Geophysical Research Abstracts
Vol. 14, EGU2012-3808, 2012
EGU General Assembly 2012

Multi-GNSS Opportunities and Challenges

A. Al-Shaery (1), S. Zhang (2), S. Lim (1), and C. Rizos (1)

(1) 1School of Surveying and Spatial Information System, the University of New South Wales, Sydney, NSW, Australia, (2) SPACE Research Centre, RMIT University, Australia

The multi-GNSS era has began attracting more attention with the declaration of full operational capability of GLONASS , with a 24 satellites being set to 'healthy' on December 8th 2011 (IAC, 2011). This means that GPS is no longer the only GNSS that provides global positioning coverage. This status brings benefits for GNSS users in areas (e.g. 'urban canyon' environments or in deep open cut mines) where the number of visible satellites is limited because of shadowing effects. In such areas adding more functioning satellites, which is one of the aiding solutions, becomes easier, at no extra cost.

The inclusion of GLONASS observations in positioning solutions will increase the available number of satellites and thus positioning accuracy may improve as a result of enhanced overall satellite geometry. Such an aiding solution is increasingly attractive due to the successful revitalisation of GLONASS. Another motivation is the availability of improved GLONASS orbits from the IGS and individual analysis centres of the IGS. The increasing availability of receivers with GPS/GLONASS tracking capability on the market is an additional motive. Consequently, most networks of continuously operating reference stations (CORS) are now equipped with receivers that can track both GPS and GLONASS satellite signals, and therefore network-based positioning with combined GPS and GLONASS observations is possible.

However, adding GLONASS observations to GPS is not a straight forward process. This is attributable to a few system differences in reference frames for time and coordinates, and in signal structures. The first two differences are easy to deal with using well-defined conversion and transformation parameters (El-Mowafy, 2001). However, signal structure differences have some implications. The mathematical modelling of combined GPS/GLONASS observations is not performed as in the case of GPS-alone. Special care should be paid to such integration. Not only is the software part affected but also the hardware. Recent research has identified one of the challenges users may face if precise positioning is sought (Takac, 2009, Yamada et al., 2010, Wanninger, 2011). A user of heterogeneous receiver pairs will experience ambiguity fixing challenges due to inter-channel bias which cannot be cancelled by differencing GLONASS observations, pseudorange or carrier-phase.

This paper outlines the opportunities and challenges of combining two currently fully operational GNSS systems (GPS and GLONASS) for precise positioning solutions. Discussion and analysis considering mathematical modelling challenges and users' selection of hardware constraints will be performed.

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