

Agricultural Forest Applications and Boundary Surveys Using Low-cost High Sensitivity GPS (HS-GPS) Receivers

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SUMMARY

GNSS is employed in numerous situations and especially the use of low-cost receivers has become very popular. The use of GNSS receivers is already standard in many applications, e.g. for precise navigation and guidance of machines, for cadastral boundary surveys or to determine the size of agricultural land for European Union funding. Often modern HS-GPS receivers are used for these tasks because they have a better performance even under unfavorable conditions like urban canyons or forests. Their accuracy and reliability is usually determined for open sky conditions. Several studies exist in which the possibilities of HS-GPS receivers in urban canyons were investigated. On the other hand, nearly no tests have been performed to determine the limitations of these receivers in forests. This study investigates the practicability of using low-cost HS-GPS for usage under forest canopies. A test area with varying types of forests, such as broad-leaved forests, coniferous forests and young forests, was selected. Long-term observations over 24 hours in three different seasons were carried out on ten survey points. It was found that the availability of HS-GPS receiver measurements in forest areas is satisfactory and static single point positioning mostly perform well. In the case of carrier phase solutions from baseline observations to a virtual reference station, however, a significant reduction of signal quality can occur. Due to a large number of outliers the number of solutions, in which the ambiguities can be solved and in which a high positioning accuracy less than one meter can be achieved, is lower than expected. Using robust estimation outliers have been efficiently detected and eliminated. In Single Point Positioning (SPP) a scattering of about 8 m for single epoch measurements and 3 m for static measurements was determined. Single frequency differential positioning with robust estimation yields to a median of less than 10 cm with an inner quartile range (IQR) of around 3 m. It can be concluded that HS-GPS measurements in forests are applicable for applications like mapping, classification and boundary surveys in most cases in dependence on a careful selection of the suitable observation time and analysis method.