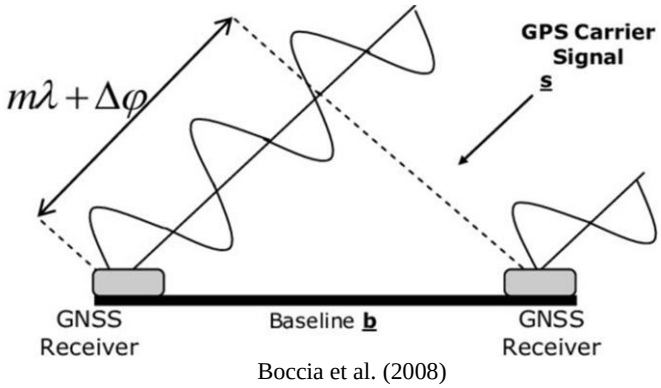
Master of Science Project

Geoscience and Remote Sensing

Theme: GNSS

Attitude determination exploiting Android GNSS raw data



Boccia et al. (2008)

Background information

The availability of GNSS raw data from Android smartphones has been an important milestone in the future evolution of new GNSS applications. Most of the research works in these last years has nonetheless been focused on positioning applications, trying to achieve a decimeter level positioning. On the other hand, by using multiple receivers with a known relative position, it is possible to perform attitude determination of such multi-antenna system.

With the adoption of low-cost multi-GNSS/-frequency receivers, it is theoretically possible to determine the (absolute) orientation of an object without the need of dedicated sensors. Furthermore, the availability of carrier-phase measurements, i.e. with precision at millimeter level, makes possible to introduce integer constraints into the attitude problem, so leveraging so-called ambiguity-fixed solutions.

Possible datasets

The availability of multi-GNSS/-frequency raw data is possible in several Android devices. For example, in December 2020, Google has released 39 datasets, collected in the San Francisco Bay Area, (California, US) and relative to a few Android smartphones placed on the same vehicle dashboard. Still, other configurations can be considered and a dedicated data collection campaign might be performed by collecting data from multiple Android devices.

Description of tasks

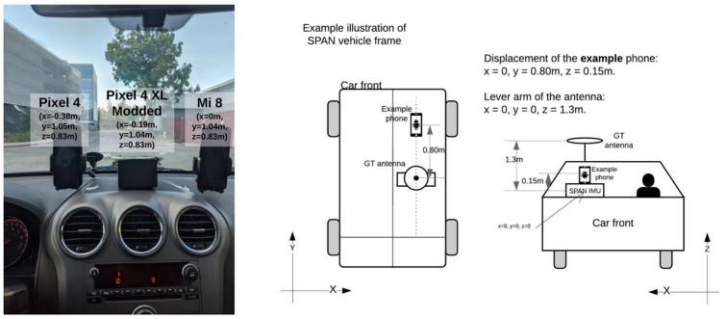
The candidate will start with a concise literature study on the GNSS raw data currently available from Android devices, along with other integrated sensors (e.g. accelerometers/gyroscopes). Some possible configurations might be proposed for the evaluation of the attitude determination problem, and relevant data could be collected by the candidate in a dedicated campaign.

Following this raw data collection campaign, an experimentation campaign will take place, where the baseline-constrained attitude problem should be solved with advanced methodologies that have been developed by the GNSS research group at TU Delft. These ones include, but are not limited to, the Constrained Least-squares AMBiguity Decorrelation Adjustment (LAMBDA) method.

The validation of the GNSS-only solutions could be performed by mean of reference solutions (if available in the datasets) or by the adoption of non-GNSS attitude sensors' data that can be retrieved from the Android devices. Ultimately, the quality of GNSS-based attitude determination with Android smartphones shall be assessed and limitations shall be presented at the end of this thesis work.

Requirements

The candidate shall have very good programming skills (MATLAB or Python), and sufficient knowledge of fundamental principles for the GNSS data processing and user positioning algorithms.



Courtesy of Google Inc.

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