The Use of GIS in Bus Crash Analysis for Capital Metro

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The analysis is performed based on Interagency Contract between Capital Metro and Texas A&M Transportation Institute.

The Capital Metropolitan Transportation Authority, commonly referred to as Capital Metro, is Austin's regional public transportation provider. It operates bus, paratransit services and a commuter rail system known as Capital MetroRail for Austin and several suburbs in Travis and Williamson counties.

Texas A&M Transportation Institute (TTI) is recognized as one of the premier higher education-affiliated transportation research agencies in the nation.
Overview

• Background
• Data Summary
• Process
• Analysis
• Conclusion
Overview

- **Background**
- Data Summary
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Background

Capital Metro Bus Collisions between FY2009 and FY 2014
Background

Interagency Contract for:

- **Phase 1**: Assessment of major contributing factors over last six years
  - Study crash distribution
  - Identify top five crash categories
- **Phase 2**: Research peer agencies and countermeasures used
- **Phase 3**: Identify countermeasures to pilot
- **Phase 4**: Evaluate countermeasures
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Data Summary

- FY 2009 to FY 2014 crash data for fixed route services and paratransit.
  - Almost 3,900 incidents in the service area
  - Narrowed to 1,230 incidents with $1000 damages or more
  - Fields: report number, fiscal year, accident description, travel direction, etc.
Data Summary

- Texas Department of Transportation’s (TxDOT) Crash Records Information System (CRIS) database
  - Crash data collected from the Texas Peace Officer’s Crash Report (CR-3)
  - Record traffic crash with apparent damage of $1,000 or more, or when the crash resulted in injury or death
  - Only 11% of Capital Metro incidents match up with CRIS
Data Summary

• Operator and supervisor reports
  ▫ Operating Conditions
    e.g. direction of travel, vehicle action at the time of the crash
  ▫ Crash Contributing Factors
    e.g. lane width, fixed objects, parked vehicle
  ▫ Location Specifics
    e.g. street name, cross street name, specific address
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Process

World Geocoding Service

- Online geocoding service
- Covert an address to an x,y coordinate and append the result to an existing record in a database

Input Fields:
- Single Field
- Multiple Fields: Address, Neighborhood, City, Subregion, Region, PostalExt, Country
Process

Inconsistent Address Specifics

- Street name
- Closest crossing street name
- Detailed address with block number
- Name of facilities
Process

Data Validation

- Add street suffix to the roadway name
  e.g. St. Ave. Dr. Ln. Rd. Blvd.
- Correct misspelling of street names
- Find out detailed address for terminals, stops, and facilities
- Multiple trials with geocoding
## Process

### Original and Corrected Addresses

<table>
<thead>
<tr>
<th>Original</th>
<th>Corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congress</td>
<td>Congress Ave</td>
</tr>
<tr>
<td>183 Frontage</td>
<td>US Hwy 183 Frontage Rd</td>
</tr>
<tr>
<td>Krieg Field</td>
<td>517 Pleasant Valley</td>
</tr>
<tr>
<td>Yard</td>
<td>2910 E 5th St</td>
</tr>
</tbody>
</table>

### Intersection GeoCoordinates

<table>
<thead>
<tr>
<th>Intersection</th>
<th>GeoCoordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside Dr. &amp; Interstate 35</td>
<td>30.247944, -97.73532</td>
</tr>
<tr>
<td>St Johns Ave. &amp; Interstate 35</td>
<td>30.332764, -97.704143</td>
</tr>
</tbody>
</table>
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Number of Bus Collisions

- **Collect Events**
  - Combines features that have the exact same X and Y coordinates
  - Converts event data to weighted point data

- **Highest Frequency Incident Locations**
  - Congress through downtown
  - Congress at Oltorf
  - Congress at Riverside
  - Lamar at US183
  - Pleasant Valley at 5th Street
  - Pleasant Valley at 7th Street
Bus Collision Density Analysis

- **Kernel Density**
  - Calculates density of points around each output raster cell.
  - Cell size and search radius greatly affect the final result.

- **High Density Areas**
  - Downtown
  - University of Texas at Austin
  - Riverside
  - Pleasant Valley
Bus Collision Hot Spot Analysis

- Hot Spot Analysis
  - Give a set of weighted features
  - Identify statistically significant hot spots and cold spots using the Getis-Ord Gi* statistic.

- Spots
  - Hot Spot: Central Austin
  - Cold Spot: North of US 290, Southern West Austin
  - Rest – Not significant
Bus Collision Rate

- Bus Crash/ Peak Hour Bus Volume

- High Crash Rate
  - Comal Street
  - Airport Boulevard
  - US 290 West around Loop 1/Mopac
  - Stassney Lane
  - William Cannon Blvd
  - Pleasant Valley
Capital Metro Vehicle Accident Classification Codes

**VEHICLE ACCIDENT CLASSIFICATION CODES**

Any accident code followed by an ‘m’ indicates mirror-only contact

### INTERSECTIONS

1.0 Other vehicle fails to stop
1.3 CMTA unit fails to stop
3.0 CMTA unit turning
3.0m CMTA unit turning - mirror
3.4 CMTA unit turning RIGHT
3.4m CMTA unit turning RIGHT - mirror
3.5 CMTA unit turning LEFT
3.5m CMTA unit turning LEFT - mirror
5.0 Other vehicle turning
5.0m Other vehicle turning
5.4 Other vehicle turning RIGHT
5.4m Other vehicle turning RIGHT - mirror
5.5 Other vehicle turning LEFT
5.5m Other vehicle turning LEFT - mirror
5.6 Squeeze Play
5.6m Squeeze Play - mirror
6.0 All other intersection collisions (includes alleges, etc.)

### BETWEEN INTERSECTIONS

1.4 CMTA vehicle sideswipes other vehicle
1.6 Other vehicle sideswipes CMTA vehicle
1.6m Other vehicle sideswipes CMTA vehicle - mirror
1.7 Mirror-to-mirror contact ONLY
1.8 Pulling from or to curb by other vehicle
1.9 Collision with standing/parked vehicle (includes opened doors)
1.9m Collision with standing/parked vehicle (includes opened doors) - mirror
2.0 Collision with vehicle entering from alley or driveway

### MISCELLANEOUS

3.1 All contact with bicycles (formerly 3.0)
3.1m All contact with bicycles (formerly 3.0) - mirror
3.2 Collisions between CMTA passenger vehicles
3.3 Collisions between CMTA non-revenue vehicles

### PEDESTRIANS

3.9 Pedestrian hit by CMTA vehicle
3.9m Pedestrian hit by CMTA vehicle - mirror
4.0 CMTA unit hit by pedestrian

### MISCELLANEOUS COLLISIONS

4.5 Collision with (fixed) stationary object
4.5m Collision with (fixed) stationary object - mirror
4.6 Due to mechanical failure
4.7 Leaving Roadway
4.8 Collisions not otherwise classified
4.9 Collisions due to CMTA vehicle backing
Analysis

Top Five Crash Types (Over $1,000 damage)

- Bus collides with fixed object
- Bus sideswipes standing or parked vehicle
- Other vehicle fails to stop at intersection and collides with bus
- Other vehicle sideswipes bus
- Other vehicle rear ends bus
### Top Crash Categories (over $1000 damage)

<table>
<thead>
<tr>
<th>Incident Category</th>
<th>Total incidents analyzed</th>
<th>Percentage of incidents (damage over $1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus collides with fixed object</td>
<td>147</td>
<td>14%</td>
</tr>
<tr>
<td>Bus sideswipes standing or parked vehicle</td>
<td>145</td>
<td>15%</td>
</tr>
<tr>
<td>Other vehicle fails to stop at intersection and collides with bus</td>
<td>136</td>
<td>12%</td>
</tr>
<tr>
<td>Other vehicle sideswipes bus</td>
<td>131</td>
<td>12%</td>
</tr>
<tr>
<td>Other vehicle rear ends bus</td>
<td>94</td>
<td>11%</td>
</tr>
</tbody>
</table>
Bus sideswipes standing or parked vehicle

- 145 analyzed incidents
  - 92% other vehicle parked
  - 7% other vehicle stopped or standing
  - 1% had no data.
Bus sideswipes standing or parked vehicle

- Cluster in downtown
- Other Vehicle parked (92%)
  - Bus Moving Straight (84%)
    - Cut in too soon
    - Misjudge the distance
    - Distracted or inattention
  - Bus Turning Right (8%)
    - Misjudge the turn
    - Avoid contact
- Over ¾ deemed preventable
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Conclusion

• Use of GIS
  ▫ Purpose
    ▪ Identify accident-prone area
    ▪ Understand crash location by crash type and crash rate
  ▫ Major Function
    ▪ World Geocoding Service
    ▪ Collect Event
    ▪ Kernel Density
    ▪ Hotspot Analysis

• Future Analysis
  ▫ Before & After Analysis
  ▫ On-time Arrival Analysis
Contact

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