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Comparison of 3D point clouds produced by LIDAR and UAV photoscan in the Rochefort cave (Belgium)

Arnaud Watlet (1,2), Antoine Triantafyllou (1,3), Olivier Kaufmann (1), and Stéphane Le Mouelic (3)

(1) Geology and Applied Geology Unit, University of Mons, Mons, Belgium, (2) Seismology-Gravimetry Section, Royal Observatory of Belgium, Brussels, Belgium, (3) Laboratoire de Planétologie et Géodynamique, UFR Sciences et Techniques, Université de Nantes, Nantes, France

Amongst today's techniques that are able to produce 3D point clouds, LIDAR and UAV (Unmanned Aerial Vehicle) photogrammetry are probably the most commonly used. Both methods have their own advantages and limitations. LIDAR scans create high resolution and high precision 3D point clouds, but such methods are generally costly, especially for sporadic surveys. Compared to LIDAR, UAV (e.g. drones) are cheap and flexible to use in different kind of environments. Moreover, the photogrammetric processing workflow of digital images taken with UAV becomes easier with the rise of many affordable software packages (e.g. Agisoft, PhotoModeler3D, VisualSFM).

We present here a challenging study made at the Rochefort Cave Laboratory (South Belgium) comprising surface and underground surveys. The site is located in the Belgian Variscan fold-and-thrust belt, a region that shows many karstic networks within Devonian limestone units. A LIDAR scan has been acquired in the main chamber of the cave ($\sim$ 15000 m^3) to spatialize 3D point cloud of its inner walls and infer geological beds and structures. Even if the use of LIDAR instrument was not really comfortable in such caving environment, the collected data showed a remarkable precision according to few control points geometry. We also decided to perform another challenging survey of the same cave chamber by modelling a 3D point cloud using photogrammetry of a set of DSLR camera pictures taken from the ground and UAV pictures.

The aim was to compare both techniques in terms of (i) implementation of data acquisition and processing, (ii) quality of resulting 3D points clouds (points density, field vs cloud recovery and points precision), (iii) their application for geological purposes.

Through Rochefort case study, main conclusions are that LIDAR technique provides higher density point clouds with slightly higher precision than photogrammetry method. However, 3D data modeled by photogrammetry provide visible light spectral information for each modeled voxel and interpolated vertices that can be a useful attributes for clustering during data treatment. We thus illustrate such applications to the Rochefort cave by using both sources of 3D information to quantify the orientation of inaccessible geological structures (e.g. faults, tectonic and gravitational joints, and sediments bedding), cluster these structures using color information gathered from UAV's 3D point cloud and compare these data to structural data surveyed on the field. An additional drone photoscan was also conducted in the surface sinkhole giving access to the surveyed underground cavity to seek geological bodies' connections.