and analyze data on days with incidents (say, crashes by severity) to quantify link-level reliability
- Compare link-level reliability from above with data on days without incidents (by time of the day and day of the week)
- Output/Deliverables
  - Research and model the effect of an incident on delay and reliability for incident management and planning
    - How far (distance)?
    - How long (time)?
    - How does reliability over distance and by time?
    - How do results vary by incident type and crash severity?
Task 9: Develop DSSs Using Visualization Tools

- GIS based decision support and visualization tools
  - Allow for exploration of reliability or performance of links in the transportation network
  - Visualize intensity and duration by time of the day and day of the week
  - Build tools with seamless transition from macroscopic level to details at a microscopic level
Task 9: Develop DSSs … (Cont.)

- **Output/Deliverables**
  - 1. DSS tool to **rank and identify top “N” congested corridors or sections** for developing congestion management plans
  - 2. DSS tool **showing possible affected links** due to an incident for incident management and re-routing traffic
  - Variation over time
  - 3. **Web-based** DSS tool to disseminate travel time and reliability by time of day and day of week
Task 10: Prepare Reports and Disseminate Outcomes

• Reports
  – Quarterly reports
  – Draft final report
  – Revised final report
• Workshop to TAC members and selected state / local agencies staff
• Presentations at TRB Annual meetings and ASCE / ITE sponsored International conferences
• Publication in journals; Website
## Project Schedule

Start Date: September 15, 2012  
End Date: September 14, 2014

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<td>Develop DSS Tools using visualization techniques</td>
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<td>Prepare quarterly reports, final report and disseminate outcomes</td>
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Contact Information

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