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Performance analysis of GPS+Galileo smartphone raw measurements

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The main objective of this work is to investigate on precise positioning with a GPS and Galileo enabled chipset embedded in a smartphone.
Sapienza research team, as member of the GSA GNSS Raw Measurements Task Force, with contribution by Politecnico di Milano, is investigating the area of real time precise positioning with single frequency, focusing on the benefits of multi-constellation GNSS and raw data quality provided by a smartphone. The analysis is carried out with code- and carrier-based algorithms in different scenarios.
Currently the smartphones use only one frequency (L1): this is an important constraint in the design of the precise positioning algorithm mainly due to ionospheric effect. Hence, the work is based in two main algorithms: the first uses the carrier phase differential approach (Static or Kinematic) in conjunction of a reference GNSS networks; the second is based on the variometric approach using the VADASE algorithm, using the carrier phase but without external data. Modern GNSS chipsets are multi-constellations (GPS, GLONASS, Galileo, Beidou) and after the release of the N version of the Android operating system, the raw data are obtainable from a phone or tablet. However, from a technical point of view, the raw data, especially the carrier-phase, are not directly available in standard format and must be properly parsed.
Moreover, on the basis of these parsed data, the work analyses the main errors. The primary error source on smartphones lies not in the GNSS chipset, which actually offers great performance in terms of tracking availability and code-based accuracy, but in the antenna, whose chief failing is its poor multipath suppression. High accuracy positioning requires a stable antenna position for referring the position. However, moving smartphones are constantly changing attitude (which affects the antenna gain also), altitude (e.g. when the smartphone is kept in hand along the body or in front of the face for reading) and obstruction conditions. In order to quantify the impact of these scenarios, tests have been conducted. The use of multi-constellation smartphone allows to increase the accuracy and the availability of the solution. In particular, the smartphone can reach decimetre accuracy in static condition and sub-metre when used in urban vehicle scenario; furthermore, the variometric approach is able to track the smartphone displacement with cm/sec velocity accuracy.