Analysis of DSRC Accuracy for Pedestrian Localization

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Motivation

- Mobility-impaired pedestrians have additional needs when navigating through intersections
- ICLL has previously developed an app to allow for communication between pedestrians and intersection controllers to give them additional time to cross
- We currently have no way to continue to provide accurate status updates to intersection controllers while the pedestrian is traversing the intersection
- Current cell phone GPS location has an average reported accuracy of +/- 10 meters, which is too inaccurate for positioning in a typical intersection
- Dedicated Short-Range Communication (DSRC) GPS receivers have a reported accuracy of +/- 1 meter

Approach

- If we can read pedestrians' position with +/- 1 meter accuracy while they are in an intersection, we can monitor their progress through the intersection
- This allows us to adapt intersection control when pedestrians perform unpredictably, such as falling or straying from the crosswalk space
- Our experiment seeks to measure the accuracy of DSRC GPS to see if the localization is precise enough to measure pedestrian progress in traffic intersections
- We also plan to look into error correction of cell phone GPS using DSRC GPS in order to increase the precision of measurements

DSRC Sleeve with iPhone 7 used for testing

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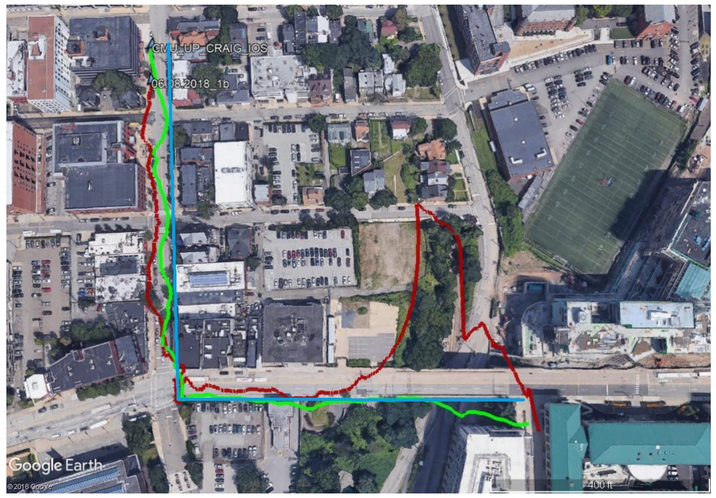
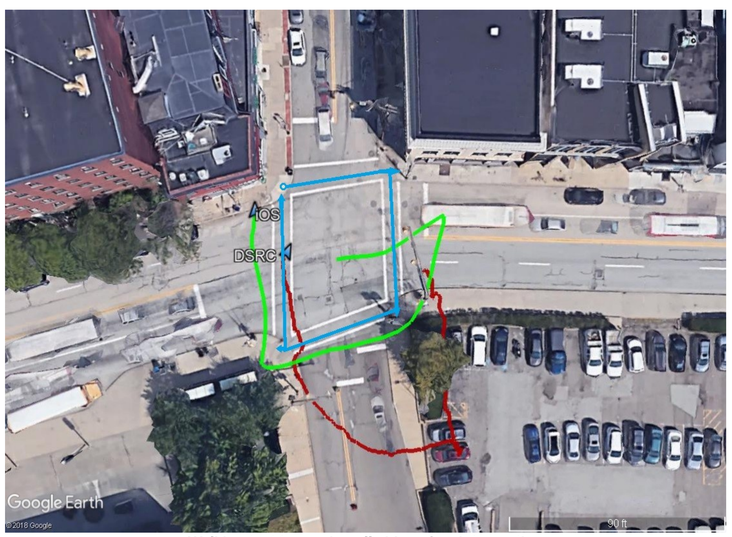


Blue: Actual Path, Red: DSRC Coordinates, Green: iOS Coordinates

Testing

- We used a DSRC-enabled interface to record both iPhone 7 GPS readings and DSRC GPS readings
- Trials were performed at several locations in Pittsburgh to test performance in different urban canyon environments
- Walking speed was kept as close to 1 m/s as possible
- All paths stuck to the center of the sidewalk/crosswalk whenever possible.
- No other DSRC signals were transmitted on the receiver's wavelength during our experiments, eliminating the possibility of interference or extraneous measurements



Walking test traversing all sides of an intersection

Findings

- iPhone GPS accuracy performed better than the reported +/- 10 meter accuracy, with actual results showing +/- 2 meter accuracy, on average
- DSRC GPS accuracy performed worse than the reported +/- 1 meter accuracy, with actual results varying greatly between 5-200 meter error
- DSRC GPS performance improves as the speed improves—tests while driving showed +/- 2 meter accuracy, whereas walking tests performed much worse

Test while driving—DSRC Readings occasionally overlap with Actual Path

Analysis

- Cellular GPS is still too imprecise to use for intersection localization, but is much more accurate than initially expected
- DSRC GPS has a much higher refresh rate (10 readings per second) than cellular GPS (1 reading per second)
- DSRC GPS can be close to cellular GPS at high enough speeds, indicating that some interior self-correction is throwing off results for pedestrian experiments

Future Work

- Currently researching ways to overcome the internal correcting to make DSRC GPS just as accurate at slow speeds as it is at higher speeds
- As both cellular and DSRC GPS are within +/- 2 meter accuracy in the best case, we plan to implement an algorithm to derive more accurate positioning from the two close GPS points
- Previous papers have developed algorithms to get +/- 15 cm accuracy given two GPS receivers with +/- 3 meter accuracy
- Once accuracy is precise enough to track pedestrians in intersections, we will pass the information to the intersection controller to increase safety