NCDOT Research Project 2015-18: 
Reduction in Railroad Right-of-Way Trespassing Incidents

2015 Right of Way Fatality and Trespass Prevention Workshop

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August 4 – 6, 2015
Disclaimer

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Background and Motivation

- USDOT Secretary Ray LaHood – railroad trespassing “one of the most vexing safety issues that the industry faces”
  - 430+ trespass-related pedestrian fatalities annually in the US
  - N.C. ranks eighth in pedestrian fatalities – 90 pedestrians have been killed or injured since January 2010

- Determine actions need to be taken to prevent trespassing incidents
  - Supplementing the current educational and enforcement programs being implemented
Map of Trespasser Fatalities (NC)
June 2011 to December 2015 [Link]

http://www.itre.ncsu.edu
Project Objectives

• Provide NCDOT Rail with information to make decisions on how, when, and where to enforce rail-trespassing events through two aspects...
  1. Prediction
  2. Detection
Prediction

• Deliverable
  – Create clear maps which portray locations where rail trespassing has the highest probability to take place

• How?
  – Develop model used to determine risk of segments of Charlotte to Raleigh corridor
  – Ensure the model is transferable
Prediction Model Methodology

• Sort Historic Data
  – Number of Strikes
  – Train Crew Rating
  – Other Evidence
• Divide the Corridor into Segments
• Geospatial Analysis
Historic Data

- Data categorized into three types
  - Count
  - Scalar
  - Binary
- Evident data (FRA strikes)
- Predictive data (demographics)

<table>
<thead>
<tr>
<th>DATA SET</th>
<th>DATA SOURCE</th>
<th>TYPE</th>
<th>EVIDENCE / PREDICTIVE</th>
<th>INFLUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRIKES</td>
<td>FRA &amp; NCDOT Records</td>
<td>Count</td>
<td>Evidence</td>
<td>(+++) Most objective measure of previous/current problem areas</td>
</tr>
<tr>
<td>TRAIN CREW SURVEYS</td>
<td>Amtrak Crews</td>
<td>Scalar</td>
<td>Evidence</td>
<td>(+) First-hand account of problematic areas</td>
</tr>
<tr>
<td>CORRIDOR VIDEO REVIEW</td>
<td>NCDOT Video</td>
<td>Binary</td>
<td>Evidence</td>
<td>(+) Visual evidence of paths, graffiti, or camps</td>
</tr>
<tr>
<td>GRADE CROSSINGS</td>
<td>FRA Grade Crossing Data</td>
<td>Count</td>
<td>Predictive</td>
<td>(+) Crossings provide access to the right-of-way</td>
</tr>
<tr>
<td>TRAIN VOLUME</td>
<td>FRA Grade Crossing Data</td>
<td>Scalar</td>
<td>Predictive</td>
<td>(+) Train volume determines the exposure on the tracks</td>
</tr>
<tr>
<td>TRAIN SPEED</td>
<td>FRA Grade Crossing Data</td>
<td>Scalar</td>
<td>Predictive</td>
<td>(+) Faster trains reduces the time to detect and avoid the train</td>
</tr>
<tr>
<td>FENCING</td>
<td>Video Review</td>
<td>Binary</td>
<td>Predictive</td>
<td>(-) Fencing should reduce access</td>
</tr>
<tr>
<td>PASSENGER STATIONS</td>
<td>NC Rail Facilities Shapefile</td>
<td>Binary</td>
<td>Predictive</td>
<td>(+) Stations inherently cause people to be near the tracks</td>
</tr>
<tr>
<td>POPULATION DENSITY</td>
<td>2013 US Census Parcel Data</td>
<td>Scalar</td>
<td>Predictive</td>
<td>(+) More people are near the tracks</td>
</tr>
<tr>
<td>HOUSEHOLD INCOME</td>
<td>2013 US Census Parcel Data</td>
<td>Scalar</td>
<td>Predictive</td>
<td>(-) People typically drive more with increased wealth</td>
</tr>
<tr>
<td>PUBLIC SCHOOLS</td>
<td>County GIS Data / Online Maps</td>
<td>Count</td>
<td>Predictive</td>
<td>(+) Young people are not risk averse, and likely to take short cuts</td>
</tr>
<tr>
<td>COLLEGE / UNIVERSITIES</td>
<td>Online Maps</td>
<td>Count</td>
<td>Predictive</td>
<td>(+) Young people are not risk averse, and likely to take short cuts</td>
</tr>
<tr>
<td>COMMERCIAL SERVICES</td>
<td>County Tax Parcels</td>
<td>Count</td>
<td>Predictive</td>
<td>(+) Food &amp; drink service generates pedestrian traffic</td>
</tr>
</tbody>
</table>
Segments: Window Sizes

Note: For illustration purposes only
Geospatial Analysis: Greensboro, NC
Prediction Model Results

• The model was applied to the Charlotte to Raleigh corridor
• Highest Risk Areas
  – Durham (April 5, 2015)
  – Elon / Burlington (Jan. 27, 2015)
  – Greensboro (July 30, 2014)
Detection

• Deliverable
  – Test and implement a prototype detection system that will provide real time trespassing information to rail personnel

• How?
  – Equipment selection
  – Installation and algorithm development
  – Implementation at sites determined by prediction model
Equipment Selection: Pros and Cons

• Visible Light Camera
  – Advantage: cost-effective

• Thermal Imaging Camera*
  – Advantage: can collect data in tough conditions, new detection software easily compatible

• Software Capabilities
  – Have a compatible software system for ease of use
Video Detection Examples
Installation and Algorithm Development

• Set up a test site at controlled locations
  • NCDOT Rail Yard
  • Centennial Campus
Algorithm Example
Implementation in the Field

- Pedestrian without a train
- Train without pedestrian
- Both pedestrian and train
Future Applications

- Develop a system that can be implemented anywhere in the United States
Key Project Outcomes

- Recommendation for the most appropriate method for determining trespass-prone locations
- Determine the efficiency and accuracy of detection software and hardware for determining trespass events along railroad ROW
- Determine the feasibility and capability of providing real-time information to railroad and safety personnel regarding trespass events in order to help prevent incidents from occurring
Questions?
For Additional Information Concerning this Presentation.

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