Mapping Large Truck Rollovers: Identification and Mitigation Through Spatial Data Analysis

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ATRI

Trucking industry’s NFP research organization

- Commercial Drivers
- Congestion and Mobility
- Economic Analysis
- Environment
- Safety
- Security
- Technology
- Transportation Infrastructure
- Trucking Industry Operations

www.atri-online.org
Research Overview

- Top RAC priority from 2010
- Explore innovative methods for identifying sites where roadway design and signage have a significant negative impact on truck safety
- Distribute database rollover locations to motor carriers and commercial drivers
- Work with DOTs to identify infrastructure solutions
Research Agenda

- **Phase 1-Completed**
  - Determine truck rollover clusters/patterns that may indicate areas where high instances of large truck rollovers occur

- **Phase 2- Underway**
  - Dissemination of real-time, geofence-based information to drivers via onboard computers
  - As truck drivers approach a high risk rollover location an in cab warning will be generated
  - Goal to modify driver behavior

- **Phase 3- Future**
  - An analysis of the features of each cluster location
  - Identify and categorize possible roadway design issues
  - Work with DOTs to propose solutions
Phase 1 - Methodology

- Defining Data Elements and Review of Data Sources
  - Determine crash record criteria
  - Collaboration with AASHTO to identify state POC
  - Collect and organize large truck rollover crash records
  - Collect FARS database records

- Data Assimilation and Mapping
  - Refine and standardize crash records
Phase 1 - Methodology

- Cluster Identification
  - Utilize GIS tools to determine clustering of rollover events within a defined proximity
  - Analyze historical crash data based on the number of rollovers at a site using the Accident Frequency method
  - Identify locations within each state with the highest frequency of rollovers
Phase 1 - Methodology

- Cluster Tolerance
  - Integrate events into coincident points
  - Count events at identified clusters
Phase 1 - Results

- **Large Truck Rollover Database**
  - Data from 9 Years
    - 2001-2009
  - 51,229 Rollover Crash Records
    - > 48,000 non-fatal
    - 2,691 fatal

- **State Participation**
  - 39 states participated
    - 31 integrated
    - 8 states not integrated
    - 10 states not participating
Phase 1- Results

- **State Summary Reports**
  - Created for each state in database (31)
  - Includes the number of fatal and nonfatal rollover crashes for each year as well as the top rollover locations based on highest frequency of rollover events
  - Collaboration with FMCSA to increase state participation

- **Online Interactive Map**
  - Aids in distributing information
  - Promotes use of spatial technologies in large truck crash research

- **Digital and Hard Copy Publication**
  - May be updated as current hot spots are addressed, causing risks to diminish, as well as when new hot spots are identified
Georgia

Rolovers by Year and Severity

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Total Rolovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>16</td>
<td>451</td>
<td>467</td>
</tr>
<tr>
<td>2002</td>
<td>18</td>
<td>421</td>
<td>439</td>
</tr>
<tr>
<td>2003</td>
<td>21</td>
<td>594</td>
<td>545</td>
</tr>
<tr>
<td>2004</td>
<td>15</td>
<td>563</td>
<td>578</td>
</tr>
<tr>
<td>2005</td>
<td>18</td>
<td>630</td>
<td>648</td>
</tr>
<tr>
<td>2006</td>
<td>26</td>
<td>600</td>
<td>626</td>
</tr>
<tr>
<td>2007</td>
<td>28</td>
<td>488</td>
<td>516</td>
</tr>
<tr>
<td>2008</td>
<td>23</td>
<td>471</td>
<td>494</td>
</tr>
<tr>
<td>2009</td>
<td>19</td>
<td>249</td>
<td>268</td>
</tr>
<tr>
<td>All Years</td>
<td>184</td>
<td>4357</td>
<td>4561</td>
</tr>
</tbody>
</table>

Atlanta Metro Area

Top Rolover Locations

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>Number of Rolovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-285 and I-75 (South Side)</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>I-285 and I-20 (East Side)</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>I-285 and I-85 (South Side)</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>I-285 and I-85 (North Side)</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>US 778 and Spar 6</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>I-75 between SR 140 and I-85</td>
<td>17</td>
</tr>
<tr>
<td>7</td>
<td>I-95 and I-16</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>I-285 and I-20 (West Side)</td>
<td>14</td>
</tr>
<tr>
<td>9</td>
<td>US 411 and</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>US 410/500 Frank Harris Pkwy SE</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>I-75 between US 316 and Old Omega Rd</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>I-285 and I-75 (North Side)</td>
<td>11</td>
</tr>
</tbody>
</table>

Please refer to the full report, Mapping Large Truck Rolovers: Identification and Mitigation Through Spatial Data Analysis, available from ATRI at www.atr-online.org for methodology and data sources.
Mapping Large Truck Rollovers: Interactive Map

Click in the interactive map below to zoom in to rollover locations. Click on a rollover location to link to the state report.
Phase 1- Conclusions

- Demonstrates the feasibility and utility of creating a spatial national large truck rollover database
  - Reveals a need for more uniform crash reporting procedures among states
  - Encourages enhanced national standard for reporting all crash types

- Methodology was effective for identifying rollover concentrations, especially those concentrations that were not limited to a single stretch of road but rather multiple intersecting roads

- Provides ATRI Research Team with a foundation to proceed with Phase 2 and 3 research
The FPM Program

- Sponsored by Federal Highway Administration (2002-Present)
- Billions of unique truck GPS positions received/processed per year
- Several hundred thousand individual trucks (mostly Class 8) in the population
- The dataset used is multi-year/multi-source
- Customized Processing System/Methods for Producing Freight Performance Measures
Utilizing Empirical Data to Analyze Road Closures and Freight Diversion
Background

- May 2011 - Flooding closes Interstate 40 in Arkansas at White River Bridge
- I-40 is a critical trucking corridor
  - 2010 average daily volume ~18,000 trucks
- Both directions closed for several days, resulting in significant detours
- Question: How can Freight Performance Measures (FPM) dataset be used to analyze closure impacts?
Methodology

- Isolated FPM data on first full day of closure (May 6) and one week prior (April 29)
- Each data point contains:
  - Unique Truck ID
  - Latitude/Longitude (precise)
  - Date/time stamp
  - Speed
  - Heading
- Using ArcGIS, data was spatially joined to the Freight Analysis Framework road network shapefile
  - Network divided into smaller segments for more detailed analysis
  - Each segment assigned a unique ID
- Number of unique truck IDs aggregated and difference between May 6 and April 29 calculated
- National control analysis performed to reduce impact of external trends
April 29, 2011: 1 Week Prior to Closure
May 6, 2011: 1st Full Day of Closure

Official WB Detour

Official EB Detour

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### Results

<table>
<thead>
<tr>
<th></th>
<th>Local Analysis</th>
<th>National Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Count of Unique Trucks</td>
<td>-4.0%</td>
<td>+0.6%</td>
</tr>
<tr>
<td>Δ Mean Spot Speed (mph)</td>
<td>-6.2%</td>
<td>+0.9%</td>
</tr>
</tbody>
</table>

### Legend

Change in Unique Truck Counts  
5/6/11 vs. 4/29/11

- **Red**: <-125
- **Orange**: -124 to -75
- **Green**: -74 to -25
- **Blue**: -24 to -25
- **Green**: 26 to 75
- **Green**: 76 to 125
- **Green**: 125+
Methodology

- Evidence of regional diversion in local analysis, corroborated by media reports
- Replicated local diversion analysis for southeastern US
- Utilized ATRI National Corridors road network instead of FAF
  - Customized for use with FPM data
  - 93,000+ segments and growing
  - Suitable for multi-directional analysis
- Longer corridors (~150 miles long) analyzed to better yield regional trends
Results

Legend
Percent Change in Truck Counts
5/6/11 vs. 4/29/11
- < -10%
-10% - -5%
-5% - 5%
5% - 10%
> 10%
May 6 Position Reads
Commercial Drivers are not permitted to drive for more than 11 consecutive hours. Congestion, weather, and other unplanned events can cause variation in the distance travelled over the course of 11 hours.
On average, approximately 7,000 trucks use I-40 in Navajo County daily. If the 25 parking spaces in facilities A & B are full, a driver may not be able to find a designated space before his or her 11 hours of driving is exhausted.
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Prepared by the American Transportation Research Institute

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