

Verge: Estimated Time of Arrival for Pedestrian Commutes

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Motivation

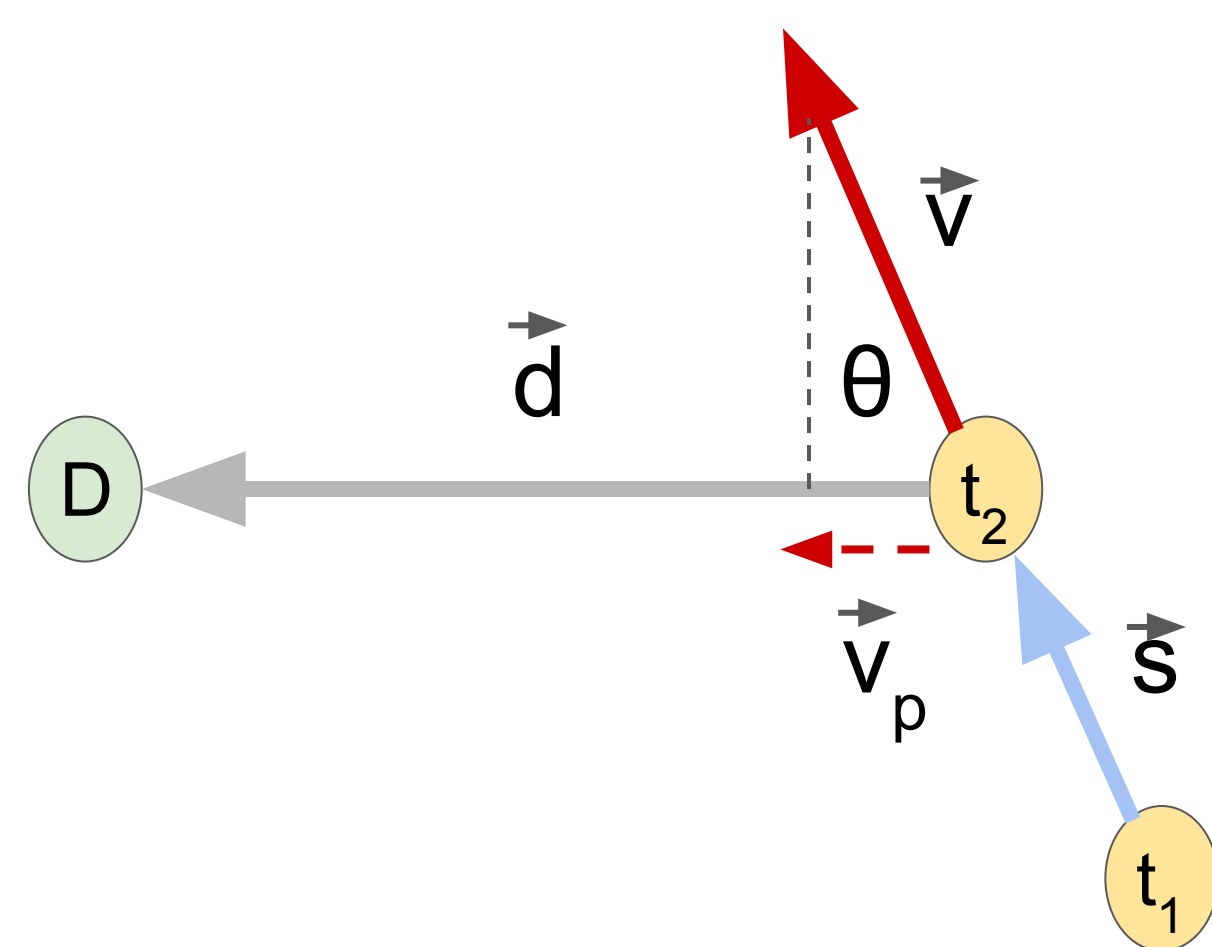
- GPS can be combined with maps of roads to estimate a user's ToA to their destination
- Assuming no map of walking routes, can we build something that does the same for pedestrian commutes?
- Verge should work in all types of environments: indoor, outdoor, rural, urban, etc.

Indoor-Outdoor Detection

- Use GPS accuracy values as an indicator for the environment
- Accuracy outdoors is usually within 15m but can drop to 250m indoors
- Verge waits for five consecutive indicators to change state

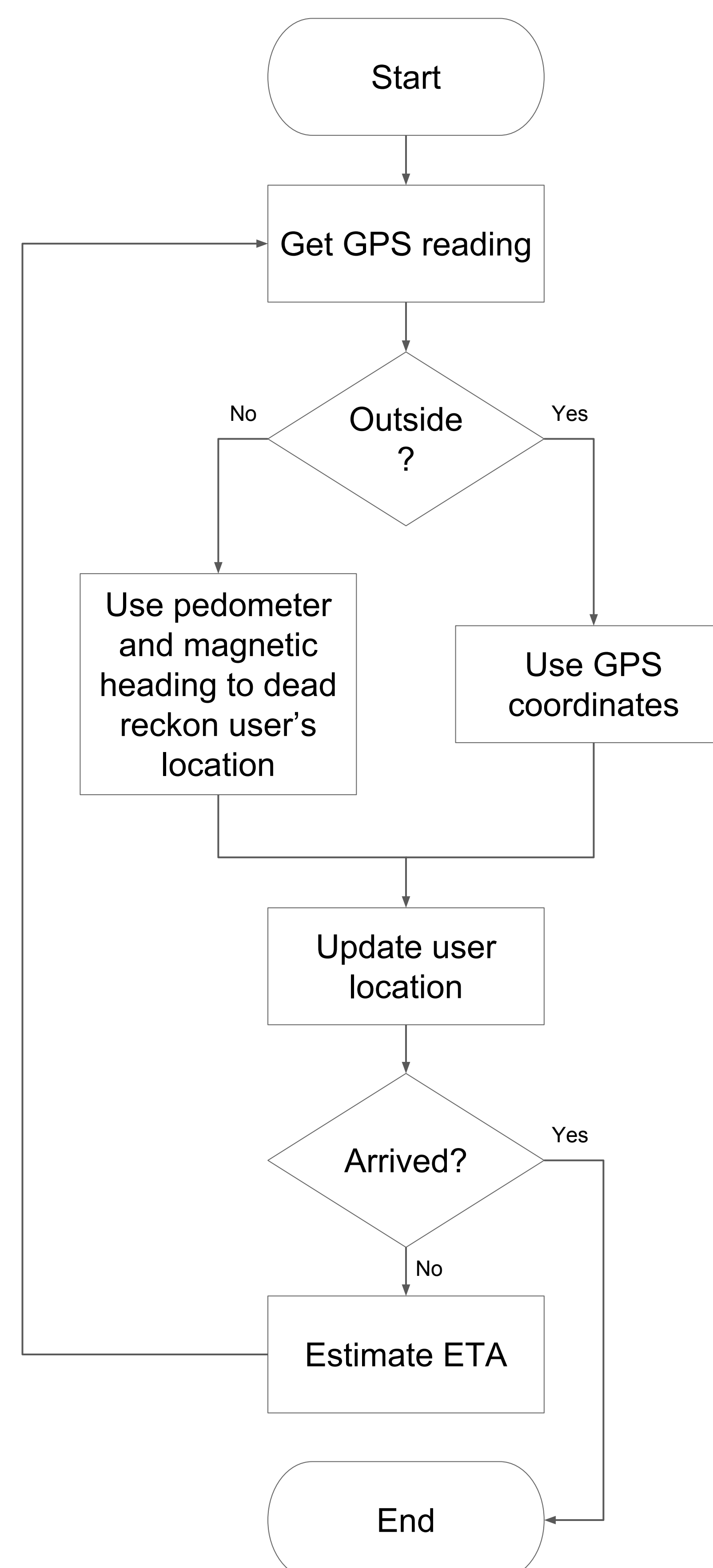
Time of Arrival Estimation

$$\Delta t = t_2 - t_1$$
$$\vec{v} = \frac{|\vec{s}|}{\Delta t} \vec{s}$$
$$\vec{v}_p = (|\vec{v}| \cos \theta) \frac{\vec{d}}{|\vec{d}|}$$
$$ETA = t_2 + \frac{|\vec{d}|}{|\vec{v}_p|}$$



Indoor Localization

- WiFi localization requires many access points, which does not apply to rural environments
- Verge uses step counting and magnetic heading for estimating the user's position indoors

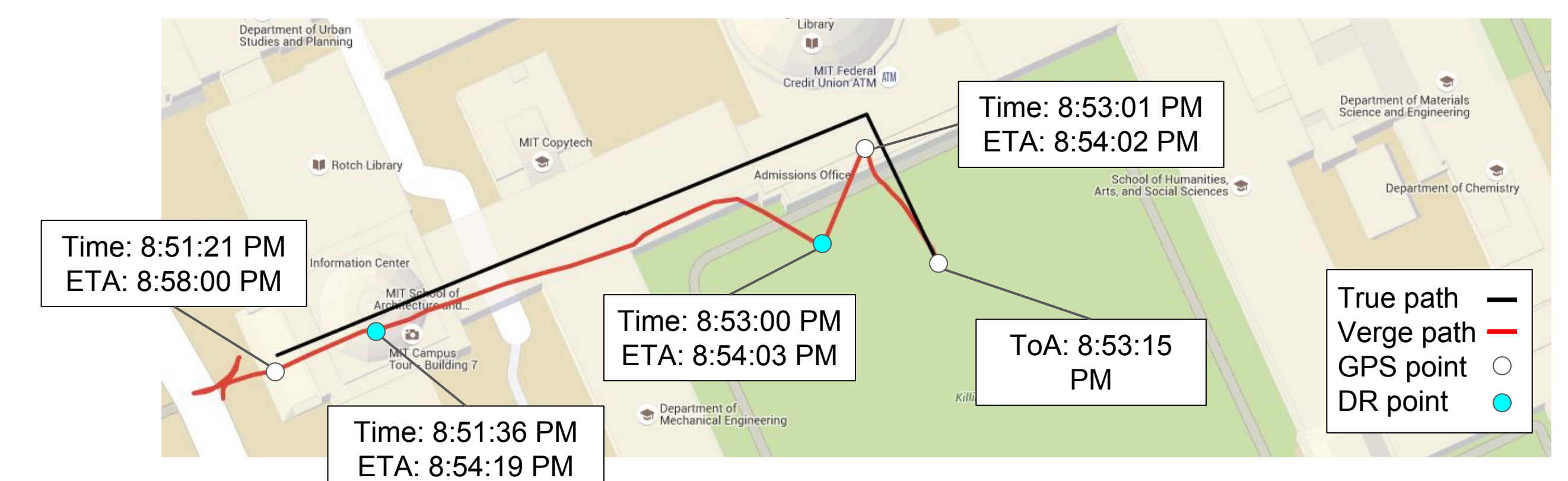


Feedback Control

- Since we assume no knowledge of the map, the user may sometimes appear to walk in a direction opposite to their destination
- Verge uses an exponentially weighted moving average to smooth the velocity and heading estimates

Test Results

- Simple walking route from the stairs of 77 Mass Ave through the Infinite Corridor to Killian Court



Future Work

- Learning can be done on previously walked routes for improved estimation
- Test and adapt the Verge algorithm to locations other than the Infinite Corridor
- Incorporate other methods of dead reckoning, such as accelerometer readings