Field Report on a Wearable and Versatile Solution for Field Acquisition and Exploration

Olivier Gamache, Jean-Michel Fortin, Matěj Boxan, François Pomerleau, Philippe Giguère

Our Platform in Multiple Environments

Figure 1: Examples of environments traveled with the acquisition platform. **(A)** Winter displacement on a snowmobile, **(B)** Winter frozen lake, **(C)** Winter dense forest, **(D)** Winter tree corridor, **(E)** Spring muddy forest, and **(F)** Summer forest.

Context & Motivations

- Real-life datasets are essential to improve autonomous navigation [1].
- Capturing data in off-road environments require specialized Uncrewed ground vehicles (UGVs) [2], or Uncrewed aerial vehicles (UAVs), which have highly limited battery life [3].
- Portable and easy-to-deploy system allows data recording on larger territory.
- The platform has to be fully customizable to our needs (stereo multi-exposure)

Platform Description

- We designed a plug-and-play multi-modalities platform averaging 20 kg with 5.5 h of battery life.
- A control panel made of a LED screen and two push buttons provides sensors' status, and the ability to manage data acquisitions without needing external devices.
- The main computer has three Ethernet cards, decoupling most of the data transfer.
- Cameras are triggered externally using hardware timers from a STM32F407 microcontroller, providing precise exposure time control and synchronization.

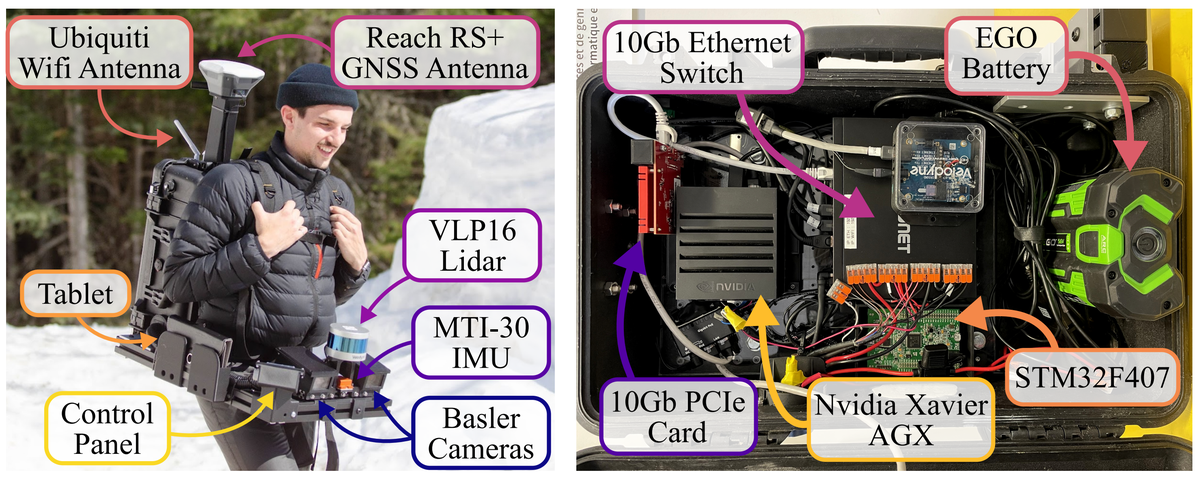

Figure 2: Pictures of the developed backpack. *Left*: Sensors' and user-friendly components' identification. *Right*: Hardwares' description.

- For our purpose, we use the bracketing technique to cycle through multiple exposure times.

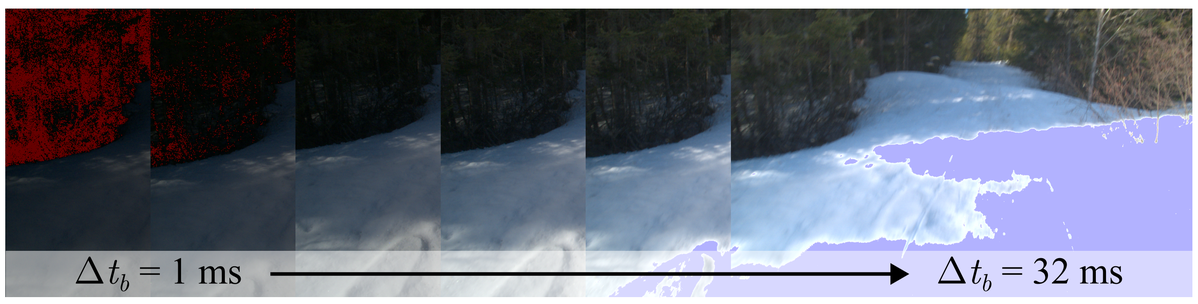

Figure 3: Example of data acquisition using bracketing. Red and blue pixels highlight under-saturated and over-saturated regions respectively.

Limitations

- Absence of wheel odometry measurements.
- Maintaining a constant speed is demanding due to the platform's weight and the fatigue.
- Walking movements create oscillations in recorded data.

Lessons Learned

- **Wired Bandwidth** - To obtain robust communication with sensors, it is preferred to improve the hardware capibilities instead of overoptimizing on the software side.
- **Plug-and-play System** - Investing time upfront in a user-friendly platform allows for faster data gathering later on.
- **Camera Power Supply** - Powering over Ethernet provides too much voltage, causing cameras to overheat and shutdown.

Applications

- Efficient data recording allowed to collect BorealHDR [4], a 10 km off-road multi-seasonal and multi-modalities dataset.

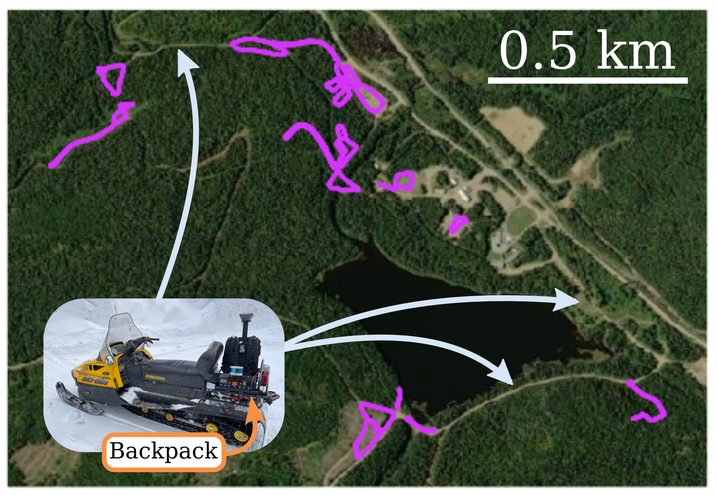

Figure 4: Satellite image of the Montmorency Forest, highlighting all the trajectories traveled on a one-day span in winter. Purple lines are the Global Navigation Satellite System (GNSS) positions from the 29 recorded trajectories, white arrows point to the roads traveled with the snowmobile. The backpack recording platform is attached to the end of the snowmobile only for the displacement between regions.

- This portable platform was used in a Teach-and-Repeat (TnR) setup to record the *Teach* path. The *Repeat* was then performed by an UGV.

Figure 5: Example of TnR application. The *teach phase* was recorded using our platform and is visible by following the imprint of walking steps in the snow. The *repeat phase* was executed with a Clearpath Warthog platform. The purple box highlights the *repeat path* centered on the walking steps from the *teach path*.

- Interest from industries, including forestry, defense, and more!

Acknowledgments and References

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 olivier.gamache@norlab.ulaval.ca | philippe.giguere@ift.ulaval.ca