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ExynPak Best Practices

Reference Guide

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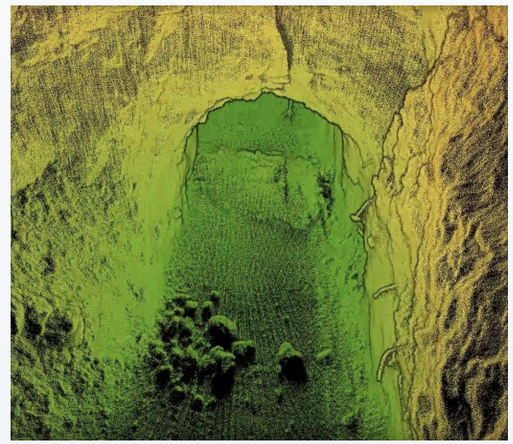
BEFORE THE SCAN

- The default Exyn frame is 0,0,0 at system start location. If you need to transform the point cloud data to a global or separate coordinate frame – **georeferencing** – you will need to do some pre-scan prep. The default method is to place at least 4 of the 5 provided retroreflector survey targets (see image below) in the general start location of the scan prior to conducting a scan. The coordinates of these targets will need to be obtained at some point to georeference.

- Plan your path through the **scan area** before beginning your data collection to ensure you move smoothly through the space. Open any doors ahead of time and turn on lights if you plan on using the colorization feature.

- When you pick a **loop closure** location, choose an environment that has rich geometric features. The ideal loop closure location will have surfaces and textures in the environment. Think anything with points, lines, or sharp corners. The images below show locations with rich geometry (industrial complex, stope of a mine)

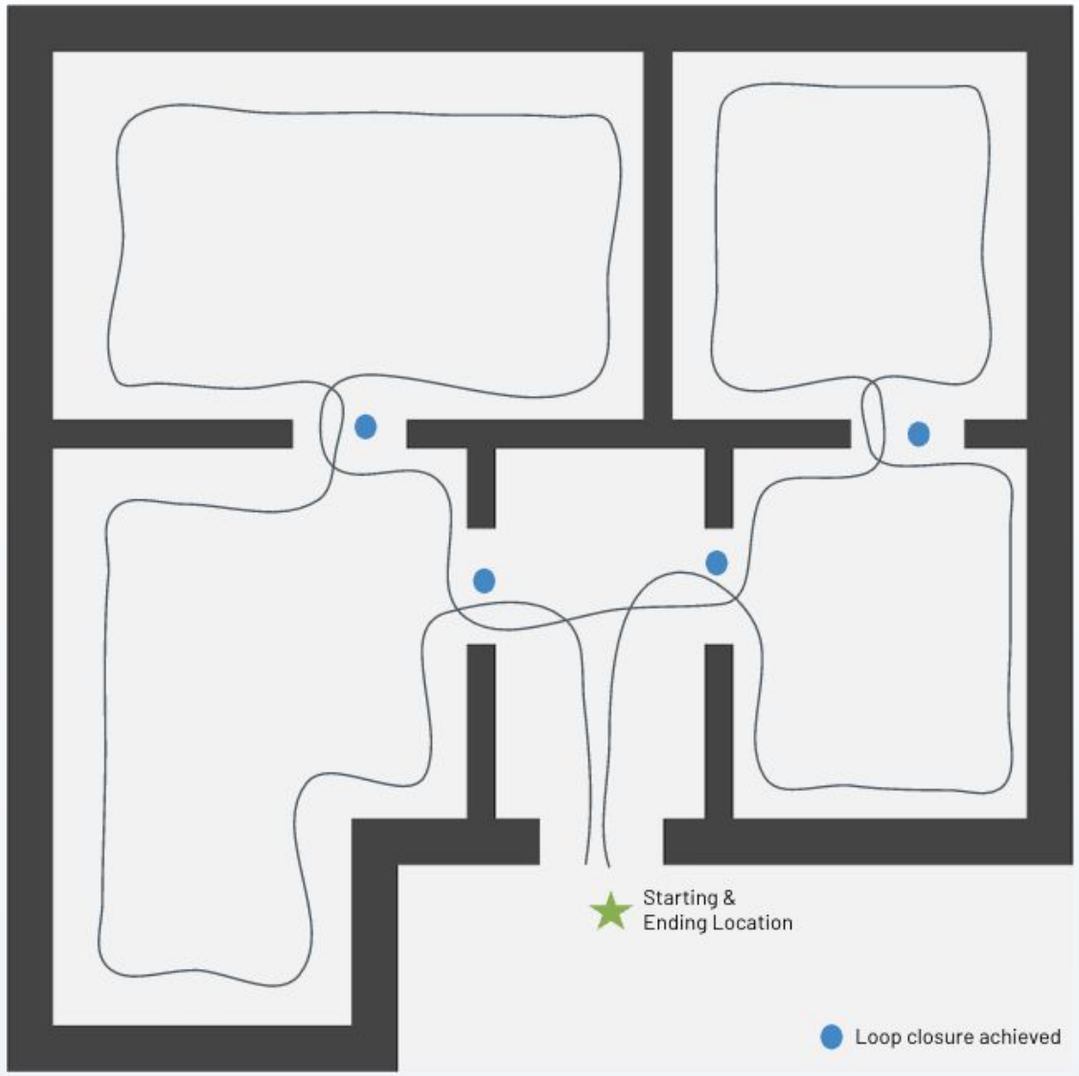


BEFORE THE SCAN

If possible, plan to achieve at least one **loop closure** in a data collection. The easiest way to achieve this is to return to the start location of your scan at the very end to enable a large single loop.

Multiple loop closures throughout a single collection are encouraged to increase global map accuracy.

In the image to the right, the blue dots indicate where loop closure has been achieved. The star indicates the starting and ending point of the path.



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STARTING THE SCAN

- Along with having rich geometry features, pick a start location that is easily identifiable – like a bench, table, or ledge – to return to at the end of the scan to enable loop closure.

- System initialization takes place during the first 15 seconds of **starting a scan**. If the system is moved or subjected to vibration, initialization will fail and you will have to attempt the scan again. Using a stable surface will ensure proper initialization and improve the results of the scan.

- You may place your hand on the system to secure it while the **LiDAR** begins to spin.

- The best place to stand when starting a scan is behind the system. This will mitigate inadvertent LiDAR returns or color draping.

- Be sure to collect at least 10 seconds of data near the start location to assist loop closure identification.

Note: The ExynPak system is positioned on the ground for system initialization. Notice that the screen indicates this status to the operator.

Note: The red post in front of the ExynPak system currently is a good location to start the scan. This a unique feature that makes it easy memorable for the user to end the scan in the same location.

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DURING THE SCAN

If you are transitioning into new spaces via hallway or some type corridor, position the system such that the scanner can see a landmark feature from the area you have already scanned, and slowly back into the new space.

One area where SLAM can struggle is what we refer to as **degenerate environments** – or areas lacking in unique features. In these areas, position the sensor towards a specific landmark feature while moving throughout the space. Additionally, keep the sensor motions slow and smooth with slow rotations and translations.

Any moving objects within the system sensors' **field of view (FOV)** will be captured in the point cloud and be evident in a **ghosting** effect. To mitigate these effects, ExynView's post-processing provides a tool to remove non-static points. However, avoiding an excess of moving objects is encouraged to limit processing time.

Note: Operator stops in doorway and positions ExynPak such that the system can still see the area it just scanned, and the area that is about to be scanned.

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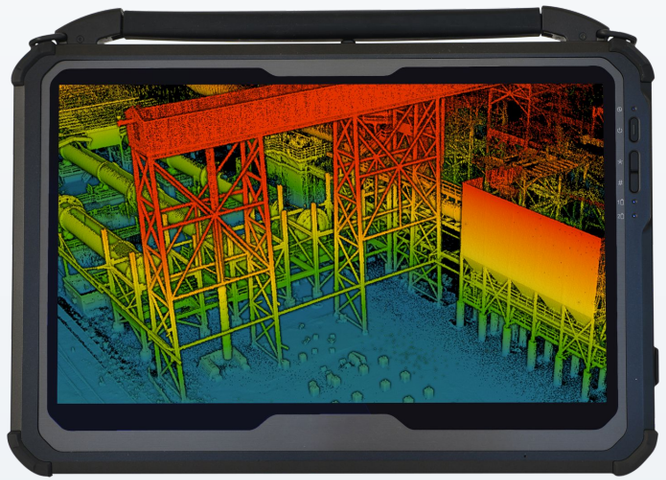
DURING THE SCAN

For handheld captures, keeping the ExynPak held out in front of you and the **LiDAR** sensor facing forward will provide the most detail of your environment by occluding the least amount of the sensors' **FOV**.

If possible, monitor the coverage of the real-time map generation and **state estimation** of the system during the data collection to ensure that your goals are being met.

Speed vs. point cloud density - The slower you move, the more points will get collected in that area resulting in a denser, more detailed point cloud (i.e. solid looking walls, readable signs, distinguished features).



Note: On the ExynView tablet operators can view the map of the area being generated in real-time.

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ENDING THE SCAN

- Once you have collected all necessary data, you will want to proceed to your pre-designated stopping location. Come to rest as close to the starting position as possible with a similar **FOV**, then continue to collect data for an additional 10 seconds before stopping the scan. This additional scan time will help with **loop closure** detection.

- If placing the ExynPak down at its resting point, do so carefully to avoid contact to the sensor head. Check that there is clearance below the spinning LiDAR so that it does not make contact with anything. The best location to place it down is on a flat surface.

Note: The red post in front of the ExynPak system currently indicates this is the same location that the user started in. This a unique feature that makes it easy memorable for the user to end the scan there.

TERMS TO KNOW

LiDAR (Light Detection and Ranging): a method that uses light in the form of a pulsed laser to target an object or a surface with a laser and measuring the time for the reflected light to return to the receiver.

SIMULTANEOUS LOCALIZATION & MAPPING (SLAM): an algorithm that uses onboard sensors to build a map of an unknown environment while estimating where the robot is inside that map.

SCAN AREA: an area of interest that you intend to capture using your mobile LiDAR scanner.

DRIFT: the accumulation of small errors during a scan that can result in large errors over time.

LOOP CLOSURE: scanning the same location at two different times during a single data collection. Loop closure adds additional information in the SLAM pipeline to reduce drift and create a more accurate point cloud.

STARTING A SCAN: starting ExynAI to begin a data collection. The robot will enter an initialization phase and record a data collection log.

GEOREFERENCING: the process of performing a rigid transformation between capture coordinate system and another coordinate system

FIELD OF VIEW (FOV): extent of the observable space at any given point in time.

DEGENERATE ENVIRONMENT: environments that lack unique features or geometric objects. (i.e. smooth walls, tunnels, empty fields) .

STATE ESTIMATION: the process in which the robot utilizes both lidar data and IMU (inertial measurement unit) data to understand its location relative to the surrounding environment.

EXYNPAK COMPONENTS

Handheld Configuration

BackPak Configuration

Survey Markers

ExynView Tablet

Vehicle mount configuration

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