Cooperative and Multimodal Localization of 5G-enabled Multi Robot Systems

Panagiotis T. Karfakis
Ingeniarius Ltd /University of Coimbra

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Introduction

- **Scope**: Mobile robot localization in outdoor scenarios can be a challenging task due to the inherent uncertainty of the process and the physical properties of the environment.
- **Objective:** Develop a 5G Simultaneous Localization and Mapping (SLAM) approach that can assist robots in outdoor environments and evaluate its suitability for field applications.
- **Features:** Ultra low latency, faster speeds than 4G, wide area coverage, suitable for processing offloading.
- **Contributions:** A 5G radio based SLAM approach can provide benefits for mobile robot Localization as it does not suffer from phenomena such as illumination and weather variations, terrain structure and GNSS denied scenarios.

Figure 1: Robotic systems (from left to right) - Ingeniarius's (a) Vinebot, (b) Ranger AGVs and (c) Carnegie Mellon University's Scout UAV

Multimodal 5G SLAM

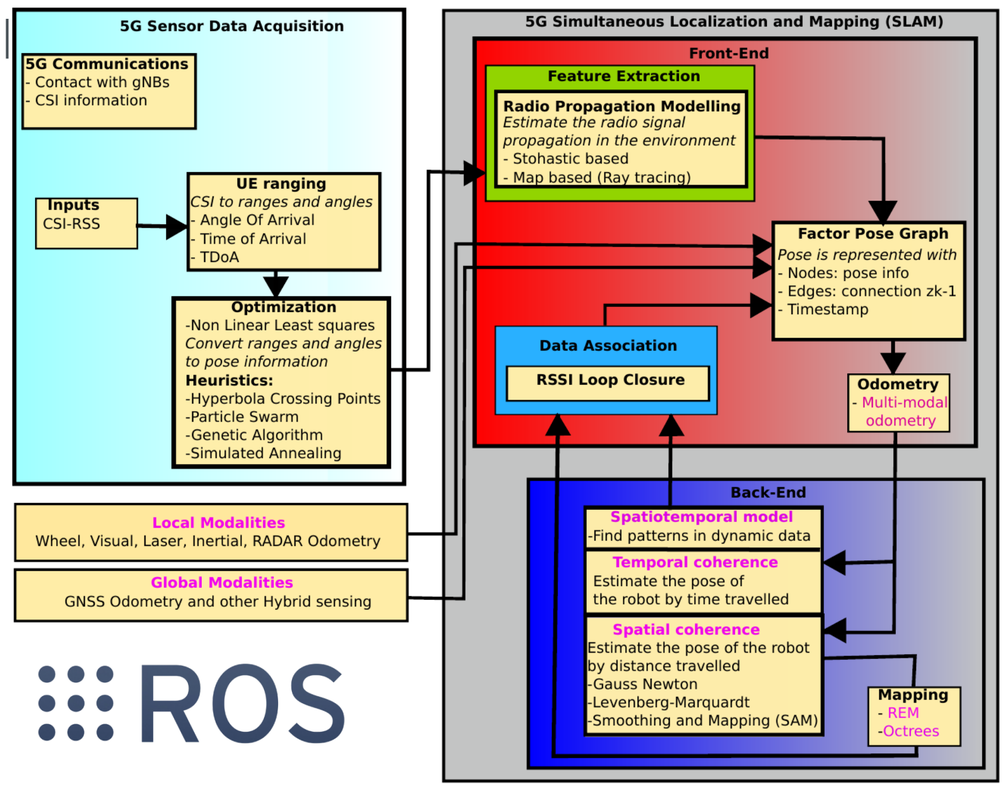


Figure 2: Proposed 5G SLAM based on multiple sensor modalities.

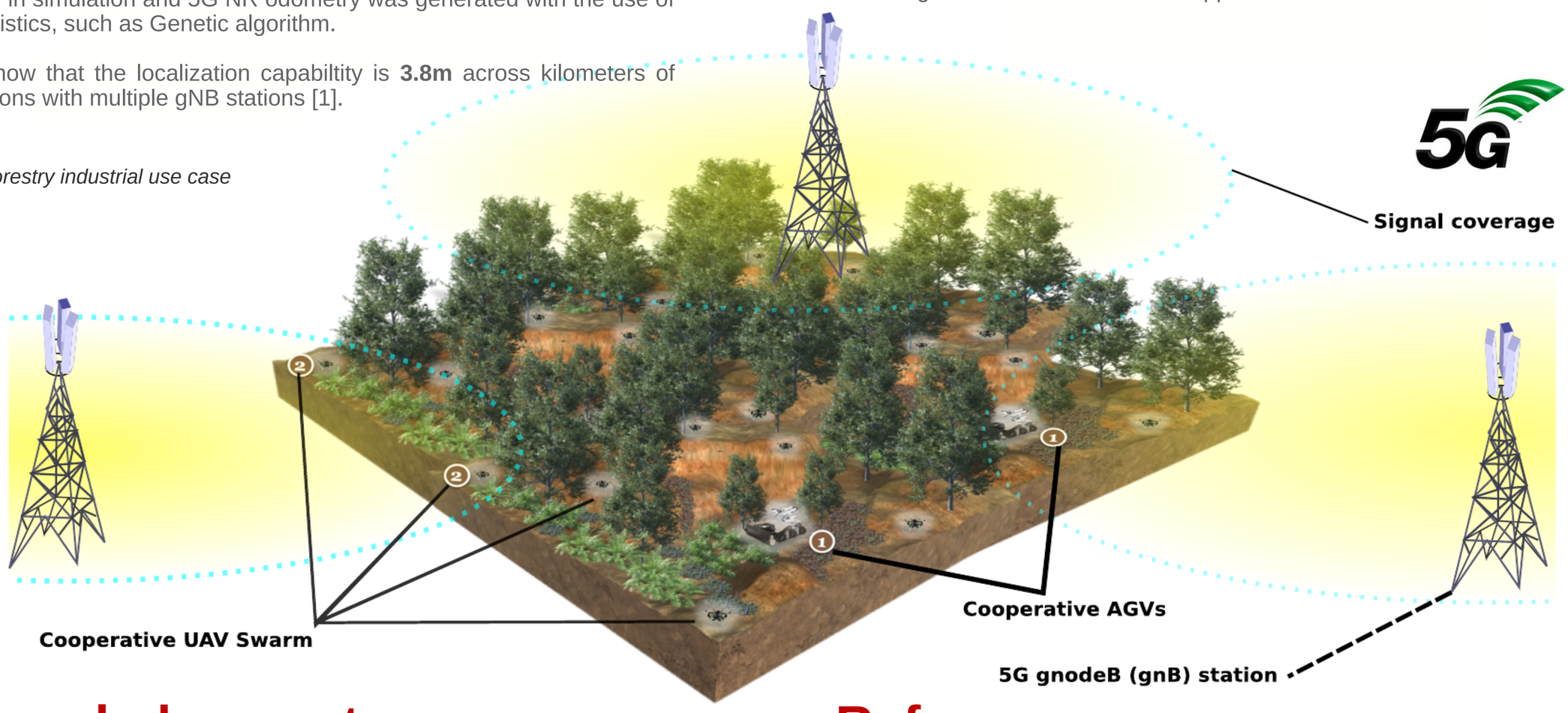
Results

- Previous SLAM approaches lack the robustness in outdoor scenarios as they are easily affected from illumination changes, changing weather conditions, unstructured terrain, appearance differences and most importantly lack of GNSS coverage.
- The localization of a mobile robot in an agricultural setup has been conducted in simulation and 5G NR odometry was generated with the use of meta-heuristics, such as Genetic algorithm.
- Results show that the localization capabiltity is **3.8m** across kilometers of transmissions with multiple gNB stations [1].

Figure 3: Forestry industrial use case

Conclusions

- An absolute terrestrial source of position estimates based on 5G RF is robust against the above drawbacks, additionally introduces the following features for robotics, such as low latency in transmission (1ms/kms), higher bandwidth, faster speeds (2.5Gb/s).
- A 5G New Radio (NR) SLAM framework to assist the localization of multiple heterogeneous robots in outdoor applications and services.



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References

[1] Panagiotis T. Karfakis, Micael Santos Couceiro, David Portugal, & Carlos Henggeler Antunes (2022). A Comparative Study of Mobile Robot Positioning Using 5G NR. In ICRA 2022 Workshop in Innovation in Forestry Robotics: Research and Industry Adoption.

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