Differential And Non-Differential Frameworks For Submeter-Accurate UAV Navigation With Cellular Signals

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BRIEF DESCRIPTION

A novel framework enabling submeter-level accurate unmanned aerial vehicle (UAV) navigation using cellular carrier phase measurements with and without a base station.

FULL DESCRIPTION

This technology introduces two innovative frameworks—differential and non-differential—for achieving submeter horizontal navigation accuracy of unmanned aerial vehicles (UAVs) using cellular signal carrier phase measurements. The differential framework leverages a base station sharing carrier phase data with the UAV, employing advanced filtering and estimation techniques to guarantee position errors remain below a set threshold with high probability. The non-differential framework exploits the exceptional clock stability of cellular base transceiver stations (BTS) to enable precise navigation without the need for a base station. Both frameworks address challenges inherent in signals of opportunity navigation, delivering unprecedented accuracy.

SUGGESTED USES

- UAV navigation and control for package delivery, search and rescue, and inspection tasks.
- Mobile device location services enhancing positioning accuracy indoors and in urban areas.
- Automotive navigation systems requiring robust positioning in urban canyons and tunnels.
- Aerospace and defense applications needing secure, accurate navigation independent of GNSS.
- GNSS augmentation providers seeking alternative or complementary navigation sources.
- Cellular network operators aiming to expand value-added services with precise location capabilities.

ADVANTAGES

- Achieves submeter-level horizontal navigation accuracy for UAVs.
- Guarantees position error remains below a predefined threshold with a desired probability in the differential framework.
- Enables navigation without a base station using the non-differential framework, reducing dependency on communication links.
- Utilizes widely available cellular signals (3G, 4G, 5G) as signals of opportunity, which are abundant and free to use.
- Robust performance in Global Navigation Satellite System (GNSS)-denied or challenged environments such as urban canyons and indoor settings.

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OTHER INFORMATION

KEYWORDS

Autonomous Systems, Signals of Opportunity, Navigation

CATEGORIZED AS

- **Communications**
  - Wireless
- **Sensors & Instrumentation**
  - Position sensors
- **Transportation**
  - Aerospace
  - Automotive

RELATED CASES

2021-777-0

» Extensive experimental validation demonstrating consistent submeter accuracy over multi-kilometer UAV trajectories.

PATENT STATUS

Patent Pending

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