Aided GPS/GLONASS navigation in urban environment

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In signal-degraded environments such as urban canyons or mountainous areas many GPS signals are blocked by natural or artificial obstacles or severely degraded; hence GPS-only cannot guarantee an accurate and continuous positioning. The multi constellation approach, integrating different GNSS systems, is a possible way to fill this gap. GLONASS, the Russian navigation satellite system, is currently the main candidate as element of a multi constellation; it is nearly fully operational and its inclusion guarantees an improvement of the satellite availability. Another possible future component of integrated GNSS system is the European Galileo currently in a validation phase with only 4 satellites in orbit GIOVE A/B experimental satellites and 2 Galileo for the IOV phase.

In this work GPS/GLONASS systems are combined and relative single point algorithm performance is assessed for different configurations in signal-degraded scenario such as urban canyon. GPS/GLONASS multi-constellation use involves the addition of a further unknown to estimate, i.e. the intersystem time scale offset, which requires the "sacrifice" of one measurement.

The intersystem offset is observed to be quasi-constant, so an aiding can be introduced to account for its behavior. A similar approach can be adopted for altitude considering its typical variations in urban scenario.

The considered estimation techniques are least squares and Kalman filter, commonly adopted to calculate the navigation unknowns from pseudorange measurements. The least squares method uses a model relating measurements and state with the drawback of solution unavailability during GNSS outages (very frequent in urban areas); to improve the continuity constrained least squares adjustments are considered. Kalman filter uses, in addition to a measurement model, a process model expressing the unknown dynamics and allowing the state estimation in case of GNSS outage.

The main purpose of this work is the performance assessment of a multi-constellation system relative to GPS-only adopting least squares or Kalman filter estimators.