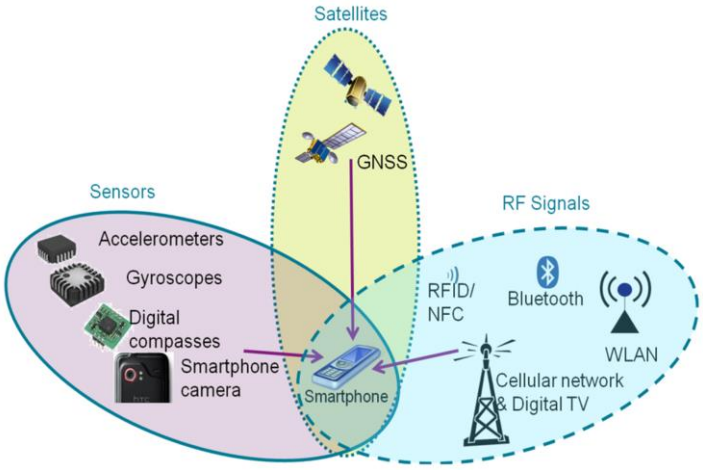
Master of Science Project

Geoscience and Remote Sensing

Theme: GNSS

Smartphone-based dm-level positioning.



Background information

"Where are you?" is the question that has been studied in the navigation and positioning fields for many decades. However, when making use of smartphones, the answer is not trivial and their accuracy far from precise positioning applications. Three main families of positioning solutions currently exist: satellite-based, sensors-based and RF signals-based.

Since May 2016, **raw GNSS data** has been made available on Android devices, along with other sensors (i.e. accelerometer, gyroscope & magnetometer). In September 2017, dual-frequency capabilities were also enabled, extending smartphones interest in medium/high-accuracy positioning. Only in 2020, almost 1000 research papers have been published on the topic, and in some cases cm-level accuracy was achieved in static conditions. When looking at dynamical tests, dm-level remains a challenge.

Data availability

In December 2020, Google has released 39 datasets, relatively to three Android devices, as collected in San Francisco Bay Area, (California, US). In each one, raw GNSS data is available, along with other sensors and ground truth reference acquired in vehicle dynamical tests. These ones provide a valuable opportunity to investigate Android real data positioning performances, so further pushing down the limits in smartphone-based positioning.

Description tasks

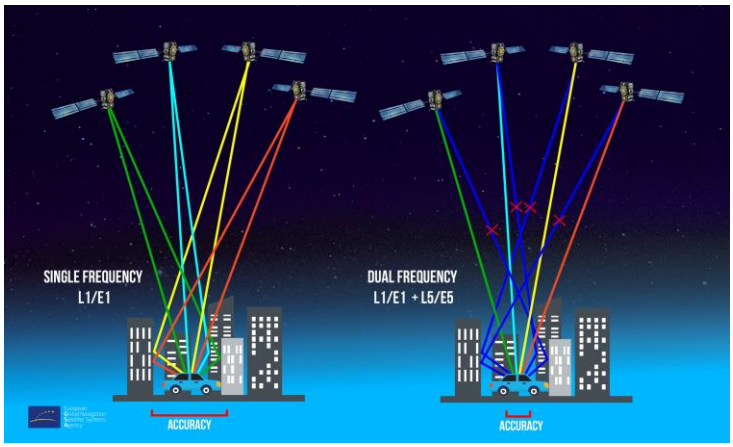
The candidate will initially perform a concise literature study on raw GNSS & sensors measurements available in recent Android devices. In a first instance, additional raw GNSS data retrieved from static tests over a geodetic pillar might be considered, while experimenting with a GNSS dual-frequency positioning.

The research objective is to exploit the availability of GNSS and additional sensors data in the best way possible to enhance the positioning accuracy of a few different devices in dynamical test conditions. This investigation should also provide a comparison between a GNSS-only and a GNSS+Sensors configuration, thus evaluating with real data to what extend those sensors can support the GNSS precise point positioning (PPP).

In a more advance stage, the candidate might consider whether additional sensors can also enhance integer ambiguity resolution capabilities, e.g. by performing a formal analysis on success rate and the expected precision improvements within the positioning domain. At the end, current limitations shall be well delineated and recommendations for future research provided.

Requirements

The candidate shall have good programming skills (MATLAB or Python), and sufficient knowledge (e.g. CIE4522) of fundamental principles of GNSS data processing and user positioning.



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