DATI, AI E ROBOTICA @POLITO

RICERCA, TRASFERIMENTO TECNOLOGICO E SUPPORTO ALLE AZIENDE SUI TEMI FONDAMENTALI DEI BIG DATA, INTELLIGENZA ARTIFICIALE, ROBOTICA E RIVOLUZIONE DIGITALE

ADVANCED LOCALIZATION TECHNOLOGIES FOR SERVICE ROBOTICS

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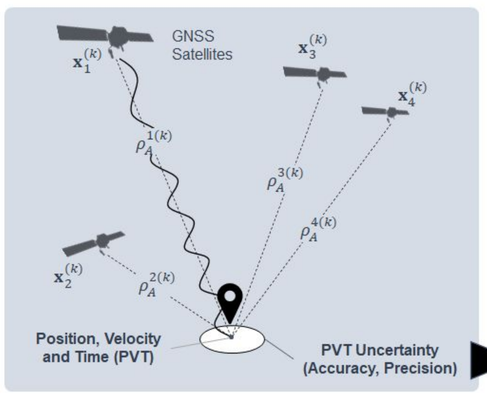
PIC4SeR

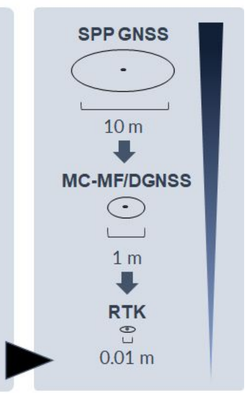
GLOBAL NAVIGATION SATELLITE SYSTEM

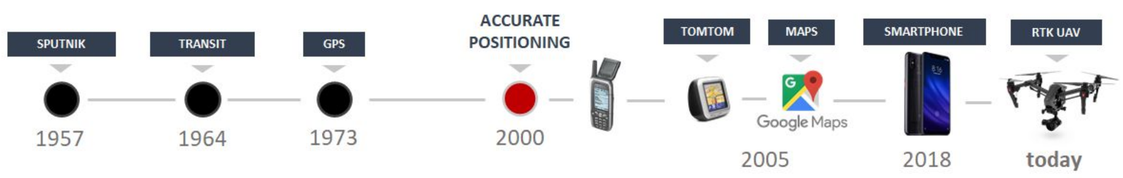
Global Navigation Satellite System (GNSS) is a radio-navigation technology that provides **Position**, **Velocity**, and **Time** (PVT) for enabled receivers. It leverages the reception of synchronous **ranging signals** transmitted by satellites like the **Global Positioning System** (GPS), Galileo, Beidou, and GLONASS. Modern GNSS receivers rely on accurate **phase measurements** from **multi-constellation (MC)**, **multi-frequency (MF)** signals for **meter-level accuracy**.

Advanced augmentation paradigms such as **Real-Time Kinematic** (RTK) lead to **decimeter-level accuracy**, thus constituting an empowering technology for service robotics applications.

GNSS can be complemented by **auxiliary proprioceptive sensors** and **network-based cooperative data** to cope with challenging conditions in a **harsh environment**.





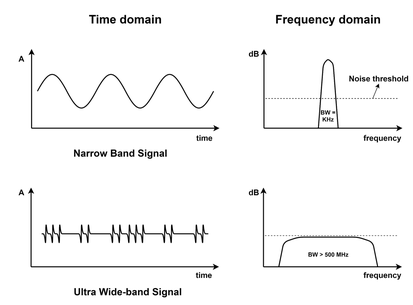


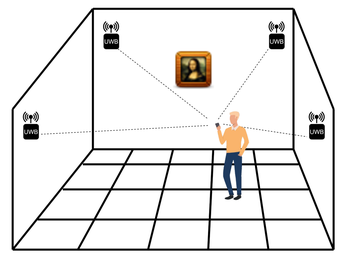
ULTRA WIDEBAND REAL-TIME LOCALIZATION SYSTEM

Ultra wideband is a radio technology that can use a very **low energy** level for **short-range**, **high-bandwidth communications**.

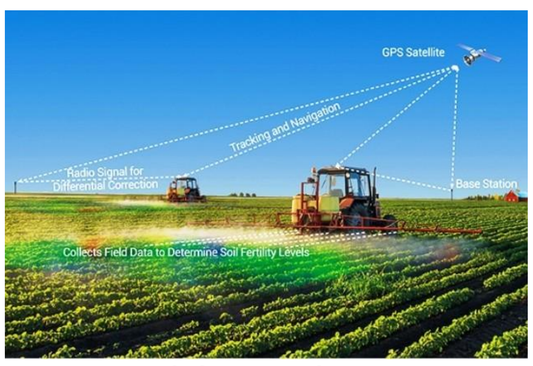
As opposed to Narrowband and Spread-spectrum technologies that make use of continuous signals, an **UWB signal is composed of a series of pulses**. The consequence is a high temporal resolution and an extremely wide instantaneous bandwidth.

These characteristics make UWB technology **particularly suitable for distance measurements, and thus localization**. Typically, UWB RTLS can reach a **3D accuracy of 30 cm** with high multipath resolution, high penetration capabilities, and low interference with existing signals.



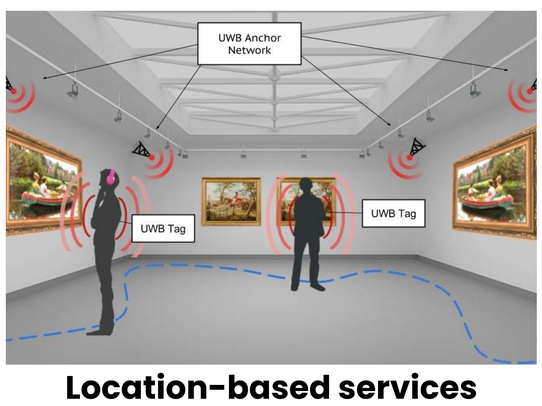


RELEVANT APPLICATION FIELDS



Precision agriculture

Asset tracking



Location-based services

Autonomous driving

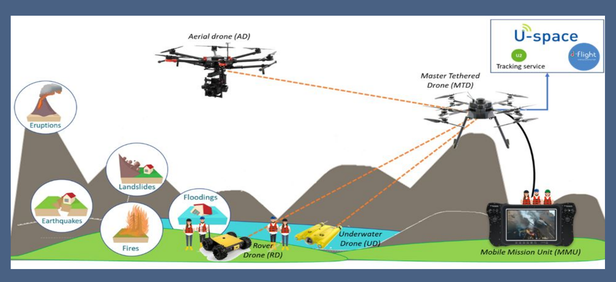
Planetary exploration

Delivery drones and robots

ONGOING ACTIVITIES

- **PATHfinder**

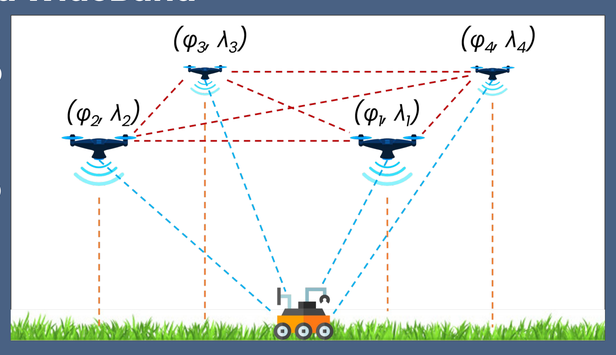
  GNSS and UWB can be cooperatively combined to achieve indoor-outdoor seamless localization capabilities and highly reliable and accurate outdoor positioning information.

  PATHfinder project designs and implements a cooperative system for emergency management in challenging scenarios.

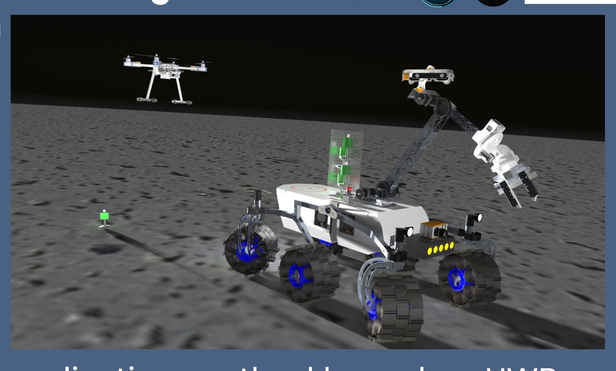
- **PRIN Next Generation – Ultra WideBand**

  We are designing a mobile localization infrastructure to improve localization in partially GPS-denied environments. Our idea is to use a swarm of 4 drones equipped with UWB devices as a “local GNSS-like constellation” that allow high precision localization in harsh environments.

- **ESA-ESRIC Space Resources Challenge** PoliTOmoon

  Design and implementation of an integrated system composed of a rover combined with an autonomous flying drone for Moon prospecting. To enable a high level of autonomy of the robotics system, the architecture does include an innovative localization method based on UWB anchors.

- **Jamming, Spoofing and Cyberattacks Countemeasures**

  Intentional radiofrequency interferences can disrupt GNSS operations. Interference mitigation techniques can ensure an improved resilience to the navigation systems.