



POLITECNICO
MILANO 1863

DIPARTIMENTO DI ELETTRONICA
INFORMAZIONE E BIOINGEGNERIA

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IoT Lab 

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Research areas

LOCALIZATION

Signal processing and learning for localization in vehicular and industrial environments.

- Active (positioning)
- Passive (sensing & target tracking)
- Theoretical
- Experimental
- 5G, UWB, LiDAR, camera

COMMUNICATION

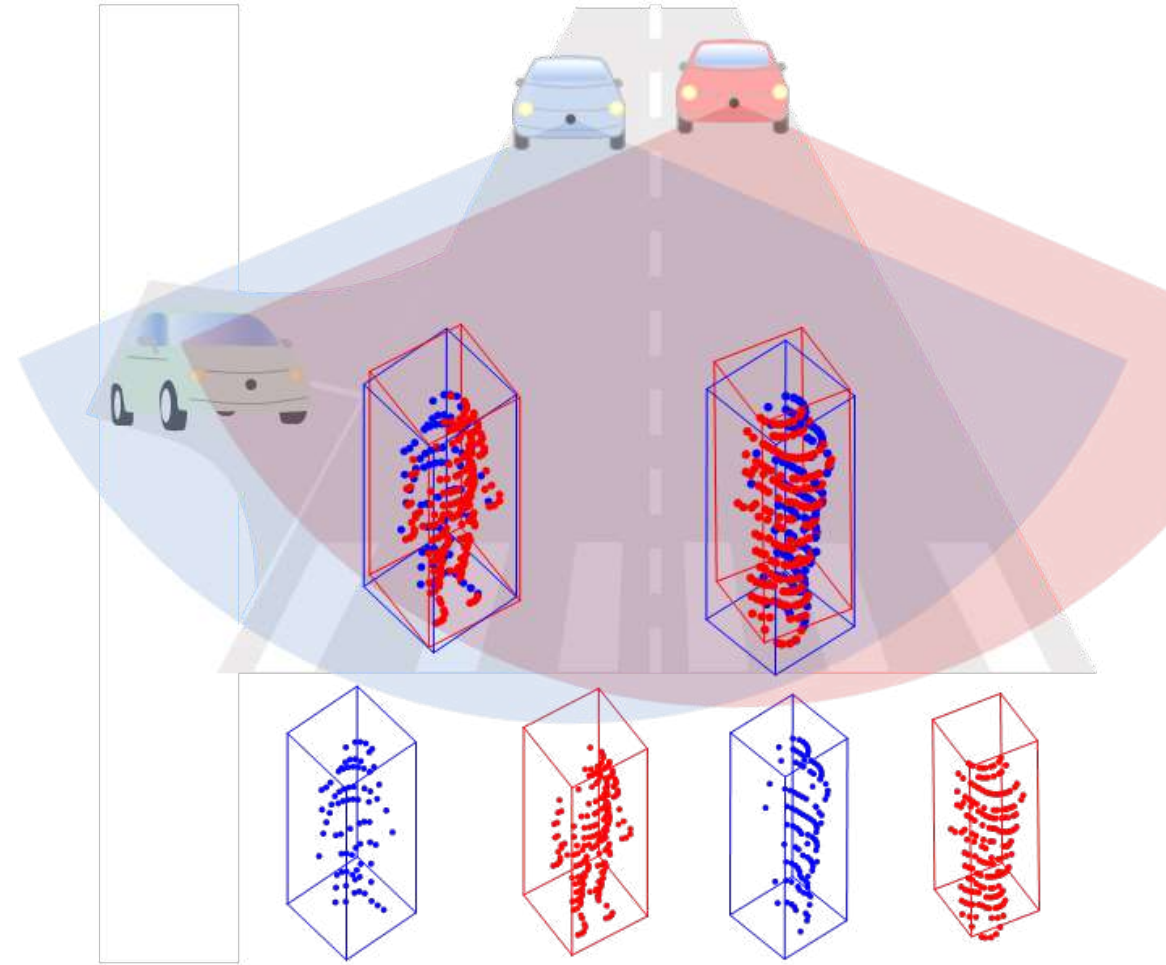
Research on beyond 5G trends, experimental assessments of existing technologies

- V2X communication
- Theoretical
- Experimental
- ITS-5G/C-V2X OBU and RSU
- Non-Terrestrial Networks (5G, Starlink)

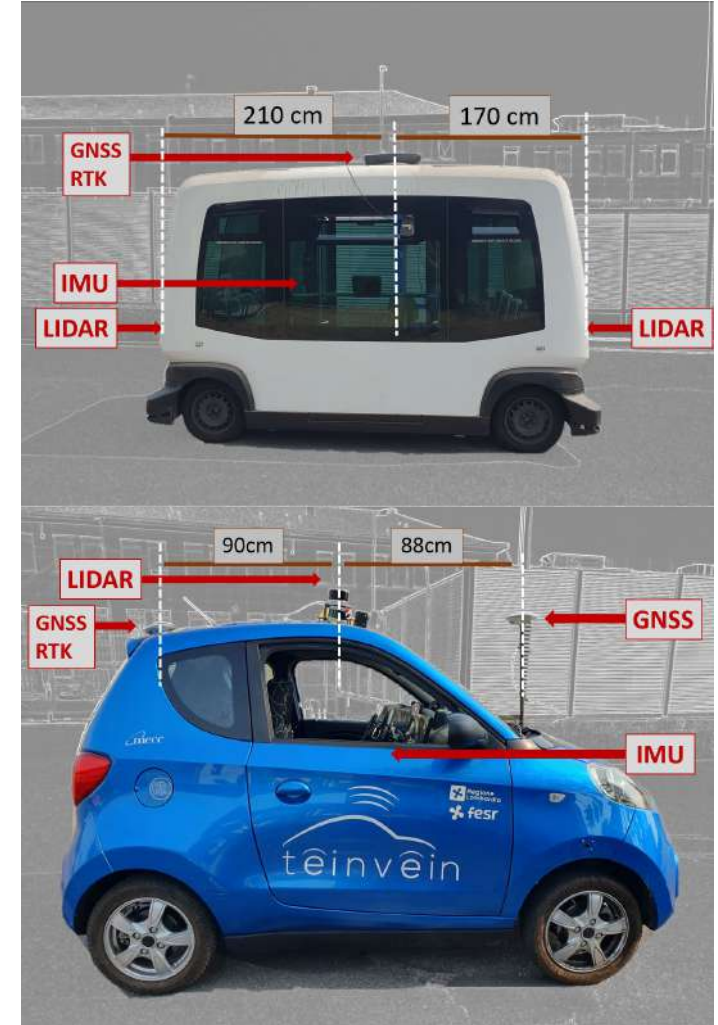
Vehicle localization



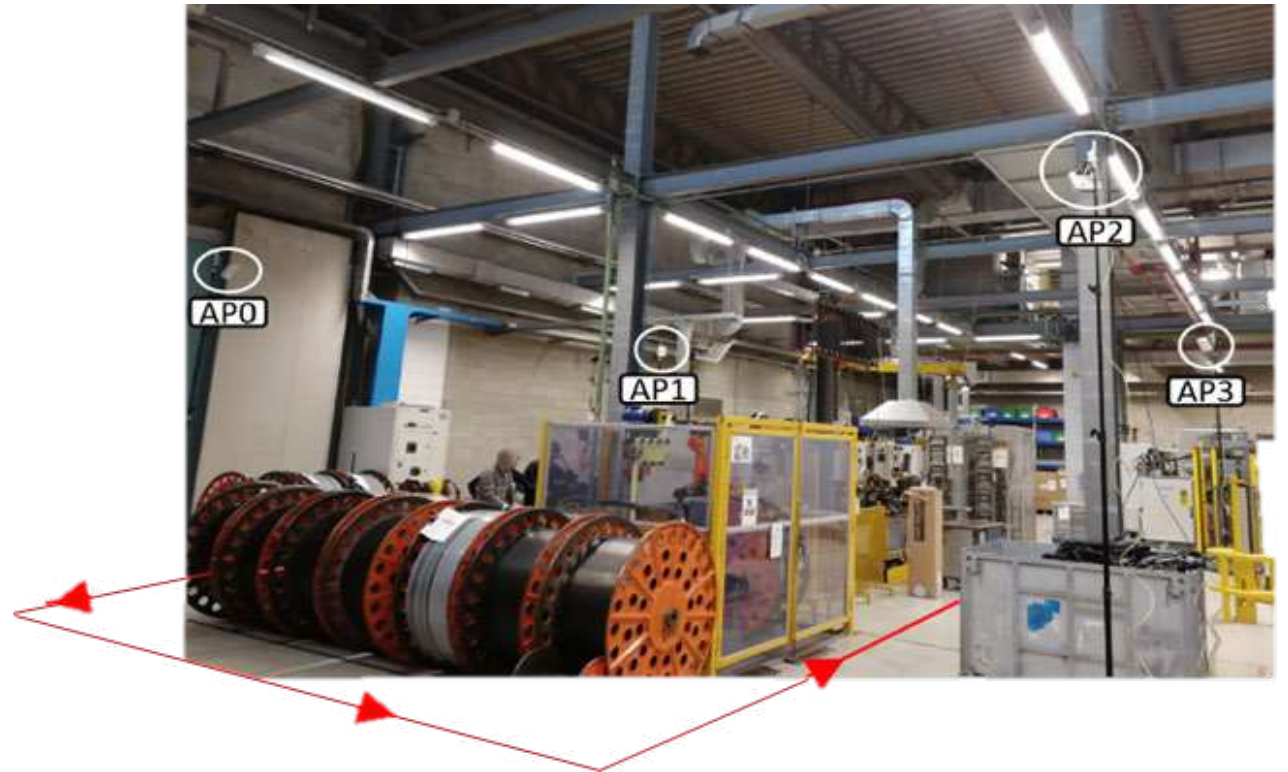
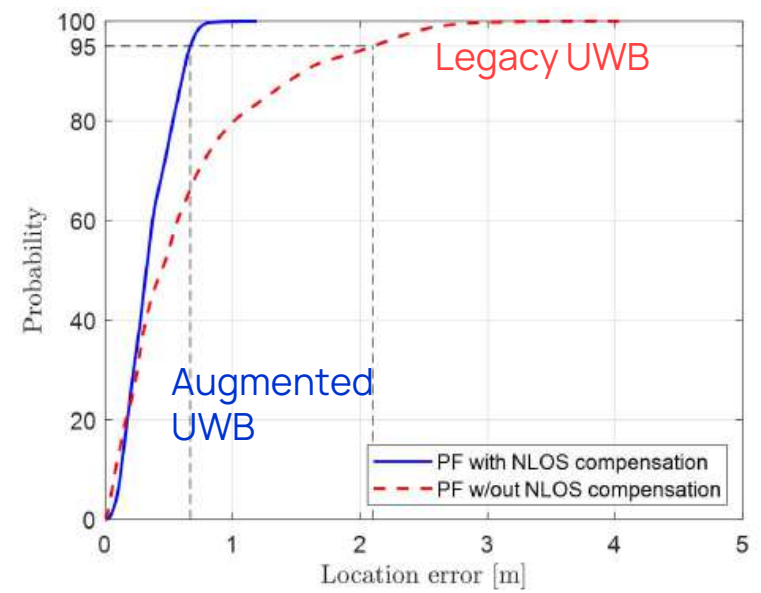
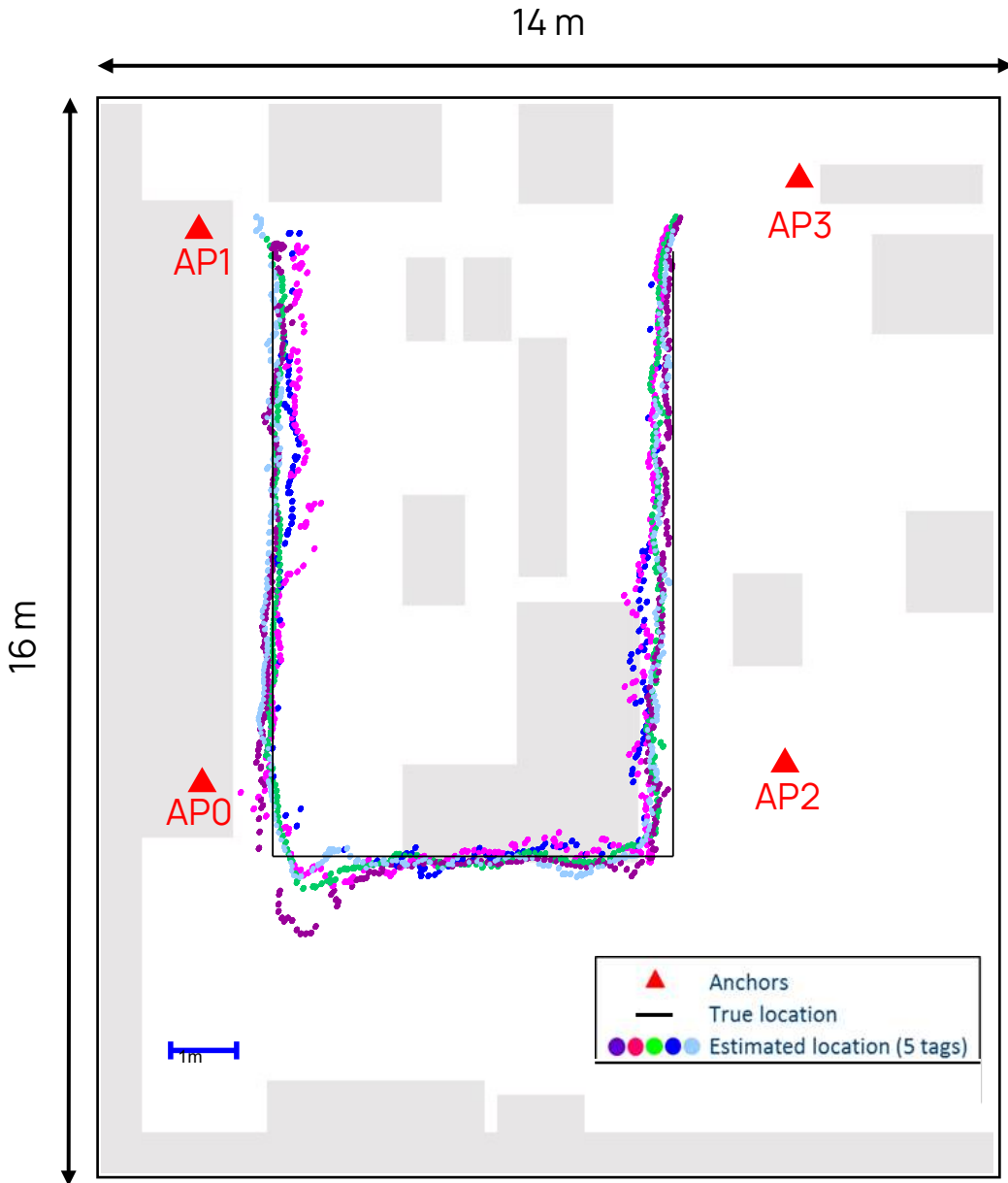
Cooperative LiDAR sensing



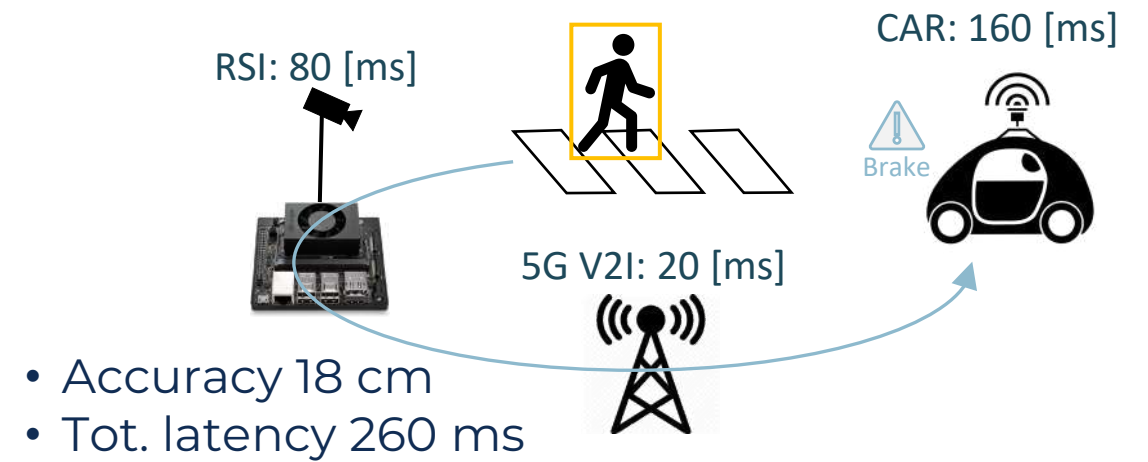
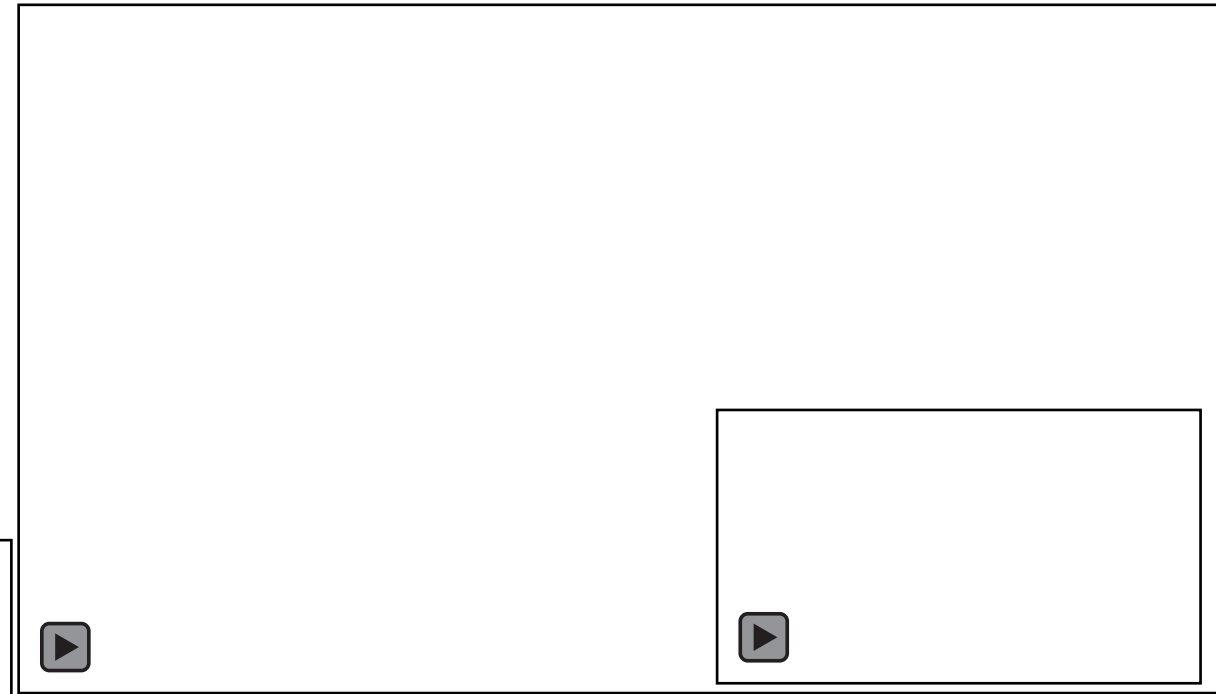
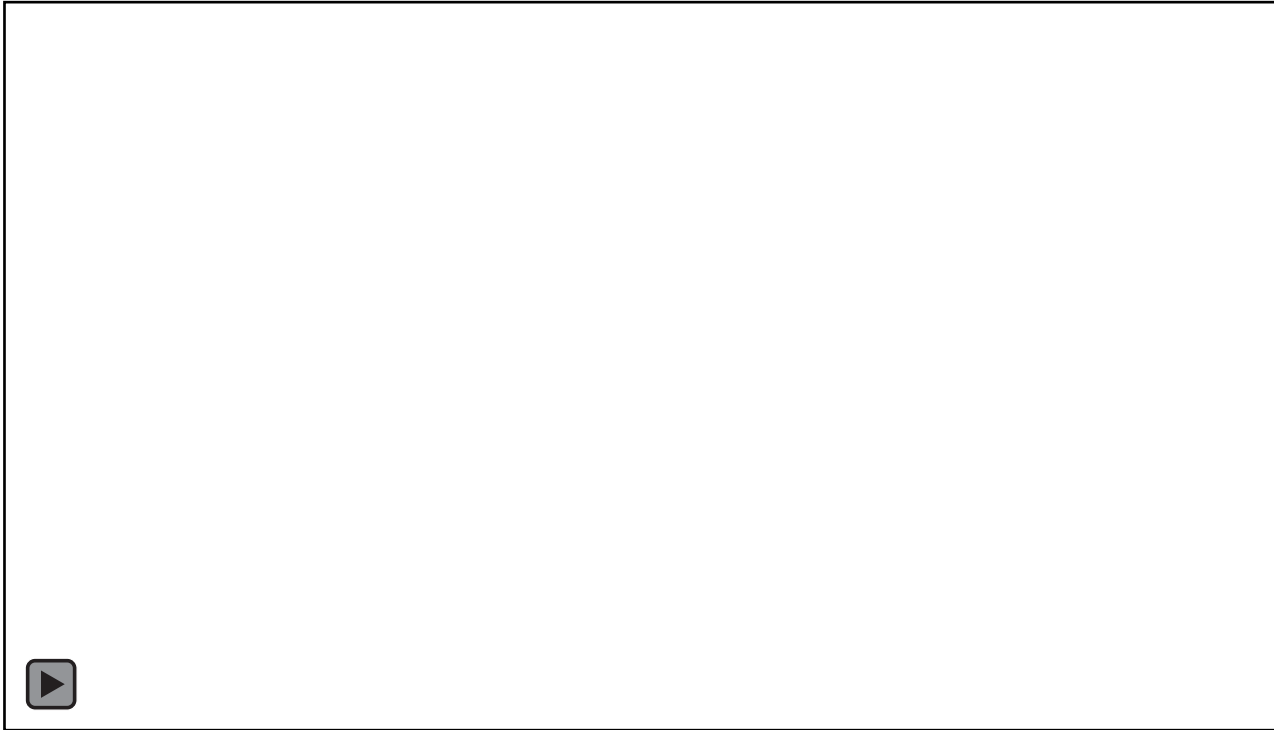
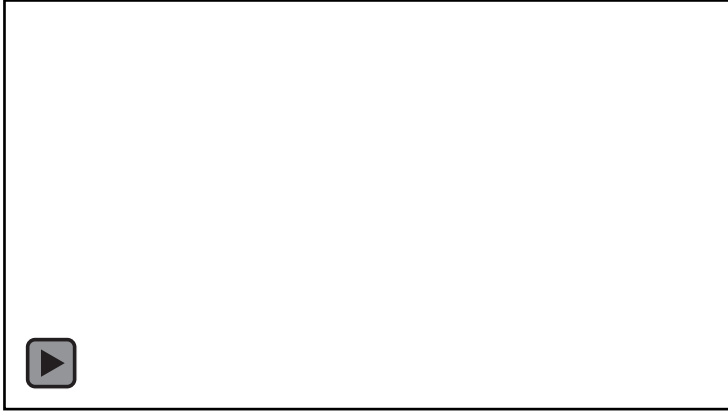
Cooperative LiDAR sensing (Bovisa)



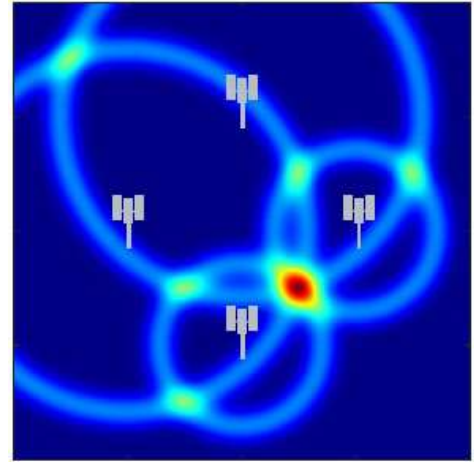
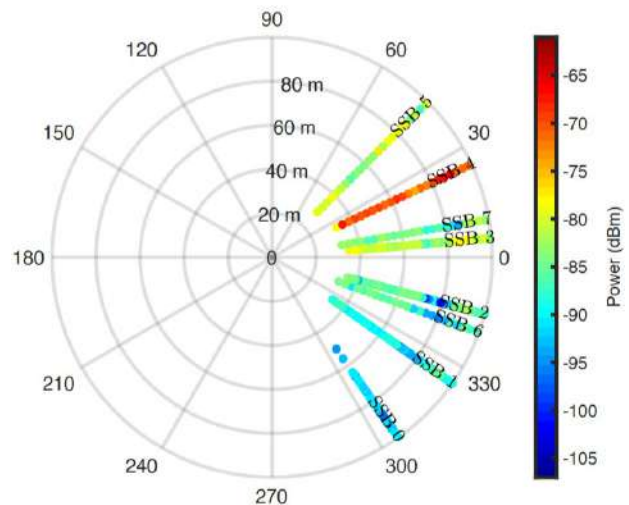
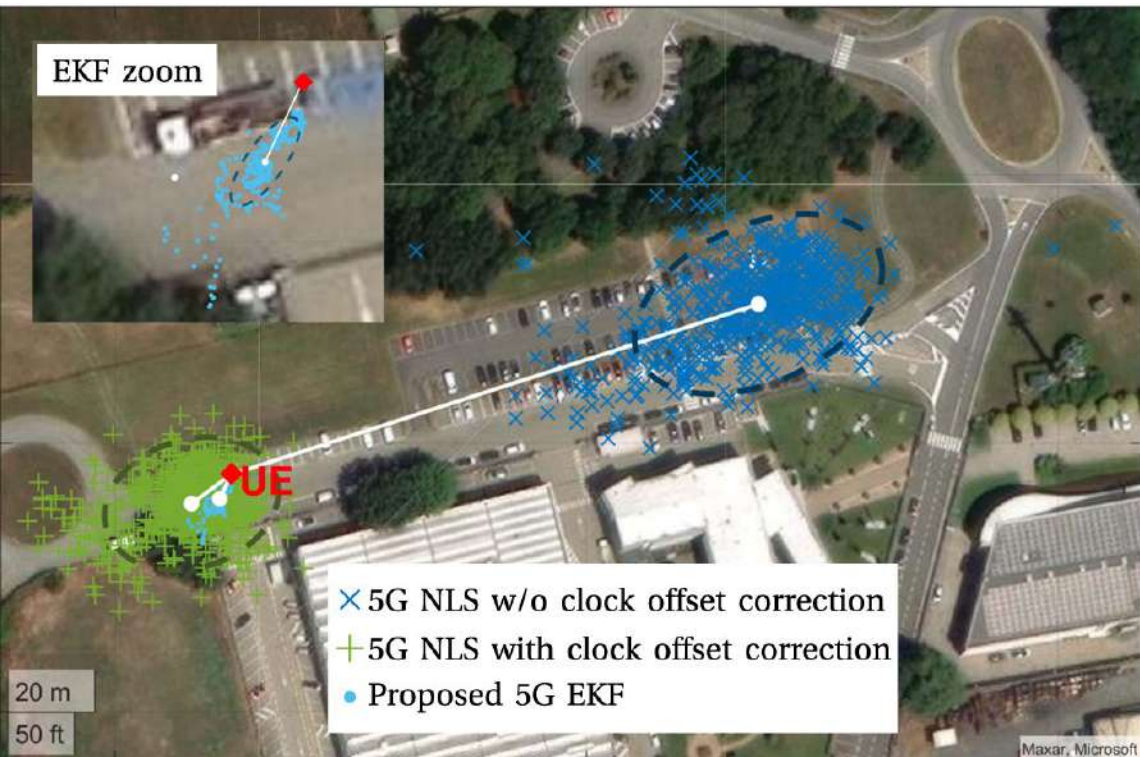
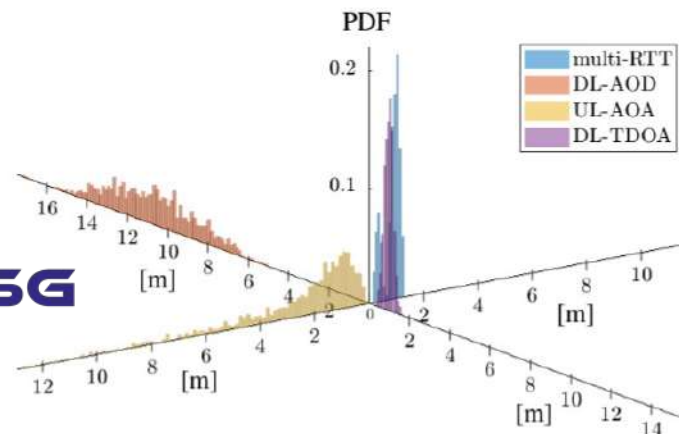
Industrial localization



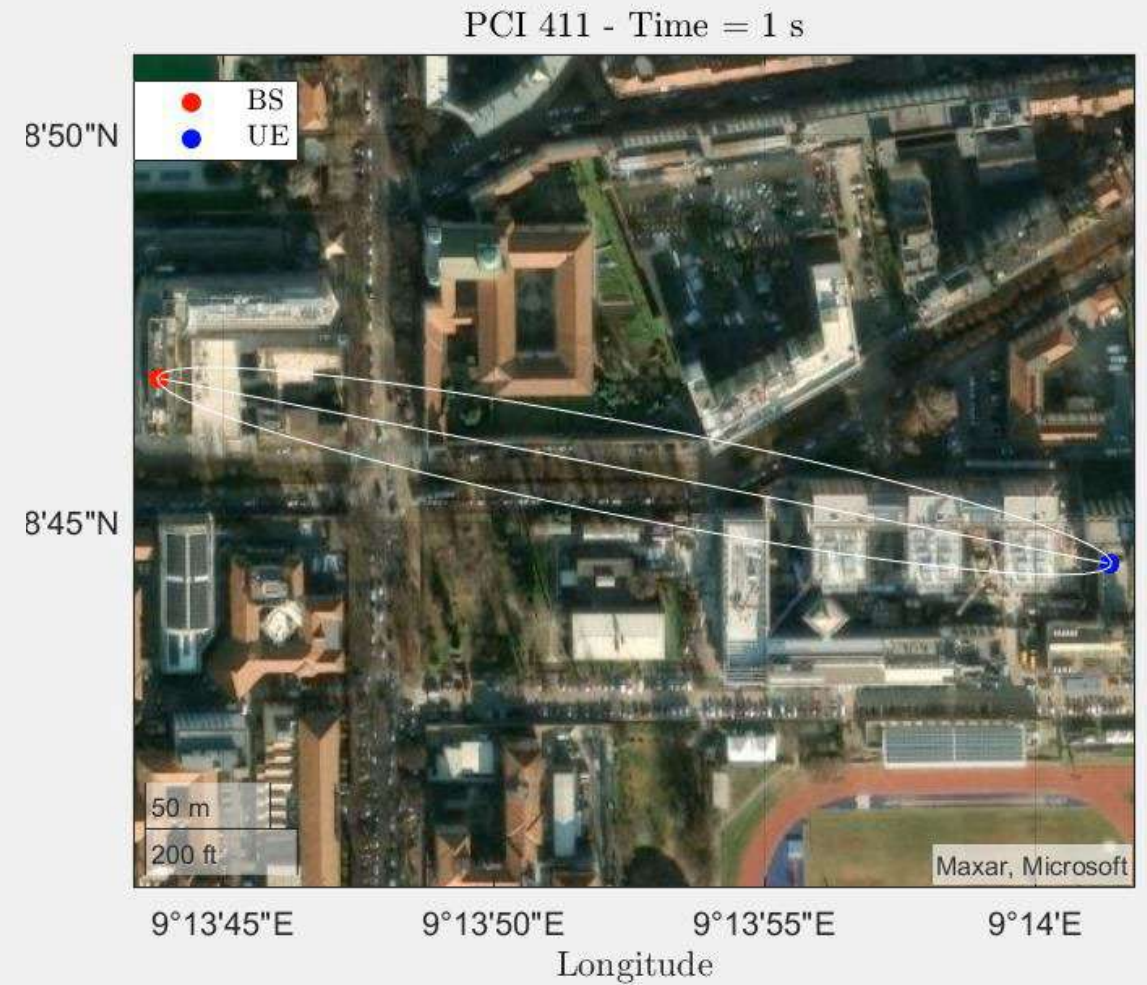
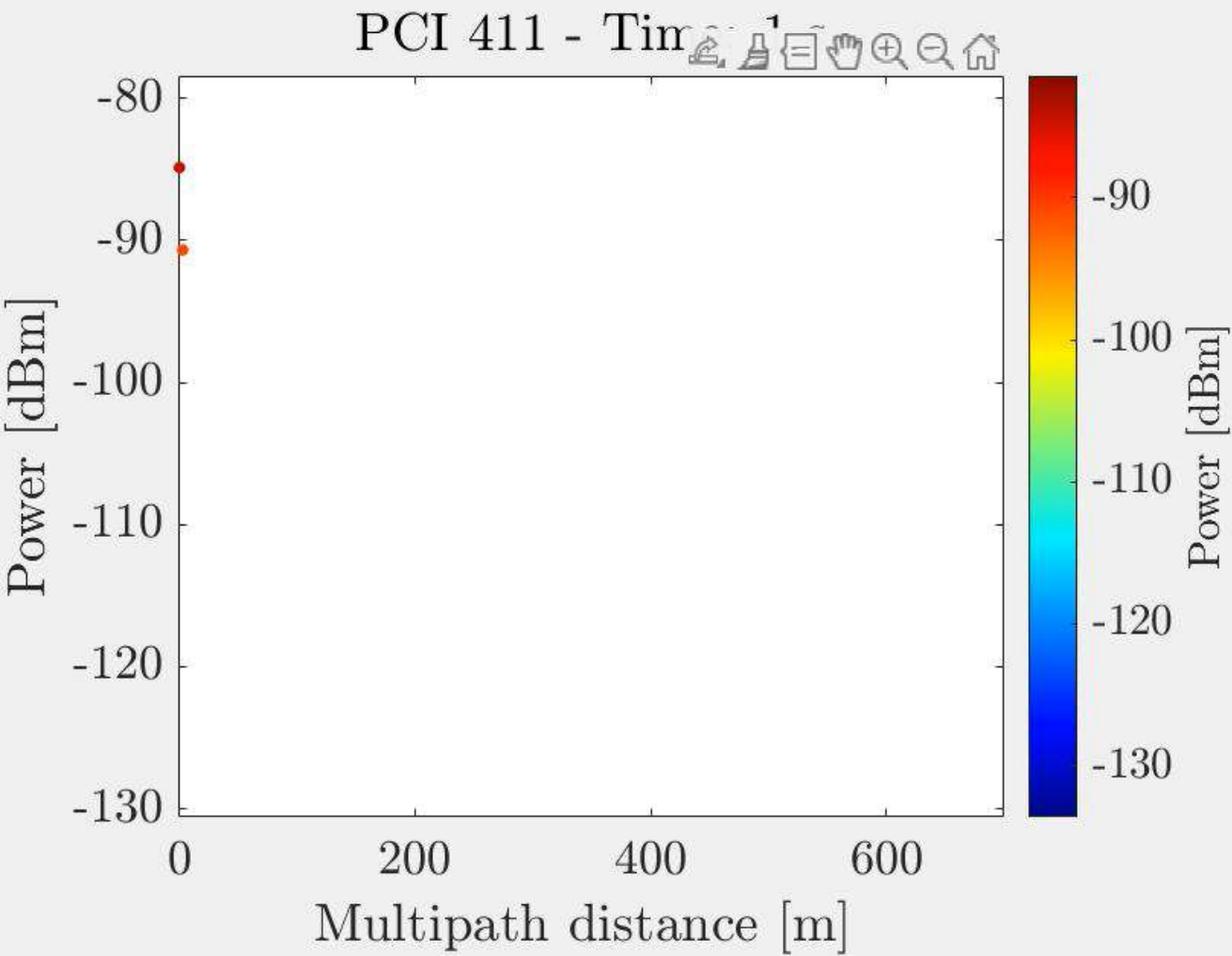
V2X pedestrian protection



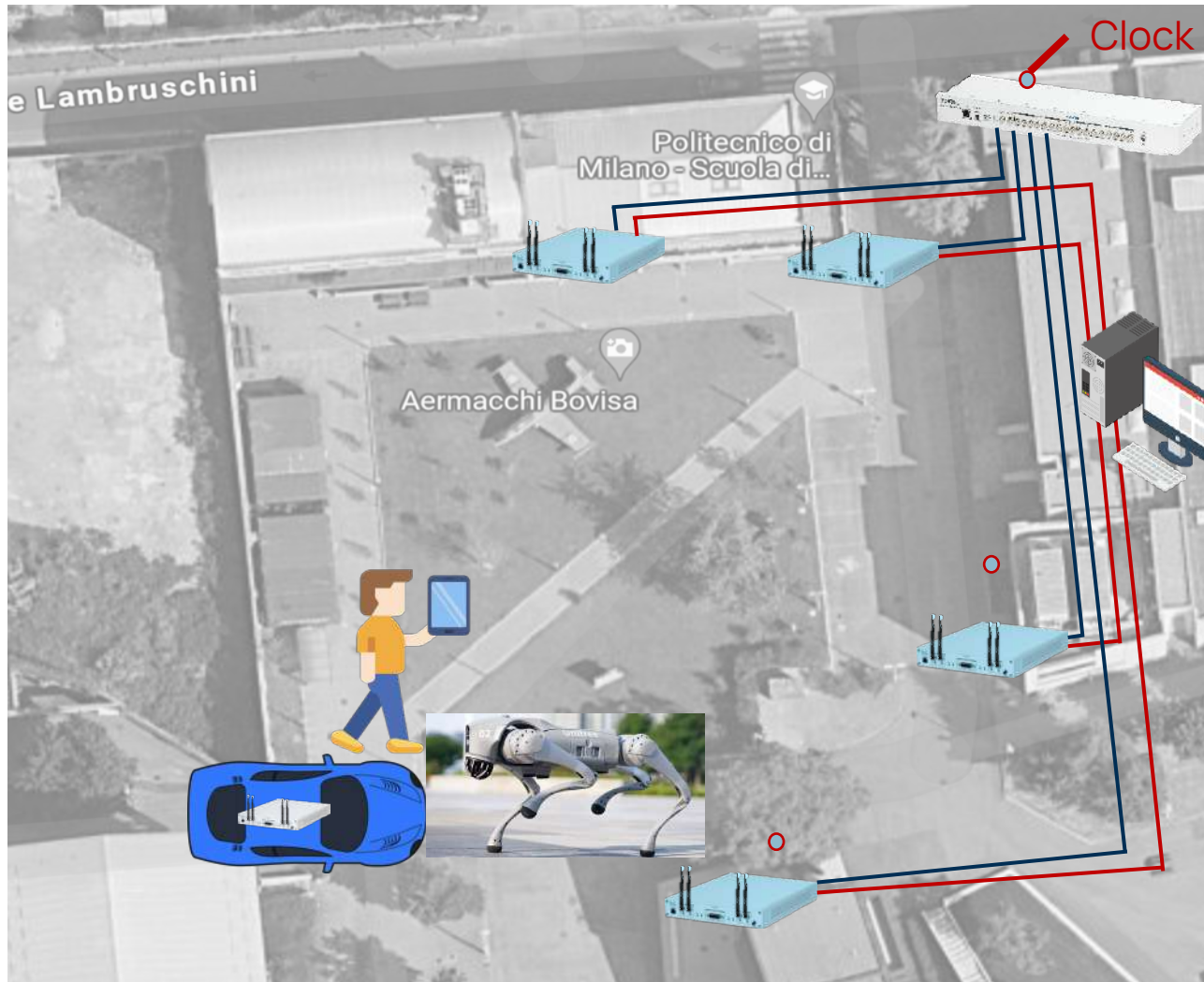
5G positioning



5G positioning data in the campus



SDR-based private 5G positioning



Thesis proposal

SDR-based positioning in MOST

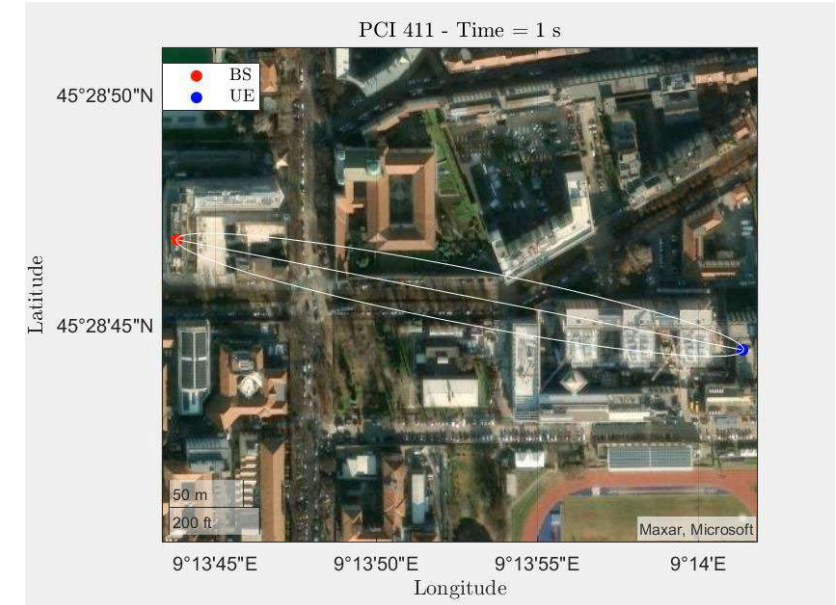
Contribute to the PNRR MOST project by processing the USRP data for positioning.

The objective is to perform real time data collections under different conditions and using different hardware, and then focus on algorithm development to enhance the accuracy of the positioning.

Thesis proposal

Campus mapping from 5G multipath

Record data of 5G base stations around the campus area and design mapping algorithm (e.g., Simultaneous Localization and Mapping – SLAM) to estimate the location of multipath reflectors. The student will investigate literature on mapping using multipath information (delay only) and implement in Matlab or Python the algorithm, validating it with real data.



Thesis proposal

5G-V2X positioning of a vehicle in a tunnel

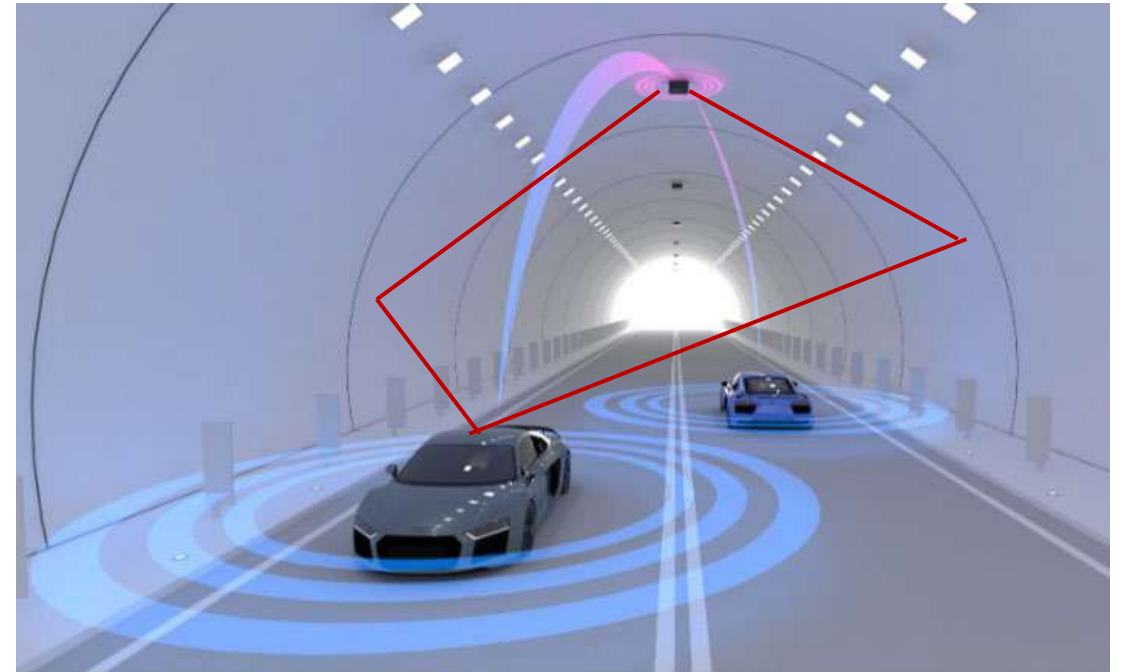
This thesis aims to investigate signal processing and learning algorithm to localize a vehicle traveling inside a tunnel without GPS coverage, using an on-site infrastructure of 5G V2X antennas.

First, the student will familiarize with an existing ray tracing software for modeling the propagation of a wireless signal in the tunnel.

Then, the student will develop algorithms exploiting the features of the received signal for positioning.

The student will also have the possibility to evaluate the developed algorithms on real measurements, assessing the portability from simulation to the real world of the algorithm.

The thesis is framed within a project with Movyon - Autostrade per l'Italia.



Thesis proposal

5G Non-Terrestrial Networks



LAB emulation

This thesis aims to implement a 5G physical layer emulation in software defined radios (SDR) of a non-terrestrial 5G network. By considering at least one SDR acting as satellite in a lab environment, and another one acting as user terminal, it is goal of the thesis to evaluate the properties of 5G communication with the recently-defined non-terrestrial implementation.

End-to-end simulation

Starting from a review on the simulation tools for an end-to-end analysis of the 5G NTN positioning service, the MSc student should identify the limits of current tools and enhance one of them by embedding the most recent standardization of the 3GPP Rel-17/18 for communication and positioning.

PhD opening

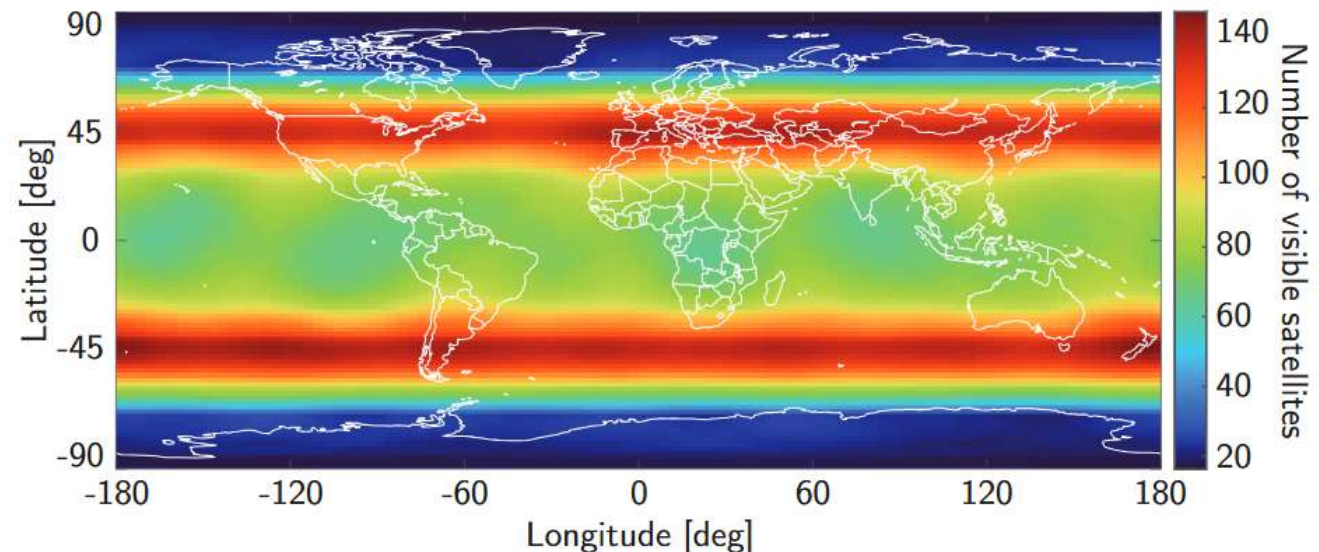
Thesis proposal

Opportunistic positioning with STARLINK satellites

This thesis aims to decode broadcast signals from STARLINK LEO satellites and use them to perform opportunistic positioning.

Opportunistic means to passively detect signals that are used for communication purposes and use them for positioning.

Literature works have demonstrated the feasibility of this approach, reaching an accuracy better than 5 m. The MSc student is requested to carry out an experimental activity with Software Defined Radio hardware for the simultaneous detection of 100+ STARLINK satellites, record data, and perform signal processing algorithms for improving the detection and appropriately estimate the position of the receiver.



Thesis proposal

Joint positioning and synchronization in 5G+ networks

The inter-base station (BS) and BS-user synchronization errors pose a serious challenge to highly accurate positioning using 5G cellular network.

The objective of this thesis is to review state of the art approach on the topic, compare them from an implementation point of view and simulate the impact of synch errors.

It is primary objective to use a Matlab-based simulator, however it is also possible to evaluate the algorithms with real 5G network data.

Thesis proposal

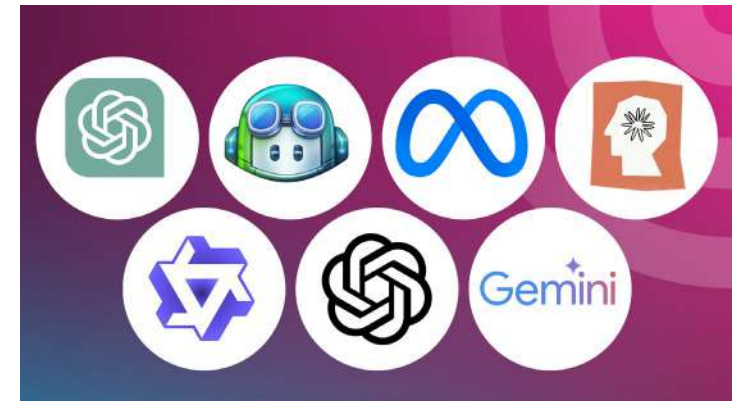
Accurate indoor WiFi localization in real time



Thesis proposal

Personalized LLM answers with IoT input data sources

Following the raising trend of AI, this thesis aims to integrate IoT sensor data into LLM prompts to enrich the input information and provide personalized answers.
IoT sensors available in the IoT Lab will be used as data sources, with their integration into a hub platform, and later embeddings into LLM prompts.
LLM models accessible through API or locally installed will be compared and analyzed.



Thesis proposal

Signal processing for 6G - MSc thesis in collaboration with Universitat de València

The research topic should be jointly agreed with the candidate and the abroad professor.

The student is requested to have signal processing skills.

Preference is given to the following topics: positioning, channel estimation, integrated sensing and communication.

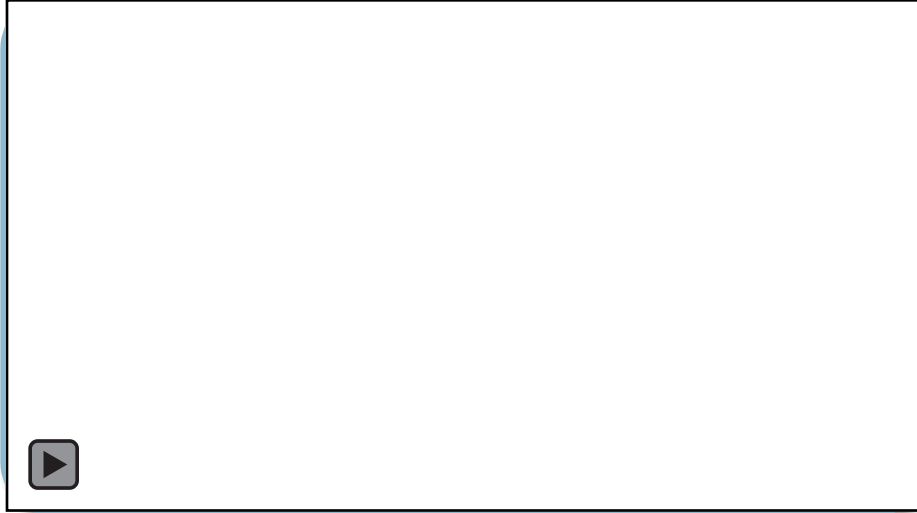
Example:



REM – Radio Environmental Map

Federated learning

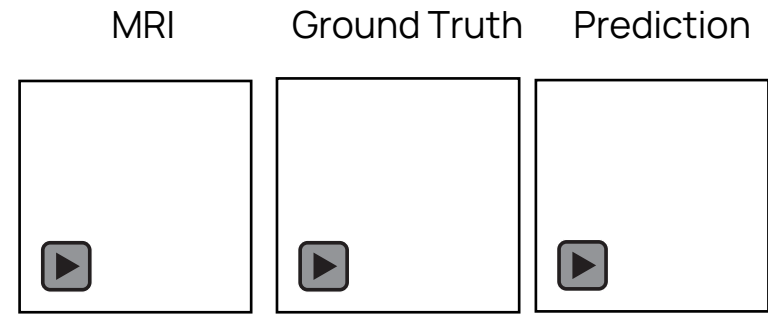
Centralized (Server-based)



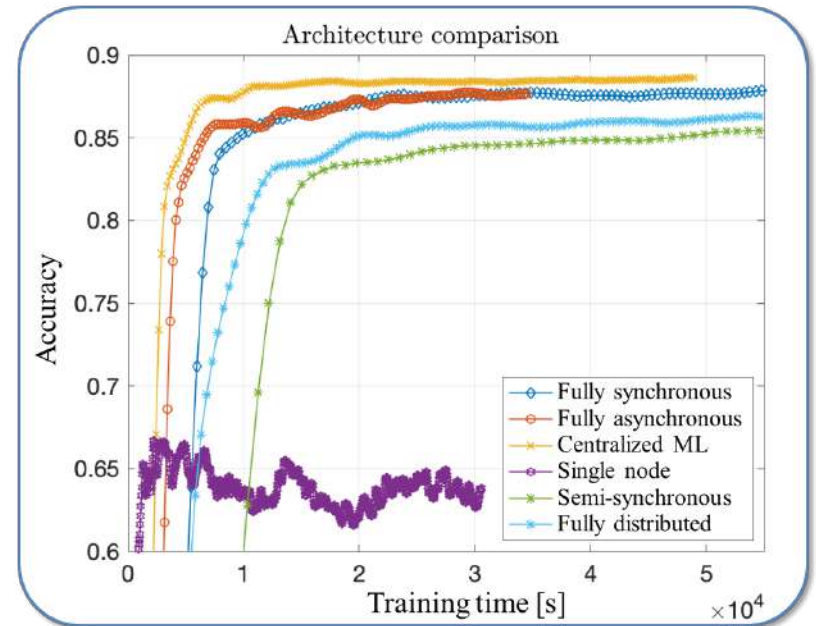
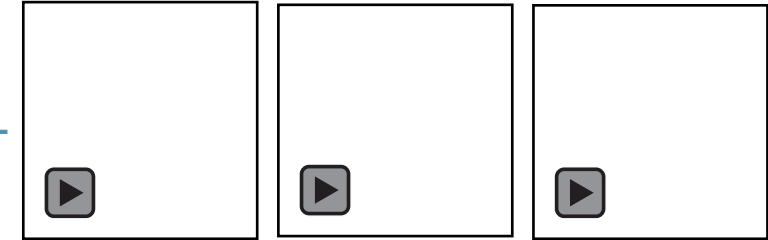
Distributed (Consensus)



FL-based



Centralized ML



Thesis proposal

Porting the FL into a tiny environment working in real time

Investigate tiny-FL and implement a network of RaspberryPi devices performing a real-time collaborative learning.

