EVALUATION OF CROWDSOURCED EVENT REPORTS FOR REAL-TIME IMPLEMENTATION – SPATIAL AND TEMPORAL ACCURACY ANALYSIS

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Crowdsourced data

• Speed data
Users allow their location information to be collected while do not share any information actively. such as google, INRIX, Waze.

• Event reports
Users actively report geo-tagged real-time traffic status on social media, such as twitter.
Research Question

Reliability of WAZE reports

1. What is the likelihood of having a Waze report if an incident happened (coverage of Waze)?

2. If a report is made, does it represent an actual event? (false report, duplicate report, retained report)

3. How accurate are Waze event reports in terms of time and space?
Data

**Waze Data**: Reported by Waze User.

**LocateIM Data**: Official records maintained by TDOT (Tennessee Department of Transportation)

<table>
<thead>
<tr>
<th>Type</th>
<th>Waze</th>
<th>LocateIM</th>
<th>Analysis Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of reports</td>
<td>terminology</td>
<td># of reports</td>
</tr>
<tr>
<td>Accident</td>
<td>8,068</td>
<td>Accident</td>
<td>2,052</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stopped vehicle</td>
<td>93,707</td>
<td>Stopped vehicle</td>
<td>5,459</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Study Area: I-40 In Tennessee State

I-40 in TN: 452 miles
Matching Methodology

Pseudocode

For each report in LocateIM:
   For each report in Waze:
      Compute $\Delta T = T_{WAZE} - T_{LocateIM}$
      If $\text{abs}(\Delta T) < T_{thre}$:
         Compute $\Delta D = D_{WAZE} - D_{LocateIM}$
         If $\text{abs}(\Delta D) < D_{thre}$:
            Add the Waze reports to the matching list of LocateIM reports
Temporal-Spatial Threshold Selection

Accident reports

Stopped vehicle reports

Percentage of Match

Distance Threshold in Miles

Time Threshold in Minutes

0.5 1 1.5 2 2.5 3

30% 40% 50% 60% 70% 80% 90% 100%

10min 20min 30min 40min 50min 60min

0.25mi 0.5mi 0.75mi 1mi 1.25mi 1.5mi

Accident reports
Stopped vehicle reports
Crash Matching Results

Threshold: 1.5 mile, 30 minutes

-2.2 min

Distance Difference (mile)

Time Difference (min)

-6 feet

Distance Difference (mile)

Time Difference (min)
Stopped Vehicle Matching Results

Threshold: 1 mile, 19 minutes

-7.8min

-132 feet
# Timeliness

On average, Waze reports are made **2.2 minutes** sooner than LocateIM reports for an accident, and **7.8 minutes** for stopped vehicles.

<table>
<thead>
<tr>
<th>Time difference (min) ( (T_{\text{Waze}} - T_{\text{LocateIM}}) )</th>
<th>Number of Reports</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0, -3]</td>
<td>832</td>
<td>16%</td>
</tr>
<tr>
<td>(-3, -5]</td>
<td>611</td>
<td>10%</td>
</tr>
<tr>
<td>(-5, -10]</td>
<td>479</td>
<td>14%</td>
</tr>
<tr>
<td>(-10, -15]</td>
<td>287</td>
<td>9%</td>
</tr>
<tr>
<td>(-15, -20]</td>
<td>167</td>
<td>5%</td>
</tr>
<tr>
<td>&lt; -20</td>
<td>96</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time difference (min) ( (T_{\text{Waze}} - T_{\text{LocateIM}}) )</th>
<th>Number of Reports</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0, -5]</td>
<td>3090</td>
<td>13%</td>
</tr>
<tr>
<td>(-5, -15]</td>
<td>2498</td>
<td>18%</td>
</tr>
<tr>
<td>(-15, -20]</td>
<td>1618</td>
<td>14%</td>
</tr>
<tr>
<td>(-20, -35]</td>
<td>1003</td>
<td>10%</td>
</tr>
<tr>
<td>(-35, -45]</td>
<td>533</td>
<td>7%</td>
</tr>
<tr>
<td>&lt; -45</td>
<td>172</td>
<td>4%</td>
</tr>
</tbody>
</table>

Note: *, negative indicate Waze reports were made earlier than LocateIM reports
Spatial Accuracy

On average, the distance between LocateIM reports and Waze reports is **-0.001 miles** for accidents and **-0.025 miles** for stopped vehicles.

Cumulative Distribution of Absolute Distance Difference
Further Analysis of Spatial Accuracy

![Graph showing the number of matched Waze reports for a LocateIM record, with categories for crashes and stopped vehicles.]
Further Analysis of Spatial Accuracy

- Use the first report to represent the location of the accident.
- Average reports around the first report to represent the location of the accident.
- Average reports that clustered together to represent the location of the accident.
Crash Matching

- Most accurate report: -8
- First report: -5
- Averaged report (first): -8
- Averaged report (clustered): -11
<table>
<thead>
<tr>
<th></th>
<th>Mean (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most accurate report</td>
<td>-5</td>
</tr>
<tr>
<td>First report</td>
<td>-132</td>
</tr>
<tr>
<td>Averaged report (first)</td>
<td>-115</td>
</tr>
<tr>
<td>Averaged report (clustered)</td>
<td>-53</td>
</tr>
</tbody>
</table>
Coverage - Crash

6002 reports in Waze that can not be matched to LocateIM:

%False report?
%Duplicate report?
%Event that not recorded by LocateIM?
Coverage – Stopped Vehicle

80194 reports in Waze that can not be matched to LocateIM:
%False report?
%Duplicate report?
%Event that not recorded by LocateIM?

<table>
<thead>
<tr>
<th></th>
<th>WAZE</th>
<th>LocateIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Records</td>
<td>93707</td>
<td>5459</td>
</tr>
<tr>
<td>Matched</td>
<td>13203</td>
<td>4674</td>
</tr>
<tr>
<td>Percentage</td>
<td>14%</td>
<td>85%</td>
</tr>
</tbody>
</table>
Findings

❖ **WAZE Coverage:** WAZE Covers 67% of crashes recorded by TDOT and 85% of stopped vehicles recorded by TDOT.

❖ **Timeliness:** Waze reports are made **2.2 minutes** sooner than LocateIM reports (**7.8 minutes** for stopped vehicle). **Forty percent** of the crash reports (57% of stopped vehicle reports) in LocateIM are reported **earlier** by Waze than LocateIM.

❖ **Spatial Accuracy:** On average, the distance between LocateIM reports and Waze reports is **-0.001 miles (-6 feet)** for crashes and **-0.025 miles (-132 feet)** for stopped vehicles.

**Future Study:**
❖ Improve the location estimation accuracy.
❖ Propose method to remove Waze duplicate reports and analyze the percentage of reports reported by Waze but not recorded in LocateIM (contribution of WAZE).
THANKS
Q&A