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Evaluation of a High-Sensitivity GPS Receiver for Kinematics Application in Regions with High Shading

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GPS positioning has been very much improved with high-sensitivity GPS (HSGPS) receivers. This kind of receiver can track the signal until 20-25dB below the level of conventional receivers. Obviously, no problem occurs when GPS technology is used for air and ocean vehicles navigation; sufficient and/or redundant signals can be easily acquired due to good hemispherical signal reception. A problem arises whenever signals cannot be traced anymore, if not enough satellites are available or if there is very weak signal reception in forest areas or between buildings. Those situations cannot be avoided or eliminated in land vehicle navigation. The HSGPS technology tries to solve those problems by tracking signals below the normal signal threshold of non-HSGPS receivers.

This paper discusses the two factors of availability and accuracy in the context of navigation with HSGPS receivers. In order to investigate these issues some scenarios of receivers-placing will be examined which represent various receiver environments: good hemispherical signal reception, strong signal shading environment and indoor environment. The signal availability and accuracy are investigated during observation sessions of several hours by comparing the measurements of the HSGPS receiver with the measurements of a conventional, non-HSGPS receiver.

As expected, the non-HSGPS receiver yields the same level of availability as the HSGPS receiver in an environment with good hemispherical signal reception. When both receivers are located in an environment with significant signal shading, the percentage of availability will significantly decay for the non-HSGPS receiver whereas the availability of the HSGPS receiver is much less reduced. However the results from the HSGPS receiver in this case are at a significantly reduced accuracy level. The accuracy level is assessed by using three parameters: i) the difference between the C/A code and the carrier phase in order to investigate how big the multipath and other disturbance effects are, ii) investigation of the carrier phase accuracy by using triple-difference, iii) comparison of the signal-to-noise ratio with satellite elevation.

After analyzing the availability and accuracy for both receivers, data processing has been done by using static and kinematic methods. Both are based on post processing methods calculating the baselines from double-difference carrier phase and code measurements.