Issues Associated with Motor Vehicle Crash Locations as Provided by ACN Systems

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Issues Associated with Motor Vehicle Crash Locations as Provided by ACN Systems

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III. Base Maps
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Alaska Emergency Medical System Optimization (AKEMSO) Project

Research effort (funded by USDOT), supports Alaska Highway Safety Office (AHSO) & Alaska’s Injury Prevention & EMS Section (IPEMS).

Objectives:

- Support IPEMS efforts to standardize EMS data collection (i.e., become NEMSIS compliant) and link with databases from Alaska Trauma Registry and Alaska DOT&PF.

- Assess needs / requirements for GPS equipment in EMS & law enforcement vehicles.

- Examine Alaska’s current emergency response infrastructure & protocols to determine how responders can best exploit Automatic Crash Notification (ACN) technologies, especially in rural areas.
  - Examples of ACN Systems: OnStar (GM), Tele Aid (Mercedes Benz), ASSIST (BMW), SYNC (Ford)
• As Automatic Crash Notification (ACN)/Advanced Automatic Crash Notification (AACN) systems proliferate, EMS dispatchers will need to become accustomed to the issues associated with using reported latitude and longitudes.

• GPS receivers can have error associated with their readings on the order of +/- 10 meters when stationary and greater than that in vehicles travelling at highway speeds.

• More important than the accuracy of GPS receivers for locating crashes, is the accuracy and completeness of street base maps, and the correct use of datum and projections.
• Base maps are available from number of sources and range in completeness and accuracy based on their intended uses.

• AKDOT maintains extremely accurate center line maps for the Alaska Highway System but not for local roads.

• Census related maps may have a high level of inclusion but with relatively low geometric accuracy while commercial options may have better accuracy but a high financial cost.

• The differences between two commonly available base street maps will be illustrated in the following slides and then recorded GPS measurements will be compared to them.
Base Maps: Vendors and Differences
ESRI Streets (Based on TIGER: Census Bureau) have a high inclusion of all addressable residences.
NAVTEQ Streets (Driven with GPS) have greater accuracy especially on highways and major roadways.
Representations of the same area can end up looking very different.
Differences in Base Maps

In some instances, both street maps may be missing roadways.

Sample GPS Heartbeat readings

- ESRI Streets
- NAVTEQ Streets
Study Area: Alaska Highway System, Anchorage, & Fairbanks
3D Elevation Model of Study Area

Fairbanks

Anchorage
Google Earth Image for Selected Study Area
Data Collection & Measurements
Test Equipment for Data Collection

• First extensive measurements along the Alaska Highway System (by AIPC collaborators) began in May 2008

• Heart Beat message, in 30 second intervals, was recorded along with the number of satellites in view, horizontal dilution of precision (HDOP), and latitude and longitude.
Illustration of Study Area

Anchorage
### Sample of Data Collected

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A minimum of 3 satellites is required for an accurate reading although more is better.

Points are colored by the number satellites in view for each reading.

- **0-2 Satellites**
- **3-5 Satellites**
- **6-8 Satellites**
Horizontal Dilution of Precision (HDOP) is an indication of how dispersed the satellites in view are.

The more dispersed the satellites are (low HDOP), the more accurate the recorded latitude and longitudes will be.

Points are colored by the HDOP for each reading:
- ● 8.1-11.1 HDOP
- ○ 4.1-8.0 HDOP
- ◼ 0.0-4.0 HDOP
Satellites in View vs. HDOP

**HDOP** can not be calculated when less than 3 satellites are in view**
Calculations and Comparison of Base Maps
Distances from GPS points are measured perpendicular to the closest street.
Points are colored by their distance in meters to the closest street in the ESRI base map.
Points are colored by their distance in meters to the closest street in the NAVTEQ base map.
Histogram for Distances to NAVTEQ Streets

X-axis: Near Distance (m)
Y-axis: Frequency

The histogram shows the frequency distribution of distances to NAVTEQ streets. The x-axis represents the near distance in meters, and the y-axis represents the frequency. The bars indicate the number of occurrences within each distance interval.
Comparison of ESRI & NAVTEQ Streets

Legend
Sample GPS Readings
Distance (m) to Road
- 0 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101 - 200
- 201 - 400
- 401 - 1300
Comparison of ESRI & NAVTEQ Streets

Legend
Sample GPS Readings
Distance (m) to Road
- 0 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101 - 200
- 201 - 400
- 401 - 1300
Histogram for Distances to ESRI & NAVTEQ Streets

- **ESRI**
- **NAVTEQ**
Uncertainty of Locations
Illustration of Expected Levels of Uncertainty

Anchorage
Using Orthoimagery
Orthoimagery Verification of Streets
OnStar Crashes from AK CARS
OnStar Crashes in AK CARS

Legend
Sample GPS Readings
Distance (m) to Road
- 0 - 10
- 11 - 20
- 21 - 50
- 51 - 100

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Summary and Conclusion

• Utilizing the best base maps available for the dispatch area will significantly lessen the ambiguity of assigning a crash to a roadway based on a reported latitude/longitude.

• Ensuring that proper datum conversion and maps projections are used will also reduce the uncertainty surrounding plotted locations.

• Understanding the issues associated with matching GPS locations to base street maps and properly addressing them enables the user to quickly and accurately translate crash locations into ‘real-world’ locations for dispatch of Public Safety/EMS.

• Distance of OnStar crash locations from roadways appear to be consistent with the distances determined from the GPS heartbeat data.

• Even with the differences between reported latitude and longitudes and base maps, ACN/AACN provide timely notification of crashes and actionable locations.
Acknowledgements

- Alaska Highway Safety Office
- NHTSA
- AKDOT&PF
- AK IPEMS
- Doug Lange (CUBRC)
- Jim Sheppard (ZK Cell Test, Inc)