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Single-frequency receivers as master permanent stations in GNSS networks: precision and accuracy of the positioning in mixed networks

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The use of GPS/GNSS instruments is a common practice in the world at both a commercial and academic research level. Since last ten years, Continuous Operating Reference Stations (CORSs) networks were born in order to achieve the possibility to extend a precise positioning more than 15 km far from the master station. In this context, the Geomatics Research Group of DIATI at the Politecnico di Torino has carried out several experiments in order to evaluate the achievable precision obtainable with different GNSS receivers (geodetic and mass-market) and antennas if a CORSs network is considered.

This work starts from the research above described, in particular focusing the attention on the usefulness of single frequency permanent stations in order to thicken the existing CORSs, especially for monitoring purposes. Two different types of CORSs network are available today in Italy: the first one is the so called “regional network” and the second one is the “national network”, where the mean inter-station distances are about 25/30 and 50/70 km respectively. These distances are useful for many applications (e.g. mobile mapping) if geodetic instruments are considered but become less useful if mass-market instruments are used or if the inter-station distance between master and rover increases.

In this context, some innovative GNSS networks were developed and tested, analyzing the performance of rover’s positioning in terms of quality, accuracy and reliability both in real-time and post-processing approach.

The use of single frequency GNSS receivers leads to have some limits, especially due to a limited baseline length, the possibility to obtain a correct fixing of the phase ambiguity for the network and to fix the phase ambiguity correctly also for the rover. These factors play a crucial role in order to reach a positioning with a good level of accuracy (as centimetric or better) in a short time and with an high reliability.

The goal of this work is to investigate about the real effect and how is the contribute of L1 mass-market permanent stations to the CORSs Network both for geodetic and low-cost receivers; in particular is described how the use of the network products which are generated by the network (in real-time and post-processing) can improve the accuracy and precision of a rover 5, 10 and 15 km far from the nearest station.

Some tests have been carried out considering different types of receivers (geodetic and mass market) and antennas (patch and geodetic).

The tests have been conducted considering several positioning approaches (static, stop and go and real time) in order to make the analysis more complete.

Good and interesting results were obtained: the followed approach will be useful for many types of applications (landslides monitoring, traffic control), especially where the inter-station distances of GNSS permanent station are greater than 30 km.