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A stand-alone, modular Sensorbox to exploit the potential of automotive lidar for geoscientific applications

Stefan Muckenhuber[1,2], Birgit Schlager[2,3], Thomas Gölles[1,2], Tobias Hammer[1,2,3], Christian Bauer[1], Victor Exposito Jimenez[2], Wolfgang Schöner[1], Markus Schratter[2], Benjamin Schrei[1], and Kim Senger[4]

[1]University of Graz, Heinrichstraße 36, 8010 Graz, Austria
[2]Virtual Vehicle Research GmbH, Inffeldgasse 21a, 8010 Graz, Austria
[3]Graz University of Technology, Rechbauerstraße 12, 8010 Graz, Austria
[4]University Centre in Svalbard, P.O. Box 156, 9171 Longyearbyen, Norway

Today, the automotive industry is a leading technology driver for lidar systems, because the largest challenge for achieving the next level of vehicle automation is to improve the reliability of the vehicles' perception system. High costs of mechanically spinning lidars are still a limiting factor, but prices have already dropped significantly during the last decade and are expected to drop by another order of magnitude in the upcoming years thanks to new technologies like micro-electro-mechanical systems (MEMS) based mirrors, optical phased arrays, and vertical-cavity surface-emitting laser (VCSEL) sources. To exploit the potential of these newly emerging cost-effective technologies for geoscientific applications, we developed a novel stand-alone, modular Sensorbox that allows the use of automotive lidar sensors without the necessity of a complete vehicle setup. The novel Sensorbox includes a real-time kinematic differential global positioning system (RTK DGPS) and an inertial measurement unit (IMU) for georeferenced positioning and orientation. This setup enables measuring geoscientific processes and landforms reliably, at any remote location, with very high spatial and temporal resolution, and at relatively low costs. The current setup of the Sensorbox has a 360° field of view with 45° vertical angle, a range of 120m, a spatial resolution of a few cm and a temporal resolution of 20Hz. Compared to terrestrial laser scanners (TLS), such as the Riegl VZ-6000, automotive lidar sensors provide advantages in terms of size (40cm vs. 10cm), weight (20kg vs. 1kg), price (150k€ vs. 10k€), robustness (IP64 vs. IP68), acquisition time/frame rate (1h vs. 20Hz) and eye safety (class 3 vs. class 1). They can therefore provide a very useful complement to currently used TLS systems that have their strengths in range (6000m vs. 100m) and accuracy (1cm vs 5cm) performance. Automotive lidar sensors record high-resolution point clouds with very high acquisition frequencies, resulting in a data stream with order 10^6 points per second. To efficiently work with such large point cloud datasets, the open-source python package 'pointcloudset' was developed for handling, analysing, and visualizing large datasets that consists of multiple point clouds recorded over time.