IIT Tirupati Navavishkar I-Hub Foundation

भारतीय प्रौद्योगिकी संस्थान तिरुपति
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विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF SCIENCE & TECHNOLOGY

Precise Multi-UAV Navigation for Indoor Radio Mapping

Breif Background

In GPS-denied or weak-signal environments like indoor spaces, achieving accurate positioning and navigation for UAVs remains a major unresolved challenge. Traditional brute-force radio measurement methods require dense sampling, which is impractical, time-consuming, and costly. Hence there is a need of a smarter solution that can efficiently generate indoor radio maps for precise UAV navigation

Application Sectors

- Industrial Warehouses,
- Search and rescue,
- Industrial IoT and Smart City,
- Millitary applications

TRL 2

Tech/Prod. Summary

A system for the fleet of drones to create radio maps and enable navigation in GPS-denied environments. It uses Loco Positioning System (LPS) with onboard sensors and a ground station to gather radio signal strength data , which is then used for localization. This approach constructs the map efficiently from limited measurements, reducing deployment time.

Tech/ Product Description

The system uses a multi-robot aerial testbed to generate indoor radio maps for precise positioning in GPS-denied environments. The core system consists of Crazyflie 2.1 Brushless nano-quadcopters and the Loco Positioning System (LPS) operating in TDoA3 mode, which enables scalable indoor localization using stationary Anchors and onboard Tags. The Flow Deck V2 provides altitude estimation using optical flow and time-of-flight sensing. A Seeed Studio XIAO ESP32S3 Sense module mounted on each drone captures RSSI values, which are fused with localization data to create signal fingerprints for radio map construction

Impact - SDG:

SDG 9: Industry, Innovation, and Infrastructure
SDG 11: Sustainable Cities and Communities

Market Potential

1. Autonomous indoor robotics: ~USD 10-12 Billion in 2025 → ~USD 25-30 Billion by 2030

Value Proposition

1. accurate indoor positioning and navigation of multiple UAVs without relying on GPS.
2. Scalable and Cost-effective
3. high-quality indoor radio maps enables reliable autonomous UAV operation.