Accurate Pedestrian Tracking

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BACKGROUND

The Global Navigation Satellite System (GNSS) consists of a family of satellite navigation systems (like GPS, Galileo, GLONASS, BeiDou) which provide global positioning and navigation from orbiting satellites. GNSS is one of the major inputs for phone location. Accurate pedestrian localization in “urban canyons” has long been limited by GNSS multipath errors and blocked line-of-sight, especially for blind and low-vision pedestrians who need sidewalk-level accuracy. GNSS-based positioning in dense downtowns is often limited to tens of meters off because skyscrapers block satellites, create multipath, and reduce signal quality, leading to especially large errors that make it hard to know which side of a street a pedestrian is on. For blind and low-vision users, conventional smartphone navigation (pure GNSS, camera-based visual positioning system, or beacon infrastructure) does not offer reliable, hands-free, street-side-accurate guidance. Most accuracy-focused approaches to date require detailed 3D models, specialized hardware, and/or substantial map annotations, limiting the scalability across urban environments and challenging mainstream apps deployment. Moreover, for blind and low-vision pedestrians, integrating precise localization with usable, low-attention interaction (i.e., no constant camera use, minimal screen looks) and robust crossing guidance is still a problem.

TECHNOLOGY DESCRIPTION

Motivated by these challenges, a research team at UC Santa Cruz (UCSC) has focused their research on inertial measurement-unit-based and map-aided localization that keeps the phone in the pocket, resulting in an approach that uniquely combines GNSS, particle-filtering, and Robust Neural Inertial Navigation in the Wild (RoNIN). This research employs a probabilistic “soft” map-matching with three map classes (impenetrable buildings, streets, and freely traversable areas) plus a tunable “jaywalking weight” which helps reduce large localization errors without fully constraining the trajectory, unlike hard map-matching. Laboratory data show fused GNSS+PF+RoNIN system identified the correct sidewalk 80% of the time, versus 71% for RoNIN+PF, and 47% for GNSS alone. These findings hold promise towards outdoor, smartphone-based, multi-route utility in real urban canyons, including covered transit hubs, without the need for 3D city models or complex GNSS shadow analysis.

APPLICATIONS

- outdoor navigation
- outdoor localizaton
- mobile applications

FEATURES/BENEFITS

- Practical and scalable approach that can be layered into existing navigation apps with minimal mapping overhead.
- Achieves substantial reduction in large Euclidean errors and across-street errors, even when GNSS alone is unreliable.
- Demonstrated outdoor deployment using only smartphone sensors and lightweight geosegmentation via polygonal segments.

RELATED MATERIALS

- Accurate Pedestrian Tracking in Urban Canyons: A Multi-Modal Fusion Approach - 01/29/2026

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OTHER INFORMATION

KEYWORDS

Global Navigation Satellite System, GNSS, wayfinding, localization, pedestrian tracking, pedestrian navigation, particle-filter, particle-filtering, satellite navigation, inertial measurement unit, IMU, multipath, RoNIN, Robust Neural Inertial Navigation in the Wild, pedestrian dead reckoning

CATEGORIZED AS

- **Communications**
  - Wireless
- **Computer**
  - Software
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- **Transportation**
  - Personal
- **Engineering**
  - Other

RELATED CASES

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