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Subject Area	Sensor, Actuator and Communication Systems

A Testbed for Victim Tracking in Avalanches

Master Thesis

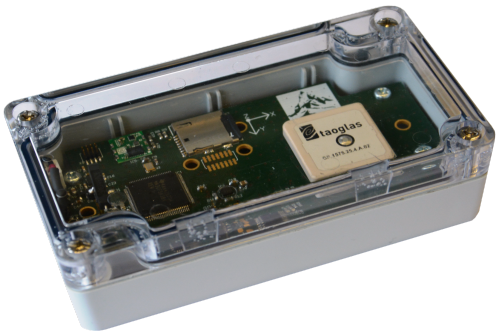

Figure 1: Avalanche Testbed

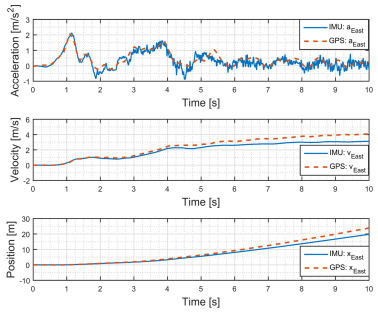

Figure 2: Strapdown inertial navigation vs. GPS navigation

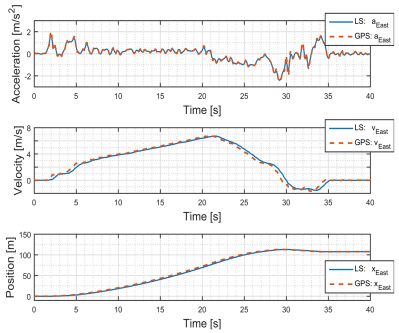

Figure 3. LS corrected strapdown inertial navigation vs. GPS navigation

This master thesis investigates the capability of a GPS-aided testbed for tracking an avalanche victim. The results of this work shall demonstrate the benefits of GPS-aided avalanche transceivers, which are capable of narrowing down the search area. Since the avalanche victim search is a very time-critical endeavour, reducing the search area is therefore a matter of life and death. This work builds up on the project thesis «Dynamics-Related GNSS Attenuation in Avalanches» carried out during winter 2014/2015.

One goal of this project is to execute measurements in an avalanche, which should give more insight whether it is possible to receive GPS signals inside an avalanche or not. If the GPS signals are lost during the incident, the possibility of extrapolating the position using an integrated inertial measurement unit is investigated. During this work, the hardware developed in the first project has been improved in order to guarantee its reliability while executing the avalanche measurement. A strapdown inertial navigation algorithm using quaternions has been implemented, which is able to track the movement of the hardware during possible GPS loss for a certain time span. Furthermore, some advanced signal processing methods have been investigated in order to extrapolate the position solution including a Least Squares approach and a dedicated Kalman filter. The mild weather made the measurement of real avalanche dynamics impossible. The navigation algorithm and the post processing have therefore been tested using data from a bicycle test drive.

The results obtained so far led to the conclusion that it is possible to track the testbed even though GPS reception is lost. The crucial parameter is thereby for how long and in which state of the avalanche movement the GPS signal is lost. It is expected to gain more knowledge about the possible usage of GPS in avalanche situations as soon as the avalanche measurement has been executed and processed.