Fachhochschule Nordwestschweiz
Hochschule für Architektur, Bau und Geomatik

MSE MASTER OF SCIENCE IN ENGINEERING

Higher Resolution Camera for an Imaging Rover and Low-Cost GNSS Setup for Water Equivalent of Snow Cover Determination

The Leica GS18 I is an Imaging Rover with a built-in camera, empowering contactless detection of inaccessible objects. However, the resolution of the built-in camera is below average. Therefore, a workflow and a measurement setup, including a higher resolution camera, are established and assessed. For another project, a low-cost GNSS setup has been assembled at Davos WSL/SLF test site "Versuchsfeld Laret" for determination of water equivalent of snow cover by RTK-GNSS.

Introduction

Two topics, with one commonality, are covered: Both use Real-Time-Kinematic GNSS (RTK-GNSS) for higher accuracy. By sending correction data to a rover (see Figure 1), phase-based GNSS solutions can be solved (Rothacher et al., 2013).

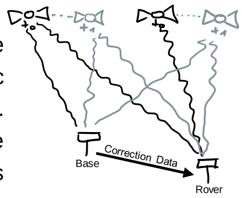

Figure 1: RTK-GNSS.

A. Leica GS18 I and a Higher Resolution Camera

The built-in camera of the Leica GS18 I has an under average resolution: Therefore, a measurement setup (see Figure 2) and a workflow are designed, to integrate a higher resolution camera into the existing process of image capturing and data processing. Further, the external camera is triggered by the Leica GS18 I.

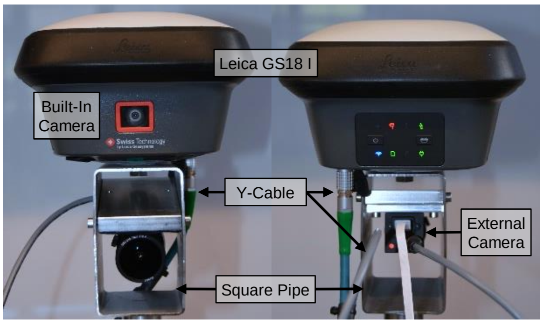

Figure 2: Leica GS18 I with externally mounted FLIR camera.

Workflow for Integration of Higher Resolution Camera

The workflow consists of three main blocks: Preparatory steps, the data acquisition and the data processing (see Figure 3).

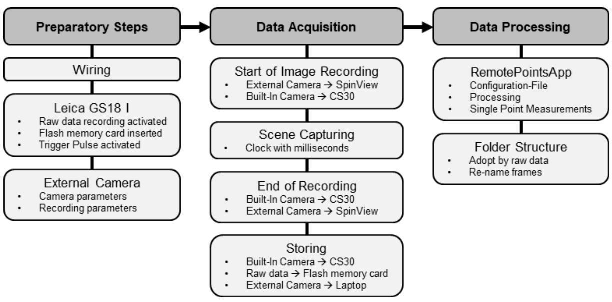

Figure 3: Workflow for time synchronized image capturing.

Assessment of Possible Accuracy Increase

An accuracy improvement of 40 – 50 percent as well as a 3D deviation within 33 mm by 95 percent likelihood can be expected by integration of a higher resolution camera.

B. Water Equivalent of Snow Cover (SWE) by RTK-GNSS

Results of a feasibility study in March 2021 (Studemann, 2021) are studied deeper during a measurement campaign over the whole snow season 2021/22. The observed SWE, an indicator for the water quantity of melted snow (WSL-Institut für Schnee und Lawinenforschung (SLF), 2013), are logged at 1 Hz at the WSL/SLF test site "Versuchsfeld Laret" at a height of 1500 m asl.

Measurement Setup at WSL/SLF test site

It consists of two ublox patch antennas, connected to Emlid Reach M2 receivers for data processing. The upper antenna is above the snow cover, whereas the sub-snow antenna is underneath it (see Figure 4). Receiving correction data from the upper antenna, the sub-snow antenna is solving and storing its baseline at 1 Hz.

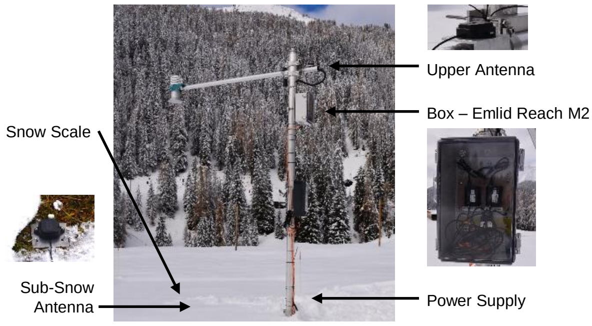

Figure 4: GNSS Measurement Setup for SWE determination.

Preliminary Results of SWE Determination

Inside a moving range of 25 mm water equivalent (mm w.e.), SWE by GNSS-RTK are scattering. Due to a lateral displacement of the upper antenna, baselines are less suitable for SWE determination.

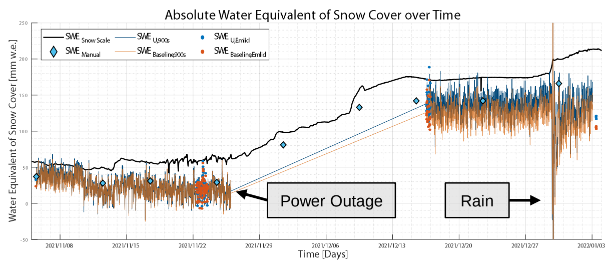

Figure 5: Absolute determined SWE over time.

Conclusion

Both projects are interesting, but at the same time challenging. For further investigations with the higher resolution camera (A), the defined setup and workflow are promising and a good basis. To assess the method's possibilities (B) within the scope of SWE determination, SWE are logged for the remaining snow season.

Bibliography:
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Rothacher, Markus et al. (2013). "Globale Satellitennavigationssysteme". Lecture script. Zurich: Swiss Federal Institute of Technology Zurich ETHZ.
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