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OVERCOMING GNSS LIMITATIONS IN FORESTED ENVIRONMENTS THROUGH COLLABORATIVE POSITIONING

Abstract

It is evident that European forests are no longer in a healthy state. This can be attributed to several factors, namely excessive and aggressive logging practices, heatwaves, and other threats. Given these circumstances, it is important to adopt a sustainable approach in forest management. Achieving this requires the implementation of efficient and safe forest utilization practices, where heavy machinery operates with precision, accurately identifying the location of each tree to be harvested. A precise positioning, velocity, and timing (PVT) solution is therefore essential.

To address these challenges, the SuperNav project explored various approaches. One of these involved combining the information provided by several antenna-receiver pairs to calculate one PVT solution. Even a short distance between the antennas can result in different signal reception, which in turn offers the possibility of using them together. By exchanging information between the receivers, the chance to obtain four good and independent sets of measurements at one master receiver, leading to a reliable position solution is increased. A master receiver decides on the basis of signal quality parameters, such as carrier-to-noise density ratio (C/N_0) and measurement consistency checks, which information is to be taken into account from the other receivers. Unlike advanced and complicated tracking algorithms that may require calibration, this method could be easily set up using commercial-off-the-shelfs (COTS) receivers that provided the necessary information.

The presentation will demonstrate the collaborative solution achieved using four antenna-receivers pairs. The dataset used for analysis was collected during the SuperNav project in the German Schwarzwald. The antenna-receiver pairs were mounted on the roof of a forwarder vehicle, which traveled through the forest under a dense canopy. Analysis of the data revealed that all four antennas experienced reduced signal reception and consequently produced poor standalone position solutions. However, the collaborative position solution significantly improved the accuracy. By utilizing multiple frequencies and multiple GNSS systems (Galileo E1 and E5, GPS L1 C/A and L5), a multi-frequency, multi-GNSS collaborative position was achieved.