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

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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 algorithms [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.

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 hability to manage data acquisitions without needing external devices.
- Cameras are triggered externally using hardware timers from a STM32F407 microcontroller, providing precise exposure time control and synchronization.

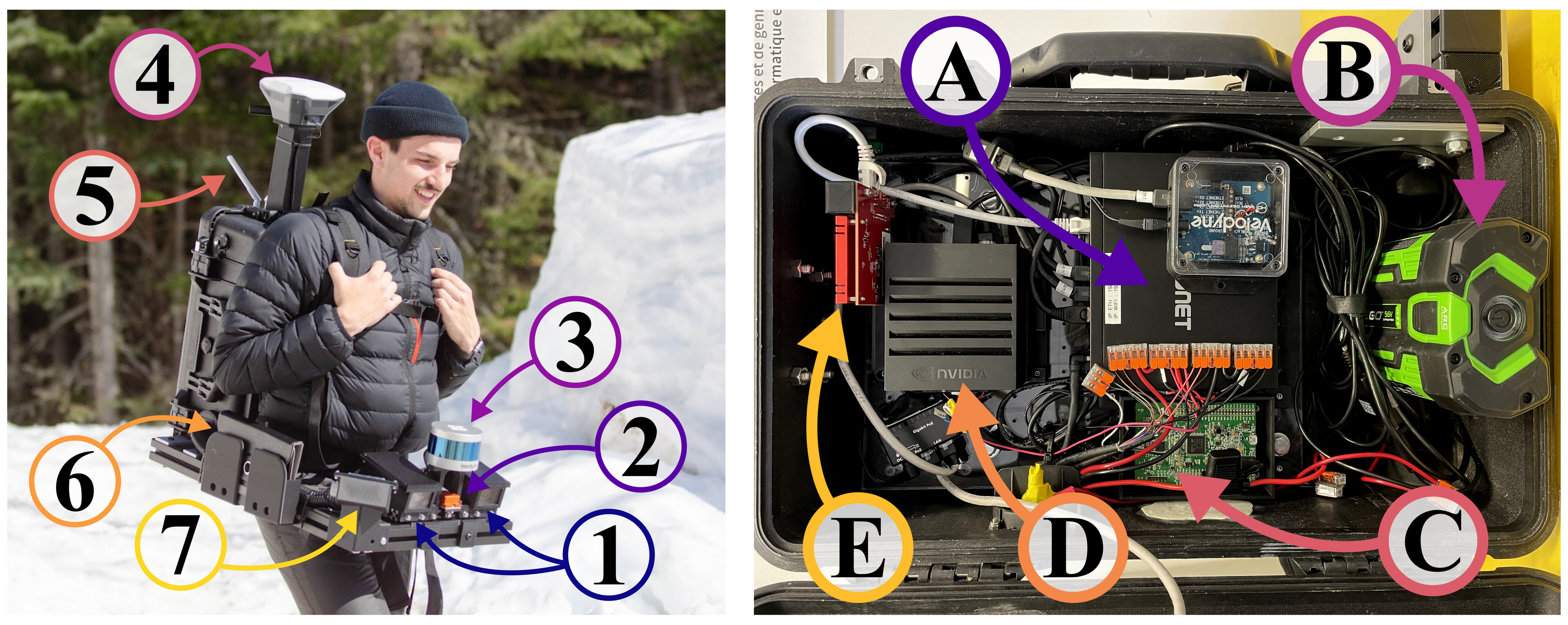

Figure 2: *Left*: Picture of the developed backpack. Main components are identified as follows: **(1)** Two Basler a2A1920-51gcPRO cameras, **(2)** Xsens MTI-30 inertial measurement unit (IMU), **(3)** VLP16 3D lidar, **(4)** Emlid Reach RS+ GPS receiver, **(5)** Ubiquiti UniFi UAP-AC-M Wi-Fi antenna, **(6)** visualization tablet, and **(7)** control panel. *Right*: Picture of the inside of the backpack. Main components are identified as follows: **(A)** TRENDnet TEG-S762 switch, **(B)** EGO battery 2.5 A h, **(C)** STM32F407 microcontroller, **(D)** Nvidia Jetson Xavier AGX Developer Kit, and **(E)** Asus XG-C100C 10 Gb/s PCIe.

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

- **Bandwidth** - To obtain robust communication, 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, while a status display provides a more robust and efficient acquisition.
- **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.

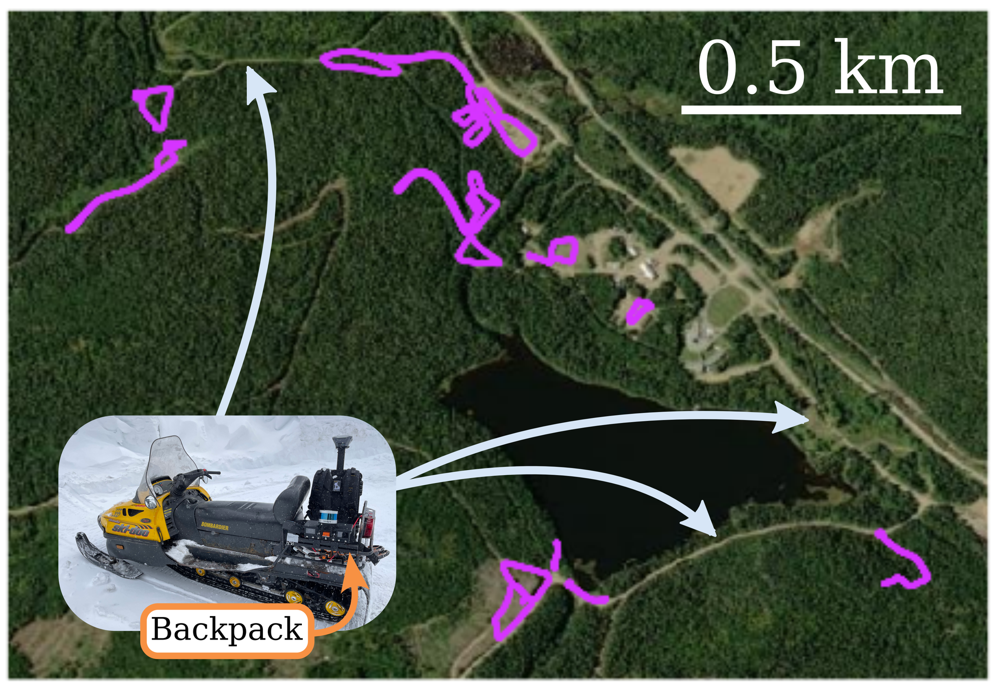

Figure 3: Satellite image of the Montmorency Forest, highlighting all the trajectories traveled on a one-day span in winter. The purple lines are the Global Navigation Satellite System (GNSS) positions from the 29 recorded trajectories, while the white arrows point to the roads traveled with the snowmobile. 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 4: 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*.

- Such versatile and plug-and-play systems are of interest for industries, including forestry, military, and more!

Acknowledgments and References

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