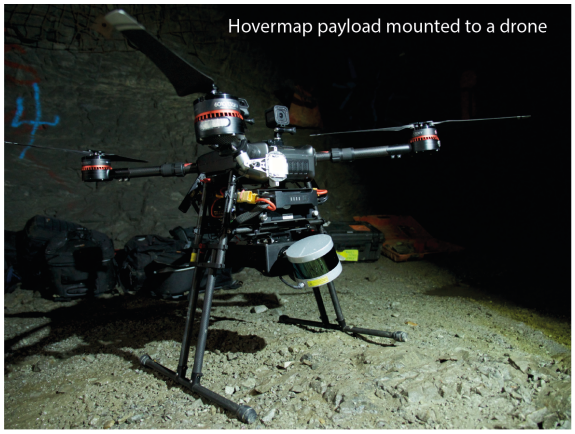
HOVERMAP

Drone autonomy and mapping for underground mines

Hovermap revolutionises access to critical underground mine data, delivering new insights for mine planning and operations

Revolutionising access to underground data

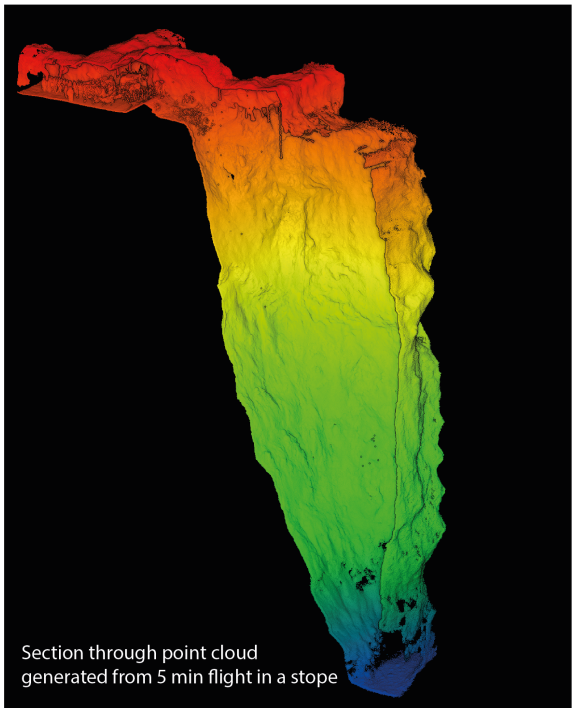
Efficient mine planning and operations require a thorough understanding of the underground environment. 3D survey data is used to reconcile post-blast stope shapes to the design, monitor drive development progress, analyse rock structures to determine ground stability and a host of other applications. Obtaining this data is challenging, time consuming and potentially dangerous using existing survey techniques. In many cases it simply isn't possible to collect the necessary data because the areas are inaccessible. Hovermap provides a safe and efficient alternative and enables data collection in previously inaccessible areas.



Hovermap payload mounted to a drone

Hovermap payload

Hovermap is a self-contained LiDAR mapping and drone autonomy payload. When coupled to a suitable drone it allows the drone to fly autonomously underground to map and explore inaccessible areas. The rotating LiDAR provides an omni-directional field-of-view ensuring 3D data is collected in all directions and obstacles are avoided in all directions. Additional sensors such as RGB and thermal cameras, gas sensors and radiation sensors can be carried to collect a variety of other useful data types. This data can be overlaid on the 3D LiDAR data for visualisation and analysis.



Section through point cloud generated from 5 min flight in a stope

SLAM-based LiDAR Mapping

Hovermap utilises Simultaneous Localisation and Mapping (SLAM) algorithms instead of heavy and costly GPS/INS hardware. This allows accurate 3D mapping underground in stopes, drives, ventilation shafts, ore passes etc. Lidar data is logged on-board and post-processed to produce 3D point clouds. Hovermap point clouds can be registered to the mine coordinate frame using standard survey control points. Automatic alignment of consecutive scans allows for the detection of small changes between scans.

SLAM-based 3D mapping

Collision Avoidance and Autonomy

GPS-Denied Flight

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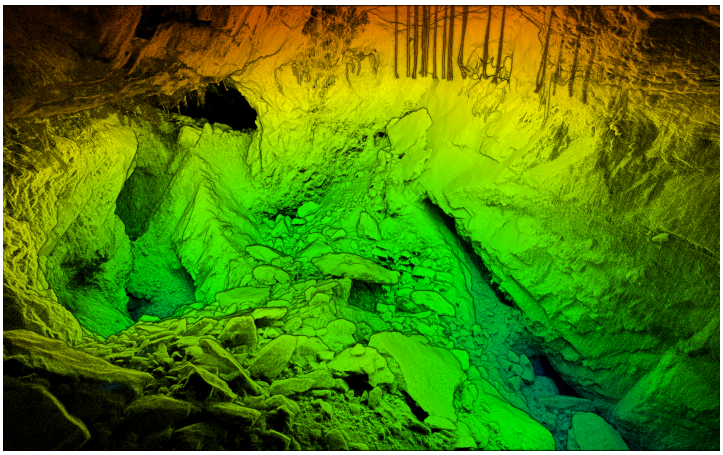

Point cloud from autonomous flight in a bulk stope

Autonomous flight into a stope

Hovermap allows access to high-fidelity, actionable data at the press of a button.

Stope Mapping Use Case

Stopes are currently mapped using a CMS (Cavity Measurement System). The boom-mounted LiDAR system is inserted into the stope entrance to take a scan. The technique requires clear access to the stope entrance and surveyors are required to operate dangerously close to the stope brow. The data collected is incomplete due to shadowing and the point density is low. A single scan can take 4-6 hours including clearing barricades for access, setting up the equipment and packing up. It can require 2 surveyors and support from others.

When using Hovermap, the drone is launched a safe distance from the stope entrance. It flies autonomously into the stope and maps the cavity completely without any shadowing and at unprecedented point density. The flight takes 5-10 mins and the entire operation takes less than 30 mins. This reduces production interruptions and allows stopes to be surveyed more regularly. Regular surveys and the accurate volumetrics provide improved insights into the stope development progress and volumes needed for backfill. The system can be operated by a single person who is not a drone expert or skilled surveyor.

Complete data coverage removes the guesswork for stope volume calculations and reconciliation to the stope plan for over-and-underbreak calculations. Detailed, dense point clouds enable the detection of geological structures. This allows optimisation of future drill and blast designs to reduce dilution from over-break.

Other Use Cases

- Drive mapping for new developments, exploring old workings and convergence monitoring
- Mapping and inspecting ore passes, waste passes and ventilation shafts
- Mapping and inspecting hang-ups in draw points
- Inspection of underground plant and equipment such as tipples
- Post-blast gas measurements
- Post-disaster inspection, 3D incidence recording, Search and Rescue
- Inspection and mapping of above-ground infrastructure, stock piles, ROMs etc.

Key Benefits

- Capture valuable data in inaccessible areas at unprecedented spatial and temporal resolutions
- Improve safety by removing personnel from hazardous areas
- Reduced cost and time of data collection

Mapping Specifications

Lidar range	Up to 100m
Lidar accuracy	+/- 3cm
Global SLAM accuracy	+/- 0.1% typical
Angular field of view	360° x 360°
Data acquisition speed	300,000 points/sec
File size	~300MB/min
Processing time	Less than data capture time
Point cloud file format	.laz, .ply