FLYABILITY

# ELIOS 3

## INSPECTOR 4

USER MANUAL

**VERSION 1.3**

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# 1 Overview

## 1.1 Inspector

Inspector 4 is the official Flyability software used to analyze the inspection footage gathered by Elios 3 & Elios 2 drones. It is not compatible with Elios 1 data, so the previous version of Inspector should be used here instead.

Flyability drones save the flight data in different locations:

- The videos and still images are saved on the CAM SD card. A new video is automatically created every flight. The maximum file size is 4GB, so when recording in 4K, several videos can be created during one flight.
- On the Elios 2, the thermal camera data and flight altitude/direction are saved on the LOG SD card. A log file is created when a battery is connected and continues recording until it is disconnected.
- On the Elios 3, the thermal camera data, flight altitude/direction, pointcloud trajectory and raw logs are saved on the embedded SSD.

Inspector is used to visualize, localize, and document your inspections. It gives you a precise view of what's happening inside your assets so your team can act quickly in just the right place.

During post processing, Inspector allows you to:

- Analyze the video frame-by-frame
- Provide a low or high density point cloud of your asset (depending on the drone employed)
- Make distance measurements
- Annotating points of interest
- Exporting inspection reports

## 1.2 Mapping

The mapping feature of Inspector 4 is meant to localize your inspection data by producing an accurate trajectory with a point cloud offering a good balance between accuracy and processing time. It does that out of regular inspection flights and not one's dedicated to optimizing data capture for photogrammetry. For Elios 3 users, the mapping and localization is performed on the drone using our homemade SLAM engine FlyAware™, with the possibility to transform Elios 3 LiDAR datasets into highly accurate 3D models using GeoSLAM Connect. For further information about the Elios 3 Mapping features, refer to this webpage.

# Installation

## 1.3 System requirements

Inspector requires an AMD64 architecture (Intel or AMD processor based) machine running Windows 10 (64-bits) or newer. It also needs 500 MB of disk space, and it is recommended to have additional 50-100 GB of free disk space for flight data, as each flight produces around 10 GB of data. Lately 8GB of RAM is recommended.

## 1.4 Installing Inspector

Inspector 4 is distributed as a standard Windows executable installer, available on the Inspector 4 webpage of flyability.com. Run the installer and follow the instructions displayed. The mapping and localization features are available for free to all Elios 3 users as the mapping and localization are performed by the drone itself during flight time. For Elios 2 users, it requires the purchase of an Inspector Premium license to create maps of inspection using the mapping algorithm embedded in Inspector.

## 1.5 Drone Firmware

Be sure to update your drone firmware and tablet cockpit app to the latest versions to improve compatibility. The M<p feature (you can now use the RGB camera in front of the drone to make sparse maps and localize your inspection data) is compatible with both Elios 2 and Elios 3. Please find below listed the requirements for each of the drone:

- For Elios 2, you will need firmware 1.4 or higher.
- For Elios 3, you will need a drone with onboarding software at least 22-24.

The FlyAware™ SLAM engine feature comes by default with the Elios 3 equipped with a LiDAR sensor.

## 1.6 Firmware upgrade

### ELIOS 2

Cockpit streams the update over-the-air to the aircraft. Next time you connect your Flyability aircraft to Cockpit, its version is analyzed, and the pilot is warned when an upgrade should be done.

A warning appears on the screen if an upgrade is necessary. It is highly recommended to perform the upgrade so that you can benefit from all the new features and bug fixes. If you keep your aircraft with outdated firmware, some of the newer features of Cockpit will not be enabled. The warning is visible as an example on the screenshot below.

By clicking on the "**Upgrade now**" button on the warning, you can access the upgrade tool. Make sure to use a full battery for running the upgrade process. It will minimize risks of the aircraft turning off in the middle of a file transfer.

The upgrade tool tells you:

- The current version of Avionics on the aircraft ;
- When the new version of Avionics is ready for transfer.

In case of an older aircraft or those not maintained for a long time, the use of an SD card for firmware upgrade can still be mandatory. In such cases, Cockpit mentions it on screen.

Upgrade using over-the-air file transfer

If the tablet shows "**Ready for upgrade**" and the start button is available, all conditions are met to start the upgrade.

1. Make sure the aircraft is close to the Remote Controller, ideally on the same table.
2. Make sure there is an SD card with free space in the log slot. Without this, the upgrade cannot succeed.
3. Press the "**Begin upgrade**" button on the tablet.

Let the upgrade run until the progress bar reaches 100%. In optimal situations, this process is expected to last for 6 minutes. Do not disconnect any component while the transfer is running.

The screen now informs us of an imminent aircraft reboot process.

1. Wait for the aircraft to restart, and check that a rapid blinking LED sequence is visible at a particular moment. This fast LED blinking sequence corresponds to the moment the new firmware package is actually being written on the system.
2. When the upgrade is successfully finished, the application should display a success message.
3. Press the "**Finish**" button to go back to the main screen.

Open the About panel in the settings menu, you can now verify that the latest version is present (no upgrade invitation message is shown).

## Elios 3

A warning appears on the tablet's screen if the firmware and Cockpit are no longer compatible (see screenshot below for an example of this warning). Please note that you should always update the drone firmware when updating the software and vice versa. If not, your drone will not function properly. To upgrade the system, you will have to connect to the Inspector 4 software.


Figure 1: Elios 3 Firmware Update

# 2 Login screen

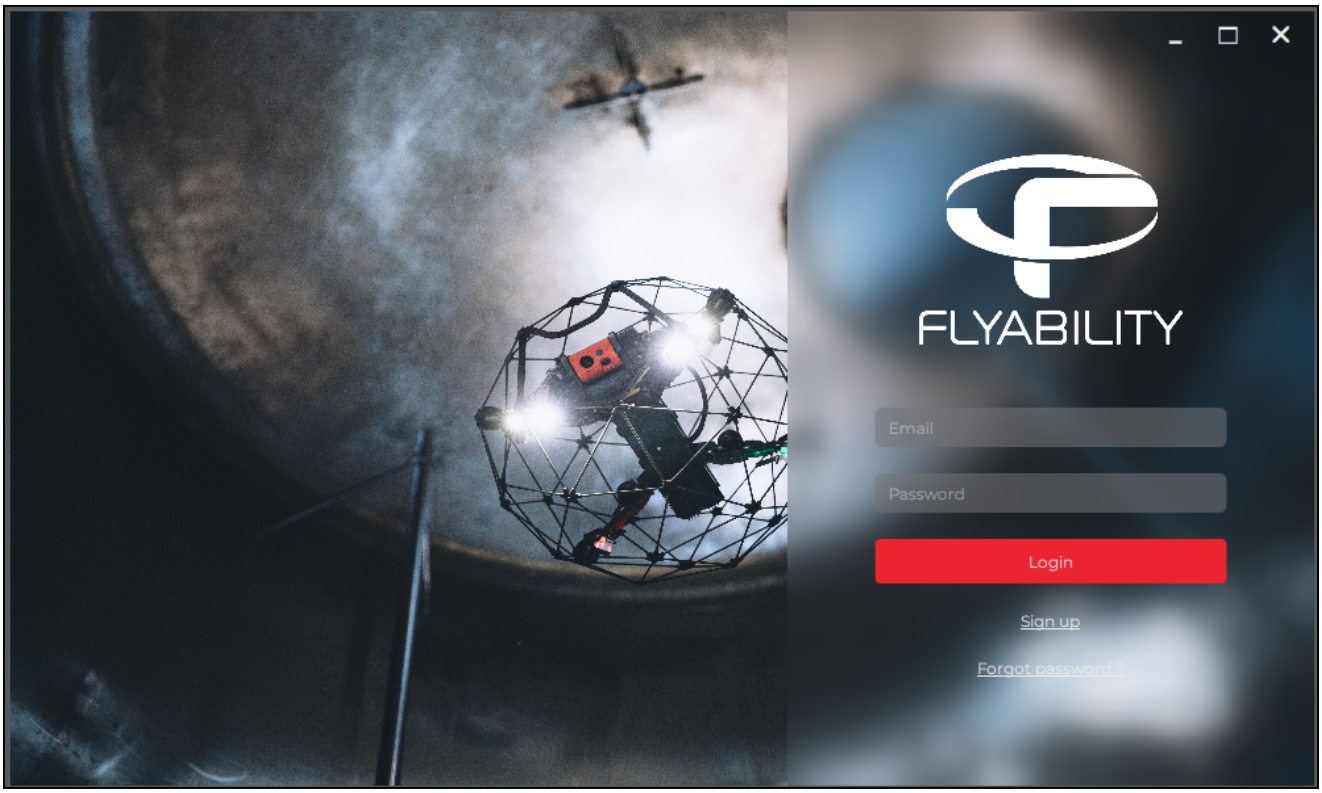



Figure 2: Login Screen

You will be asked to log in the first time you open Inspector. If you don't have credentials, you will need to create an account online. Be sure to have internet access the first time Inspector is started.

# 3 Home Screen

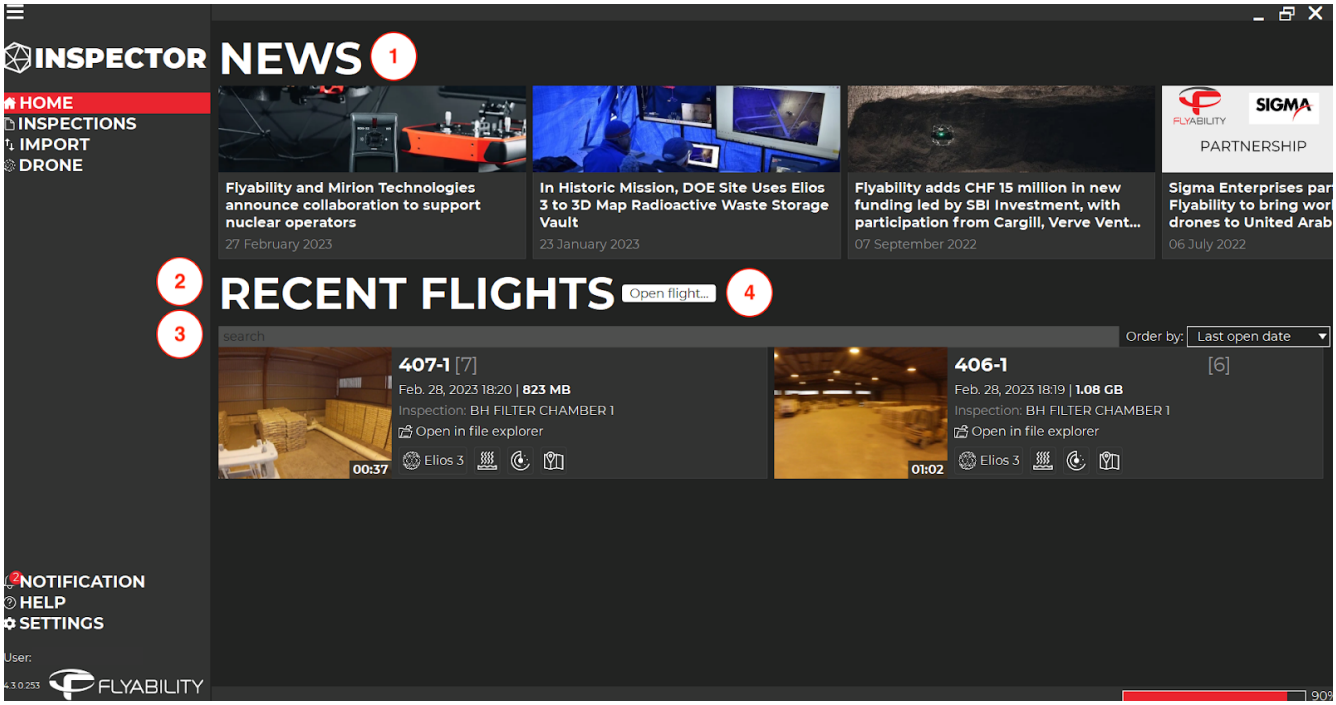



Figure 3: Inspector 4 Home Screen

### News

This section will display recent updates and information concerning our products and software, as shown in figure 3 as (1).

### Recent Flights

This is a list of projects which have been opened or imported on your computer. Flights can be sorted according to: last open date, flight date, or flight name, as shown in figure 3 as (2).

### Search bar

This search bar can be used to quickly search for a specific flight, as shown in figure 3 as (3).

### Open flight

If the flight you are looking for is not shown in the list, then you can use this button to browse for it on your computer, as shown in figure 3 as (4).

# 4 Inspections Screen

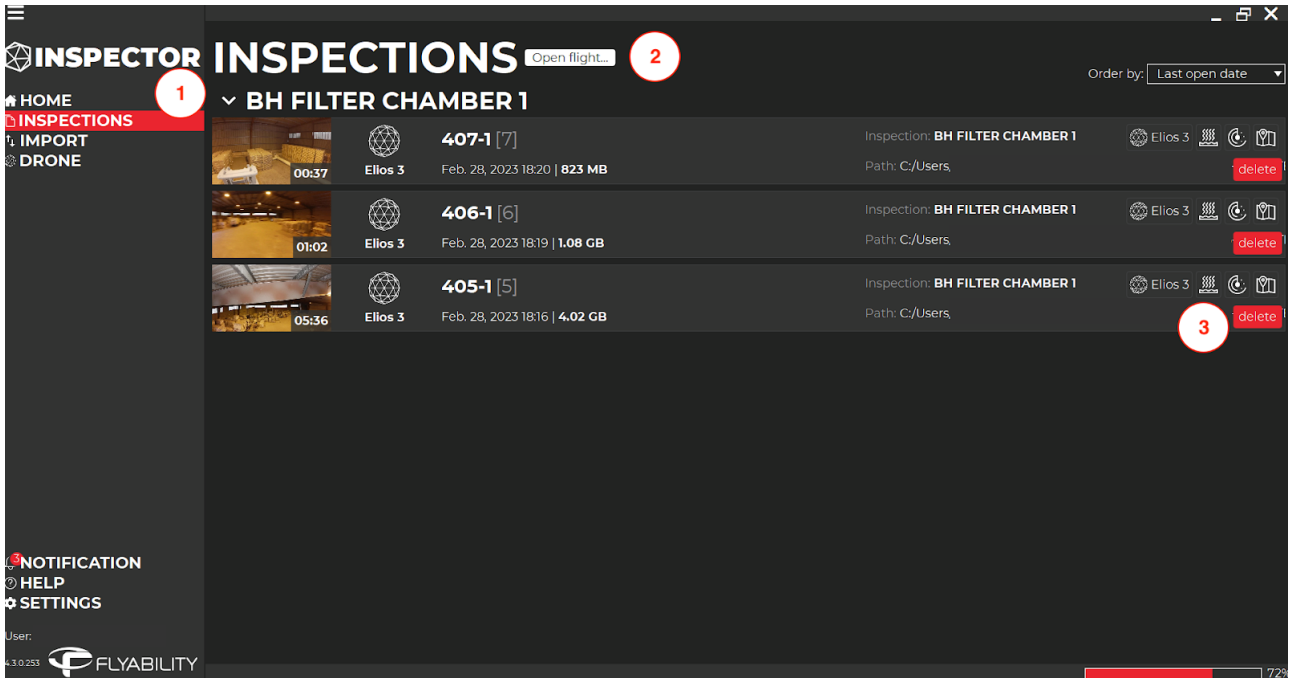



Figure 4: Inspector 4 Inspections Screen

Like the Home Screen, this lists all flights found on your computer, with the difference that they will appear grouped by mission name. This makes it easier to find all flights from a specific inspection.

### Inspections

This is a list of inspections which have been opened or imported on your computer, as shown in figure 4 as (1). Flights can be sorted according to: last open date, flight date, or flight name.

### Open flight

If the flight you are looking for is not shown in the list, then you can use this button to browse for it on your computer, as shown in figure 4 as (2).

### Symbols - Explanation

This is a list of the features utilized during the flight, as shown in figure 4 as (3). For more information on each symbol and icon: when hovering over an icon, a text box displays information about that element as a description.

# 5 Import Screen

This screen is used to import flights from your Elios 2 and Elios 3 onto your computer.

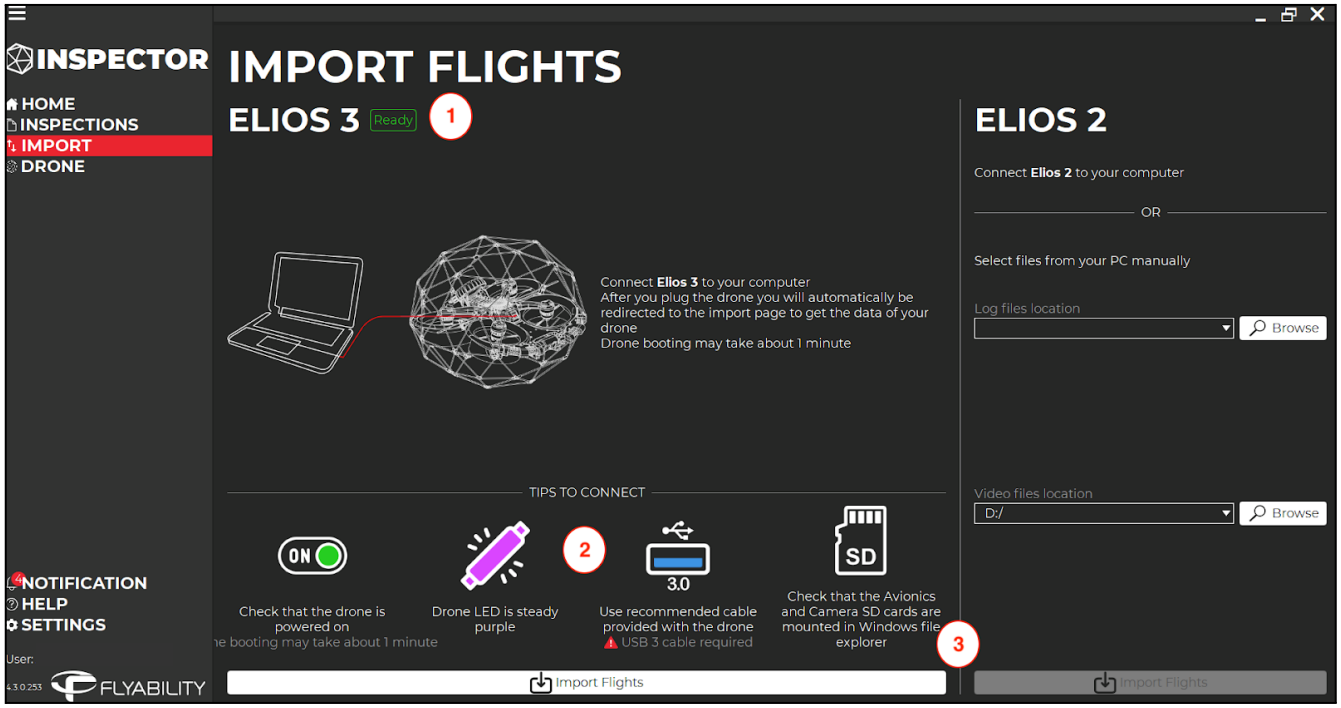



Figure 5: Inspector 4 Import Screen before connection

### Connection

This is where the connection process between the drone (Elios 2 and Elios 3) and your computer is described, as shown in figure 5 as (1).

On Elios 3, for the connection process to start, plug the USB-C cable, and power-up your drone by plugging in a battery pack and then pressing the power button, as this will access the Elios 3 data directly. After you plug the drone, you will automatically be redirected to the import page to get the data of your drone. Please note that drone booting may take about 2 minutes to complete.

On Elios 2, for the import process to start, click on the browse button either from the files or videos bar, and then select the appropriate flight.

### Tips to connect

Here you will find the tips related to the drone connection, as shown in figure 5 as (2).

### Importing Flights

This is where you will be able to import flights from both the Elios 3 and the Elios 2.

### Connection Troubleshooting

1. Wrong cable: Always use the appropriate USB-C cable, which is the one Flyability provided you with.
2. Interference: If you are facing connection issues, we recommend you connect the Elios 3 drone to the computer, via an USB hub, instead of directly using the USB-C cable.
3. If connection issues remain, please disconnect the wifi and try again.

## Elios 2

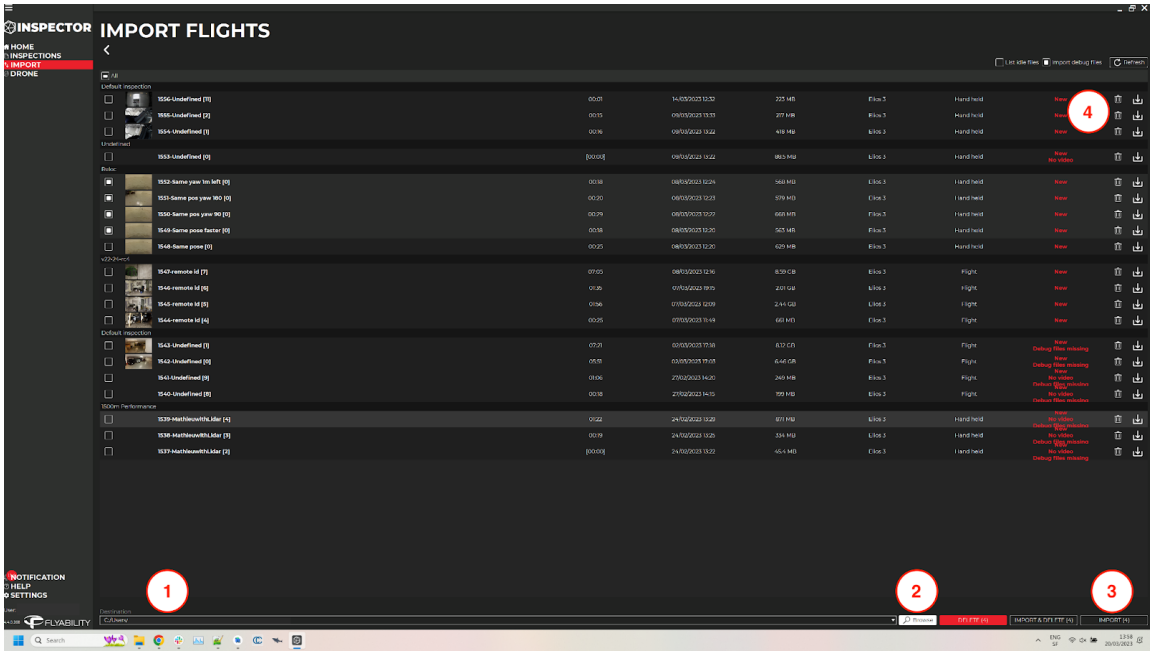



Figure 5.2: Inspector 4 Import Screen after connection - Elios 2

### Destination

This is the location on your computer to where the flight data of imported flights will be saved, as shown in figure 5.2 as (1). The default destination is <documents/Inspector>.

### LOG files location

The location of the .LOG files of the flight you wish to import. If an Elios 2 is connected via USB-C then this will automatically read from the LOG SD card.

### Video files location

The location of the video files of the flight you wish to import. If an Elios 2 is connected via USB-C then this will automatically read from the Camera SD card.

### Search flights

This will list all the flights found in the selected LOG and Video files locations, as shown in figure 5.2 as (2). Inspector automatically matches videos and log files. They must be imported and saved as a project locally before viewing. All flights found will be ordered by mission name and flight number.

### Import

Click this button to import one or more flights. You can import several flights by checking the boxes on the left and clicking on "**Import**", as shown in figure 5.2 as (3). The progress will be displayed on the lower right corner of the window.

This will create for each flight selected a flight project folder in the specified destination, containing the following data:

- The Video file (.mov format)
- Still images of POI's taken in flight (.jpeg format)
- The Inspector Project file (.efly)
- The Drone's inertial and distance sensor data (.LOG)
- The thermal camera raw data, later converted to a video file (.thm and .mp4)

### DELETE

Delete the selected flights from the drone's SD card, by clicking on the delete button, as shown in figure 5.2 as (4). Copies previously imported onto your PC will not be affected. CAUTION: Data cannot be recovered once deleted.

## ELIOS 3

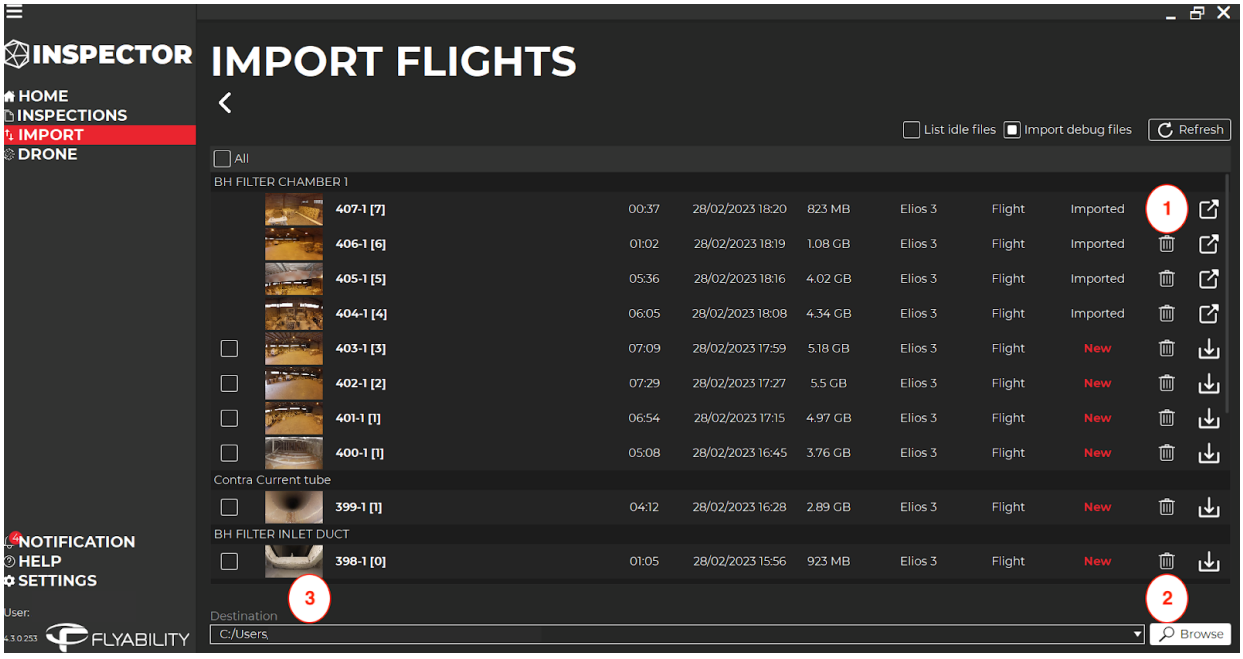



Figure 5.3: Inspector 4 Import Screen after connection - Elios 3

### IMPORT

This will create for each flight selected a flight project folder in the specified destination, as shown in figure 5.3 as (1), containing the following data:

- The Video file (.mov format)
- Still images of POI's taken in flight (.jpeg format)
- The Inspector Project file (.efly)
- The Drone's inertial and distance sensor data (.LOG)

- The thermal camera raw data, later converted to a video file (.thm and .mp4)

**DELETE**

Delete the selected flights from the drone's SD card, by clicking on the delete button, as shown in figure 5.3 as (2). Copies previously imported onto your PC will not be affected. CAUTION: Data cannot be recovered once deleted.

**DESTINATION**

This is the location on your computer to where the flight data of imported flights will be saved, as shown in figure 5.3 as (3). The default destination is <documents/Inspector>.

# 6 Menus

Miscellaneous menus and options are displayed in the lower left corner of the window.

## 6.1 Notification

Any error messages or available updates will appear here.

## 6.2 Help

Contains a link to the on-line support page.

## 6.3 Settings

**CORE SETTINGS**

- File import folder: Allows you to set the default import folder when importing new flights.
- Unit system: Change the unit system in which flight data is displayed. The options available are: metric and imperial.
- Radiation Unit: Change the unit system for the radiation unit. The options available are Sv, and rem.

**GRAPHICS**

- Palette: inspector comes in a light and a dark color palette; we recommend you use the dark palette in dark environment, and the light palette in a light environment, for it to provide you the best contrast.

## 6.4 User

This shows the user who is currently signed in, click the exit icon to sign out.

## 6.5 About

Click the Flyability icon in the bottom left corner to review the License Agreement.

# 7 Drone Screen


Figure 7: Inspector 4 Drone Screen

This page will show once the drone will be done connecting via the USB-C cable. This is where you will be able to check:

- The firmware version.
- The drone serial numbers.
- The drone storage and available space within the SSD and the camera card.

### Empty Storage

From here, you will be able to delete the data stored in the camera card and on the SSD, as shown in figure 7 as (1). CAUTION: Data will be permanently deleted and cannot be recovered. Use this function with extreme caution.

### Empty debug data

From here (figure 7 as (2)), you will be able to delete the debug data stored in the SSD, but only the ones which are not considered relevant for your flights (data captured while on ground).

### Firmware Upgrade

From here (figure 7 as (3)), you will be able to upgrade the firmware version.

# 8 Preview Screen

To open a flight, click on its thumbnail in the Home or Inspections Screen, use the 'Open flight' browser, or double click the .efly project file. This will open the preview screen.

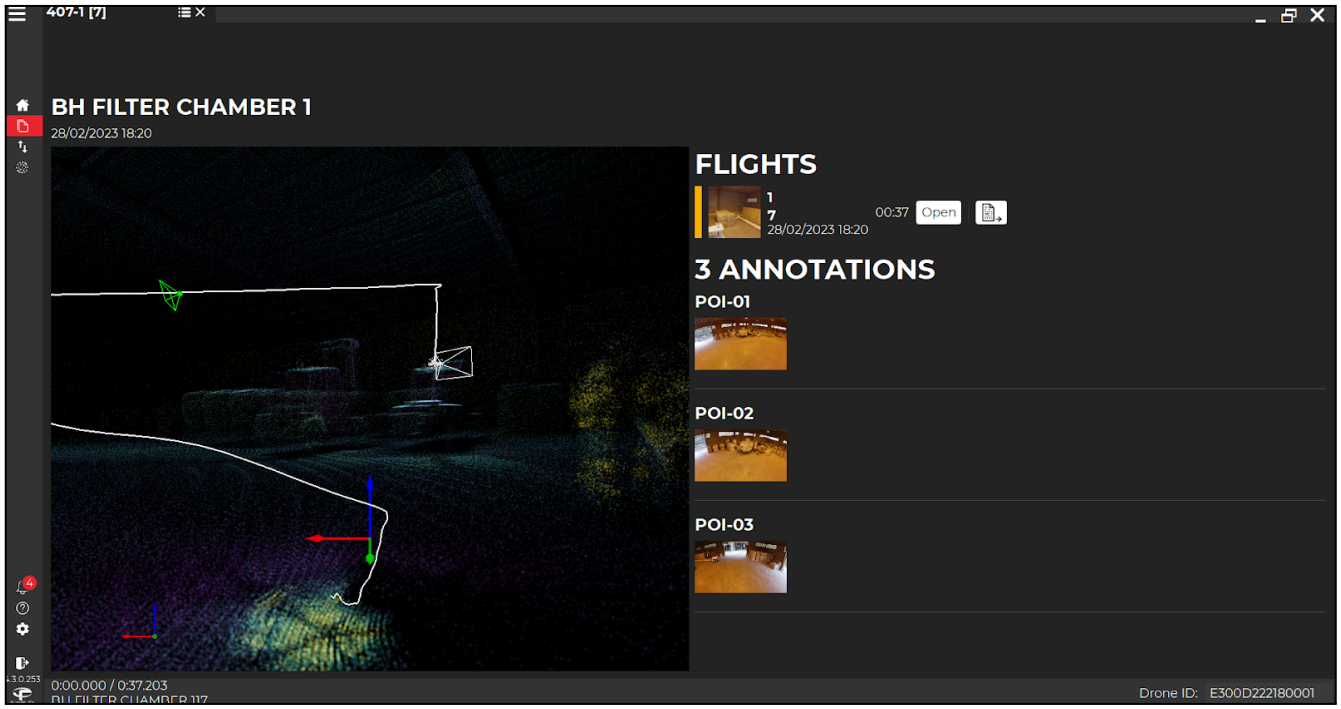



Figure 8: Inspector 4 Preview Screen

On the preview screen you will see a preview of the 3D map and a preview of the points of interest taken during the flight, along with annotations already made in post processing.

The mission and flight names will appear, provided that they were filled in on the tablet before the flight. You can also change the name by double clicking and editing the text.

Continue to review the video by clicking "**Open**" next to the thumbnail under "**Flights**". You can always return to the preview screen by clicking the  icon at the top of the screen.

Once the flight is open, you will see that there are two parts to the screen:

1. The point cloud viewer (3D Viewer) on the left.
2. The video on the right.

The point cloud viewer allows you to navigate within the point cloud, it will show you the drone trajectory, its position, camera angle, and the 3D positions of the POI's (captured during flight), as it flies through the facility.

# 9 Flight Screen

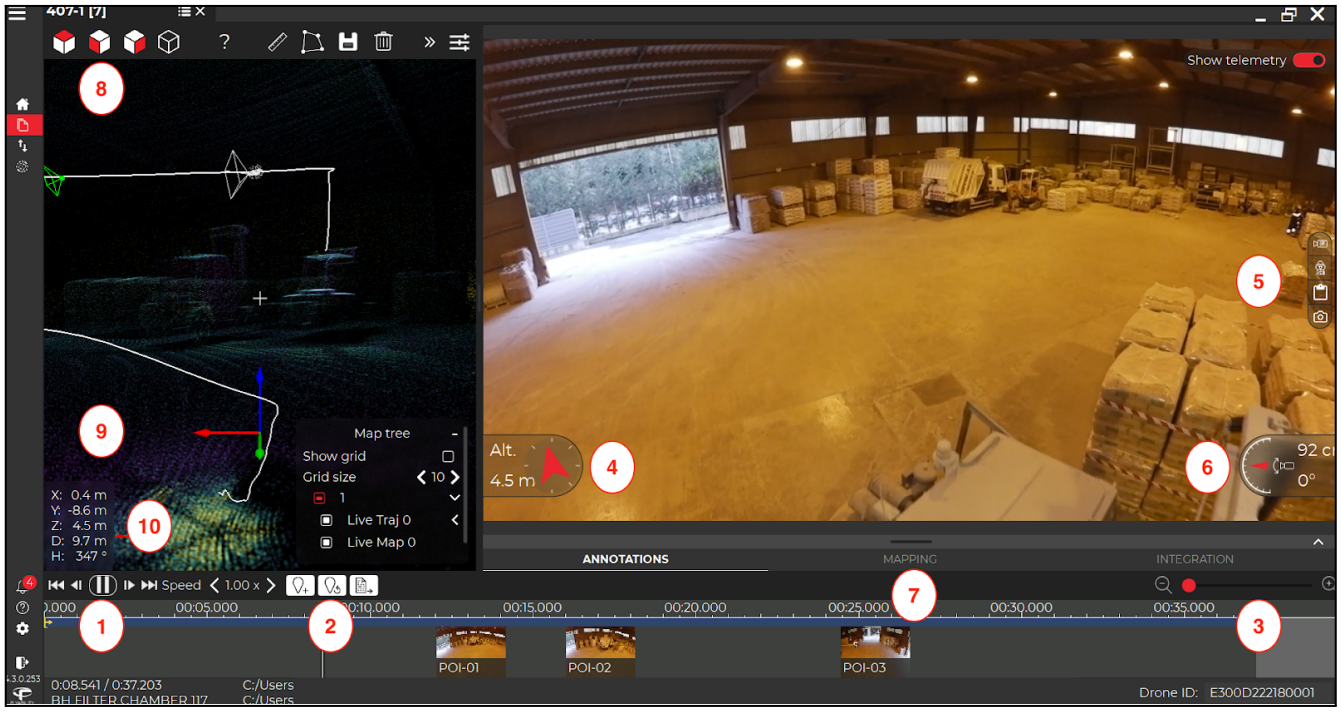



Figure 9: Inspector 4 Flight Screen

The flight screen shows the flight video, along with the Points of Interest (POIs) in the timeline at the bottom. The data and controls overlaying the video image can be toggled on and off by clicking the video area. Double clicking toggles full screen mode.

### Video Controls (1)

- Play or Pause the video.
- Previous/Next frame (arrow left/right).
- Move to the beginning/end of the flight.
- Set the playback speed.

### Point of interest controls (2)

 Add a POI ;

 Restore all original POIs from flight ;

 Export the flight report ;

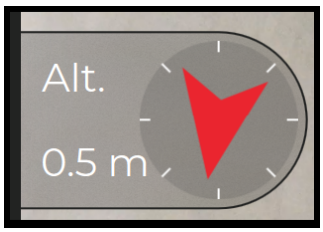
 Export points from the scene.

### Zoom Control (3)

Zoom in during playback.

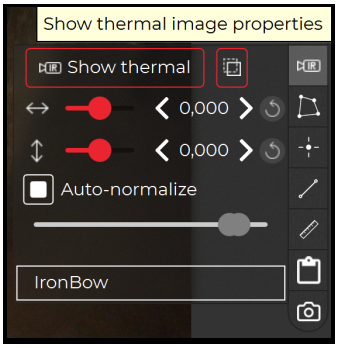

### Altitude and Orientation (4)

Displays the altitude and orientation of the drone as shown on the cockpit display in flight with up orientation corresponding to the initial orientation of the drone when powered up and can be reset in flight if needed.

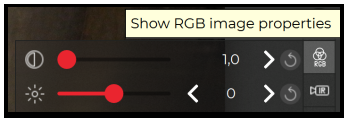



### Image settings (5)

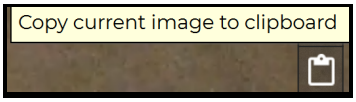
Clicking on the IR camera icon expands a menu, allowing the thermal camera video to be toggled on and off, in semitransparent mode or in full screen. Use the arrows to adjust the position of the video to correct for small differences in camera alignment. You can also choose the scale of the thermal camera (you can change the color mapping related to the thermal camera).



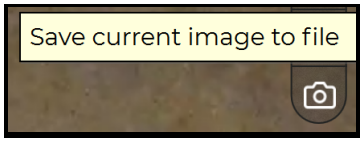

Clicking the RGB icon expands contrast and brightness settings for the video camera.




Clicking the Clipboard icon will save the current video frame to the clipboard.




Click the Camera icon to save the current video frame as a jpeg file.




All video's controls :


### Camera tilt angle and distance measurement (6)

Displays the camera pitch angle and distance to the object in view, as shown on the cockpit display during flight.


### Mapping/Annotation/Frame Export (7)

Click the bar to expand the corresponding window.

### Viewing Directions (8)

The "**Cubes**" in the top right corner can be used to select the viewing direction, and to switch between orthographic and perspective projection. We recommend you click on the "**Question mark**" tab, as this will open a 3D viewer commands description page.

**Drone's Position** (9)

The drone's current position in the video is represented in the 3D model by a white icon which indicates the position and field of view of the drone. The POI's are likewise represented by green icons.

**Axes** (10)

The data in the lower left corner indicates the x, y, and z position of the drone, as well as its absolute distance and heading with respect to its starting position or to the last "**Reference reset**" performed in a flight.

The appearance of the models, grid and flight path can be modified in the Map tree tab.

# 10 Mapping a Flight with Mapping

Before being able to map a flight, you need an Elios 2 or Elios 3 drone with a license for Mapping (previously called Datamap).

In Inspector, under the camera view : Click on the Mapping tab (1) to access the mapping feature. You can either map the entire flight (default setting), or specify a start and stop time (2). This range can also be selected on the video timeline (3).

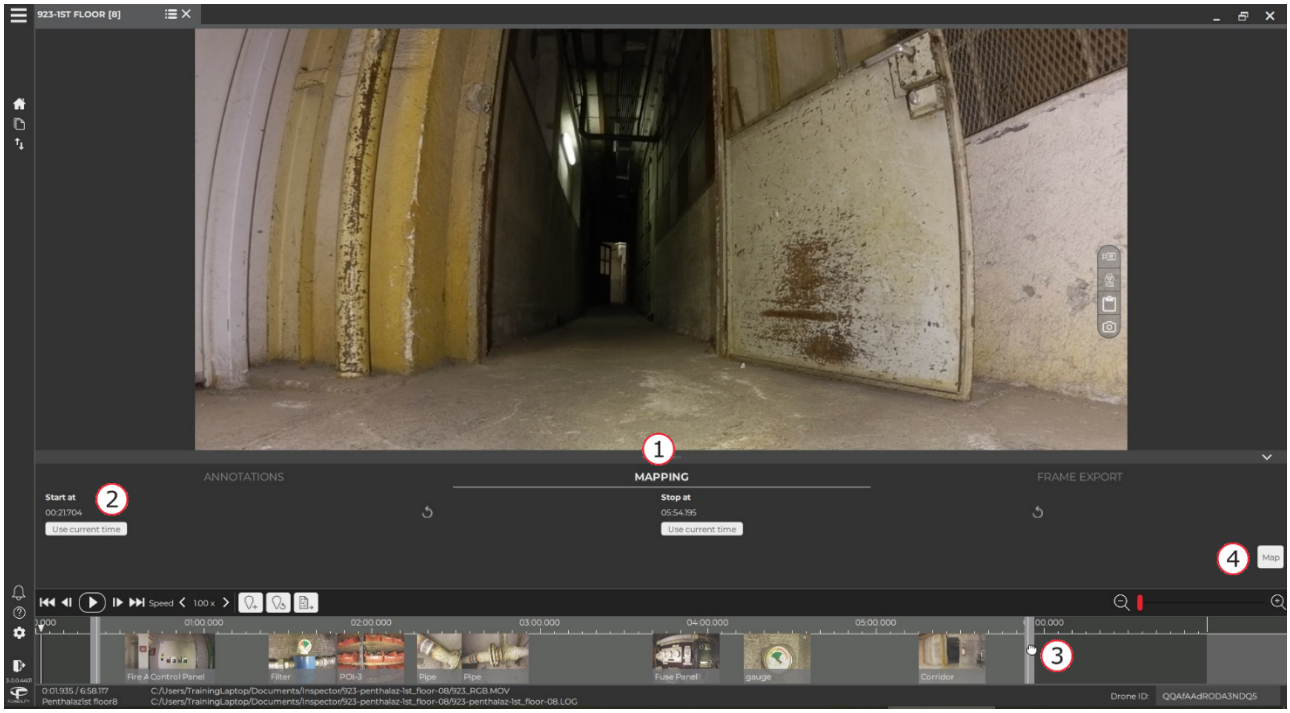



Figure 10: Inspector 4 Mapping

Click the map button (4) to start mapping. The progress will be displayed in the bottom right corner. The mapping button will be grayed out if you do not have a valid mapping license.

When the mapping process is complete, the 3D model of the flight area will appear as a new map (as a white point cloud) in the Map Tree menu (right bottom corner of the 3D viewer).

# 11 Managing Points of Interest

Points of Interest (POI) can be created during flight by pressing the POI button on the controller. They can also be created later in Inspector by clicking the button above the timeline, or right-clicking on the timeline.

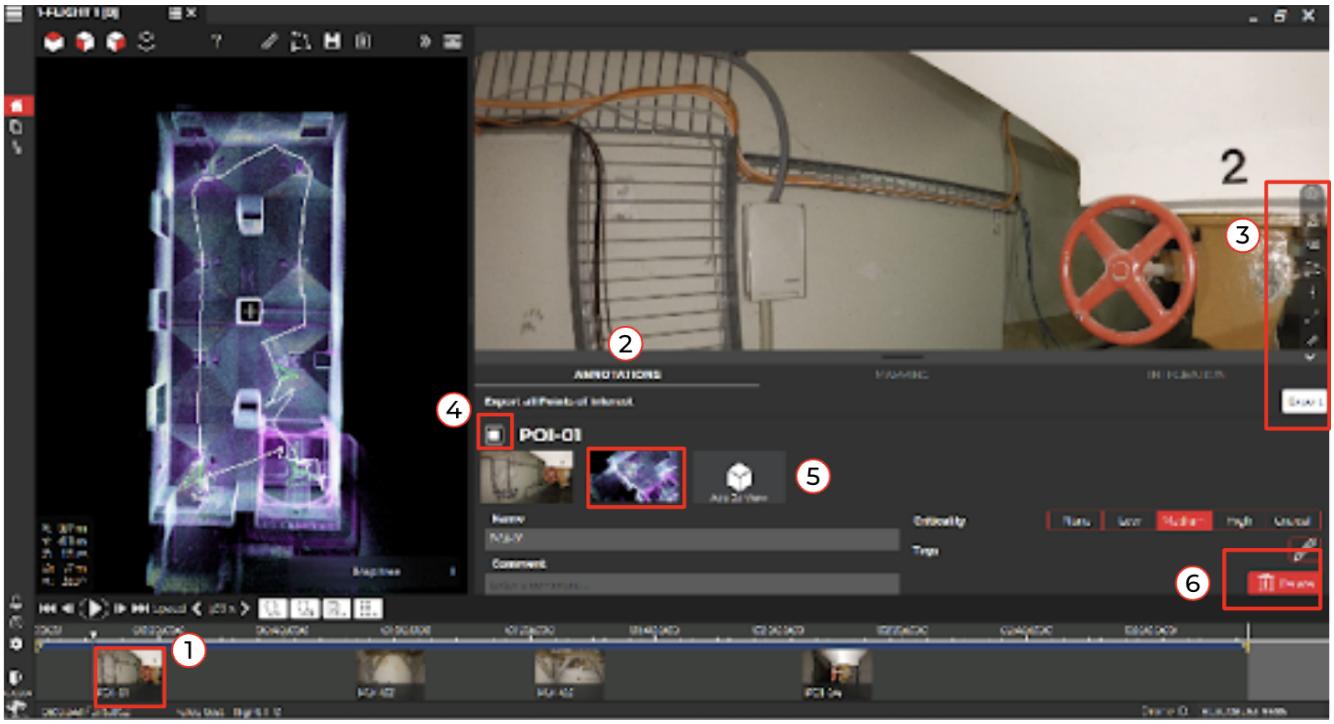



Figure 11: Inspector 4 POI's

Clicking on a POI in the video timeline (1) opens the POI edit menu. A list of POIs and their annotations can be displayed by expanding the annotations window (2).

POIs are used to highlight defects and save observations made during a flight, they can also be used to make measurements, and can be annotated with a name, comments and tags. The criticality level can also be indicated. If the POI is checked (4) then all these elements will be included in the inspection report automatically, along with an image of its location within the 3D model (5). To help localize a POI in an asset, it is possible to associate an image from the 3D viewer. For this, move the view in the 3D viewer so that the POI is well visible, and then click the "**Add 3D view**" button to take a screenshot of the 3D viewer and associate it with the POI. A POI can also be deleted in the annotations menu by clicking delete (6).

### POI TOOLBAR

The toolbar on the right hand side of the screen will have more options when you are in the POI edit menu (3). The settings changed here will only reflect the current POI, and not the entire video.

### RGB CAMERA MENU

This allows you to modify the brightness and contrast of the POI image.

### Thermal Camera menu

This allows you to show the thermal camera images over the video images.

### Undistort

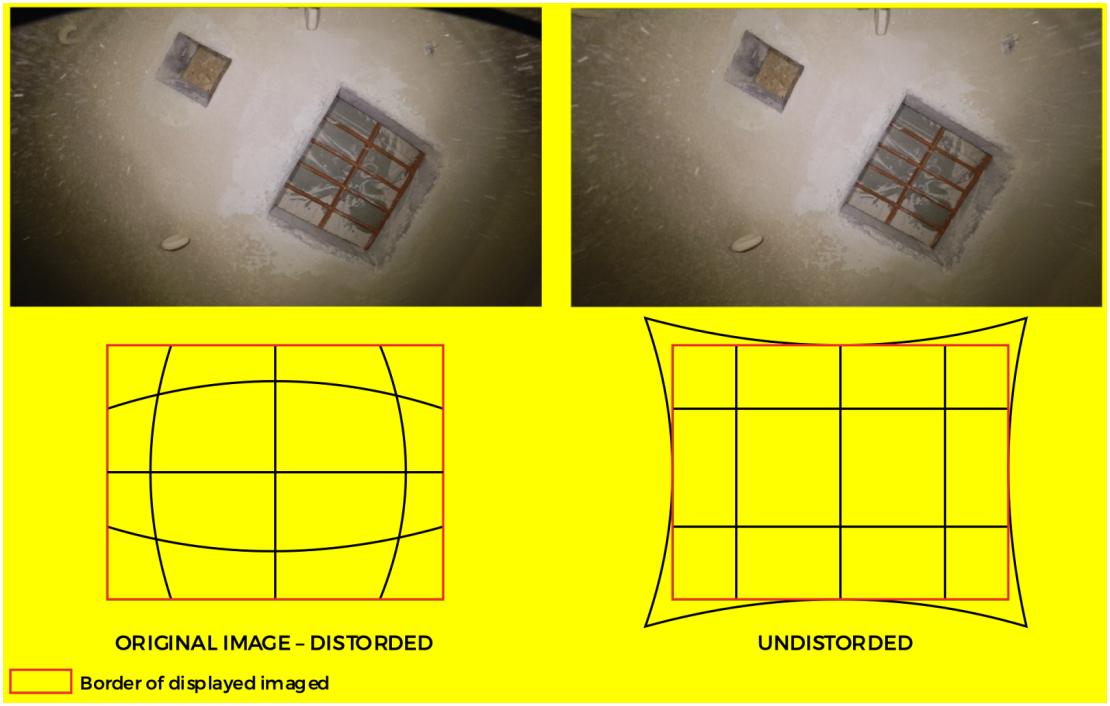



Figure 11.2: Inspector 4 Undistort

Due to the fish-eye effect of the optical camera, the image is distorted. Meaning the straight lines appear to be bent in the image. In a POI the image can be undistorted or flattened. As the transformation stretches the image, the resulting frame displayed is slightly cropped. This feature works best on images taken perpendicularly to a flat surface.

### Add Placemark

Specific areas on the image can be highlighted with placemarks. Click and drag to move an existing placemark, double click to edit the name or delete it.

### Add Line

Specific areas on the image can be highlighted with lines. Click and drag to move an existing line, double click to edit the name or delete it.

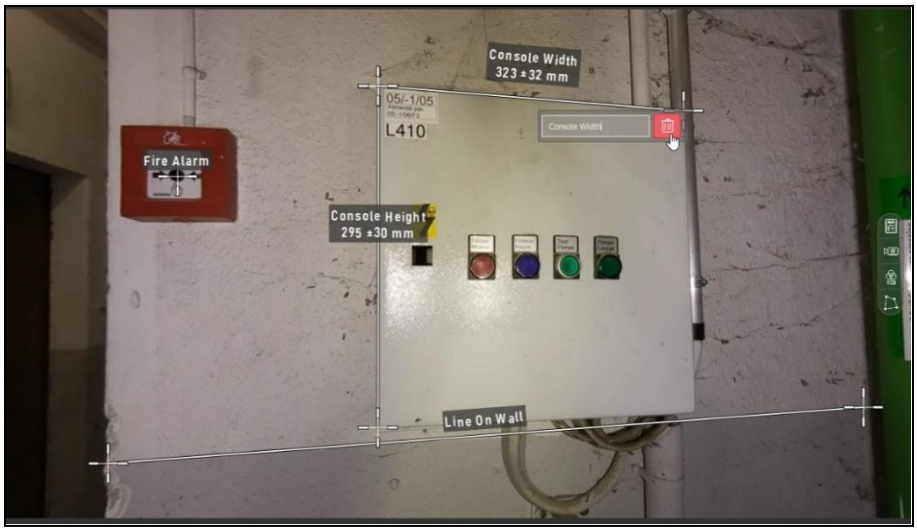



Figure 11.3: Inspector 4 Add Line

## Add Measurement

This feature uses information from the distance measurement sensor on the drone to make measurements using pixel calibration and triangulation. The measurement needs to be made on a flat surface perpendicular to the camera's optical axis. The accuracy of the measurement is ±10% of the measured length with a maximum of ±5 mm accuracy. The 2D measurement result is displayed on the frame with its estimated accuracy. The button is grayed out in case of unreliable camera distance data.

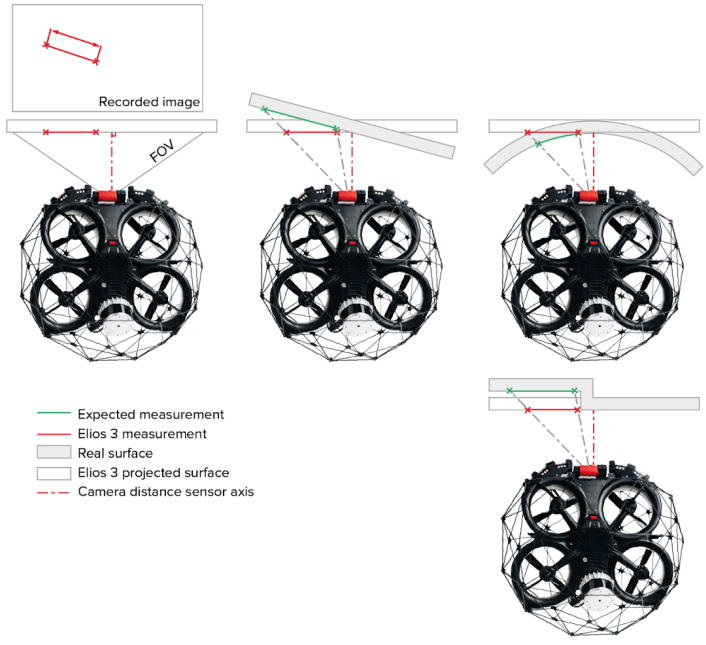



Figure 11.4 Inspector 4 Add Measurement

**THE USER MUST ASSESS IF THE MEASUREMENT MAKES SENSE BY UNDERSTANDING ITS LIMITATIONS. FLYABILITY DOES NOT GUARANTEE THE ACCURACY OF MEASUREMENTS.**

# 12 Managing the 3D Live Map

### Helper panel for navigation shortcuts

This button displays the mouse and keyboard shortcuts for moving the 3D camera around.

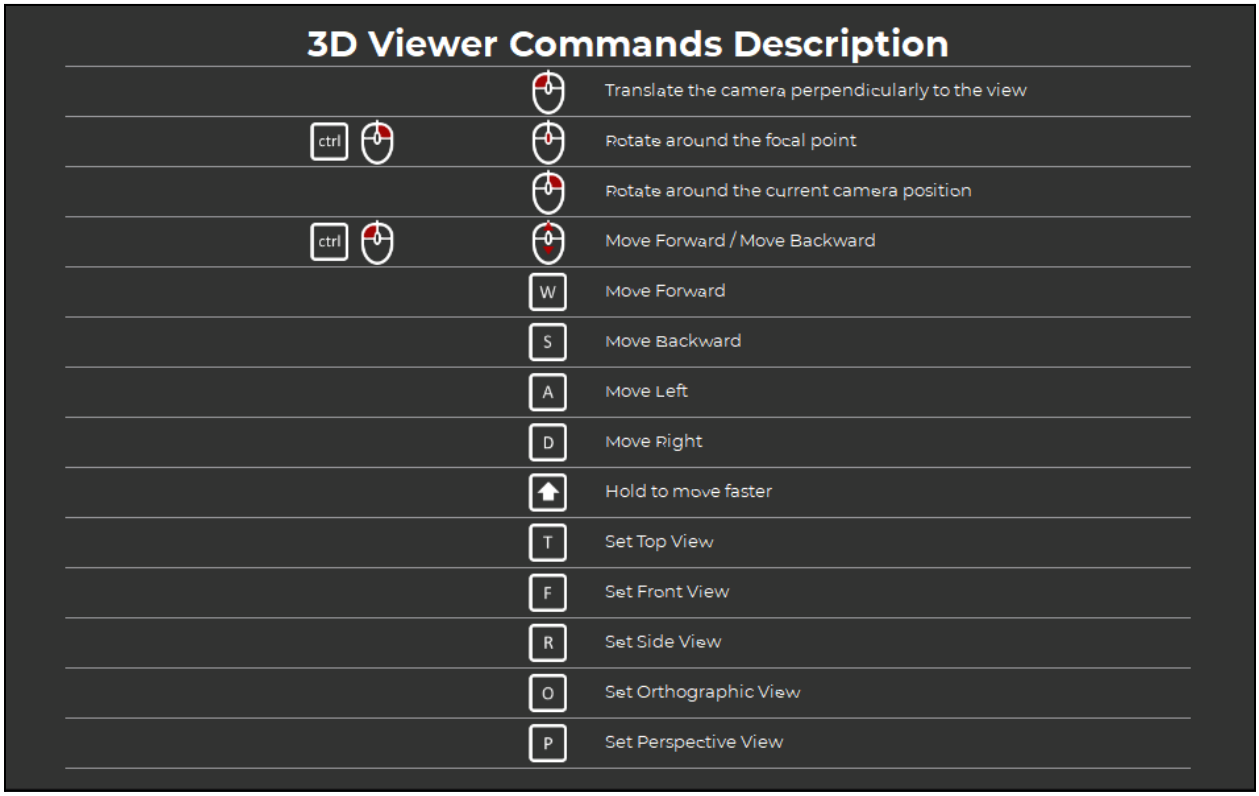



Figure 12: Helper Panel

### Measurement tools

These options allow the user to measure distances between two points, or surfaces between multiple planar points. Different measurements can be visible at the same time by using the save button. The easiest way to accurately select surfaces is by using the Circle or Contour point shading modes, as they result in points that are large enough to be selected directly.


Figure 12.2: Measurement Tools

The different control buttons for this feature are:

- Distance measurement:
  This activates the distance measurement mode, in which every two clicks will show the measured distance between two points of the scene.
- Area measurement:
  This activates the area measurement mode, in which a number of consecutive clicks will select an area and display both the distances between points, and the surface value, as long as the points are approximately located on a flat plane.
- Save measurement:
  Saves the measurement being currently taken, until the flight is closed.
- Discard measurement:
  Discards the measurement being currently taken, or the last saved measurement.

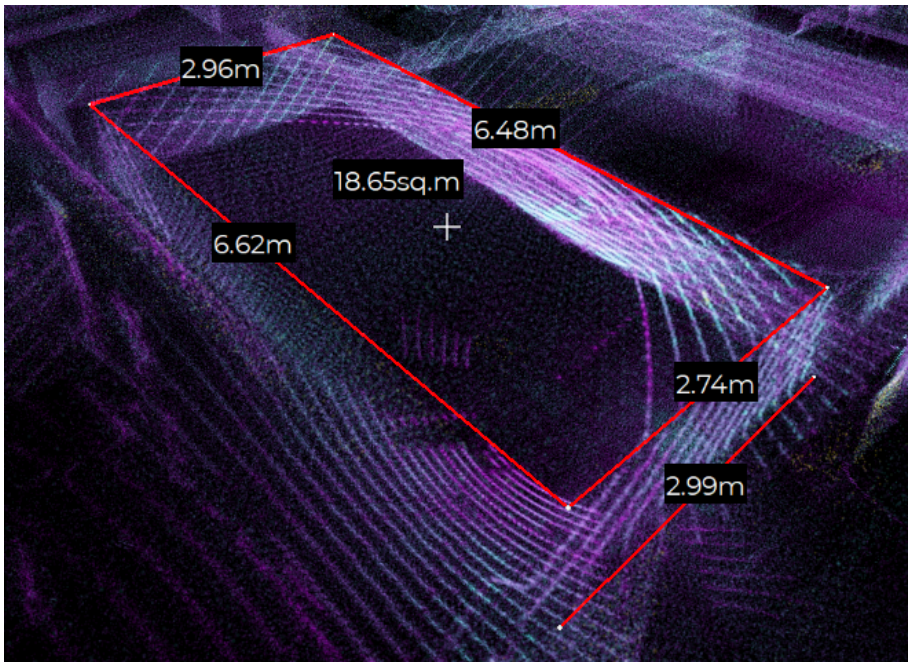



Figure 12.3: Measurement Tools - Part 2

### Camera locking

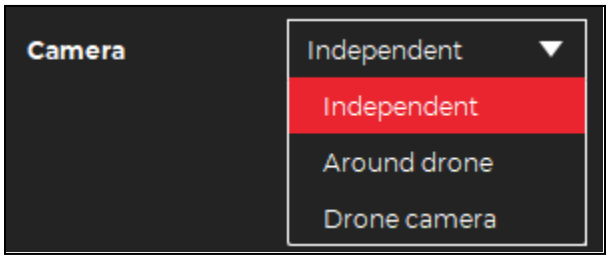



Figure 12.4: Camera Locking

This setting controls how the camera behaves and has the following options:

- Independent:
  The camera can move anywhere and has no restrictions.
- Around drone:
  The camera can rotate, but will always be locked towards the drone. This option is ideal to focus on the drone's current position without having to search for it.
- Drone camera:
  The camera is in first-person view (FPV), and is locked in the position of the actual camera of the drone. The pitch of the camera during the actual flight is also applied to the user camera.

### POINT SHADING

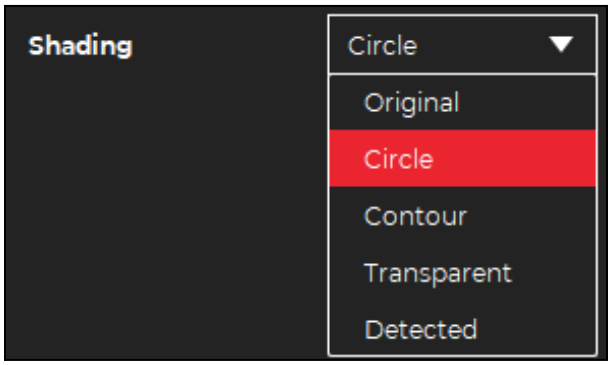



Figure 12.5: Point shading

This setting controls how the points are rendered and has the following options:

- Original:
  Simple points with a fixed size in pixels. In this mode, structures like walls or floors look more see-through the closer the user camera gets.
- Circle:
  Circular points with a physical size. As a result, walls, floors and ceilings look more filled.
- Contour:
  Same as Circle, but with the contours of points highlighted in dark to accentuate depth.
- Transparent:
  All points are additively transparent, which can be useful to show multiple layers behind each other. If the intensity of points in a flight is too low or high, the user can adjust the point sizes or opacity.
- Detected:
  Same as the Transparent mode, but each point is highlighted when detected by the drone's LiDAR. This can give a good overview of the LiDAR's coverage during flight.

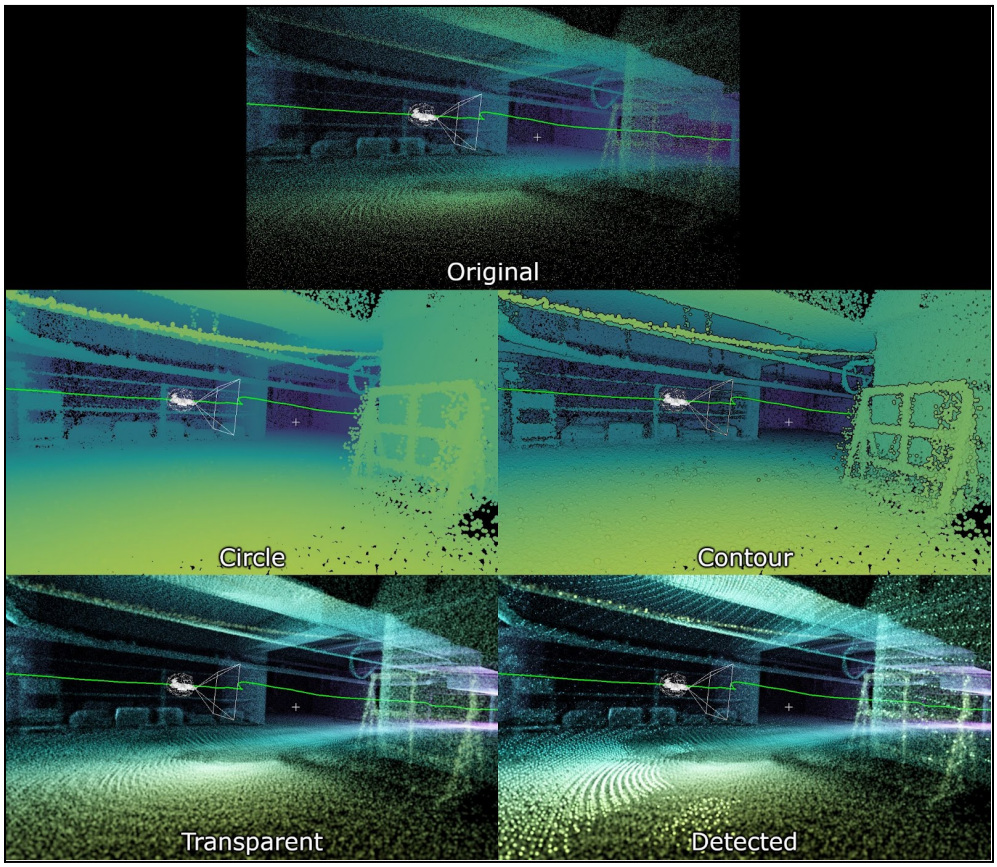



Figure 12.6: Point shading - Part 2

### Point colors

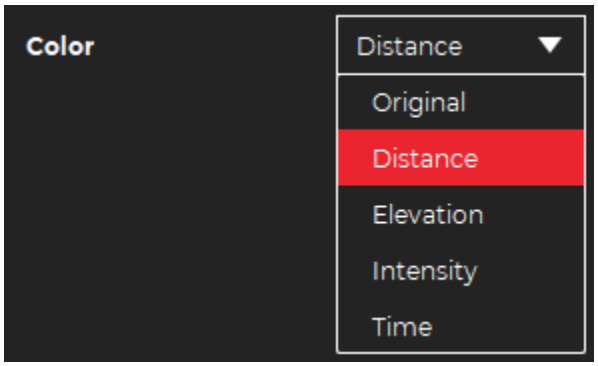



Figure 12.6: Point Colors

This setting controls the color of points and has the following options:

- Original:
  The original color of points as stored in the dataset. This usually corresponds to the intensity colors as displayed in previous versions of Inspector.
- Distance:
  The color of points changes depending on their distance from the user camera. This can be a useful depth indicator in a scene.
- Elevation:
  Point colors change depending on elevation. In case of a large structure (>6m), the elevation colormap is stretched from the lowest to the highest point, whereas in a smaller structure the range of the colormap is always a fixed distance (6m).
- Intensity:
  The intensity of points corresponds to the material reflectivity reported by the LiDAR.
- Time:
  The color is determined by the point detection time during the flight. This provides a useful indication on the global path that the drone has followed within the asset.

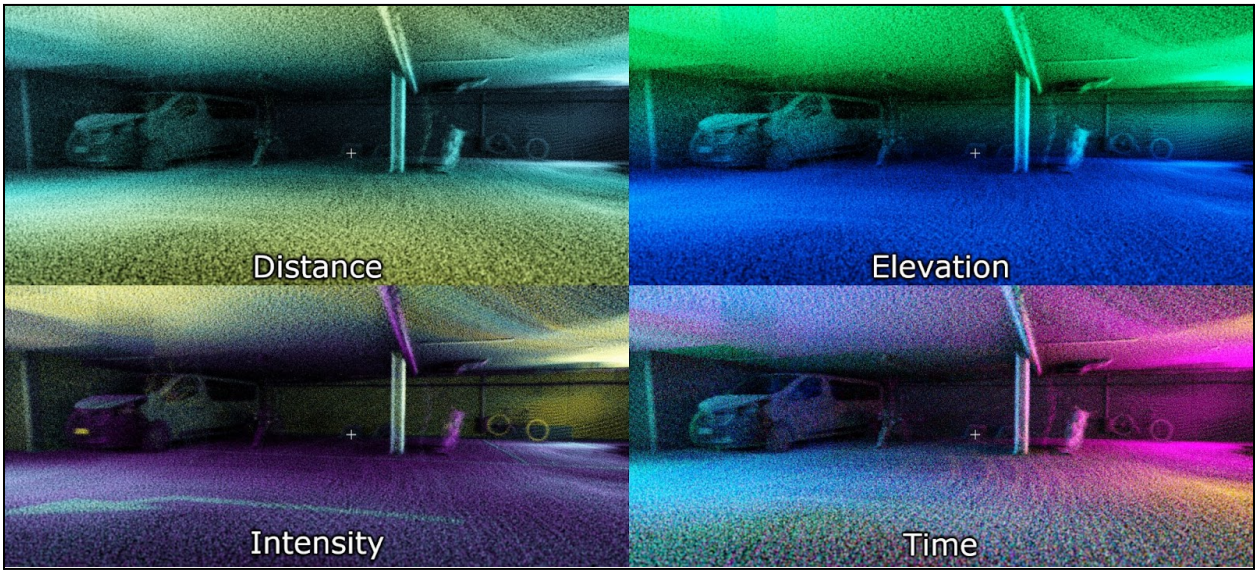



Figure 12.7: Point Colors - Part 2

### Point slicing


Figure 12.8: Point Slicing

The map slicing slider cuts the point-cloud at specified minimal and maximal boundaries. This can be used to only visualize certain floors of buildings, or hide the ceiling to get a better view inside. The slider has non-linear scale to provide better resolution in denser areas, and also to avoid wasting input distance for outlier points.

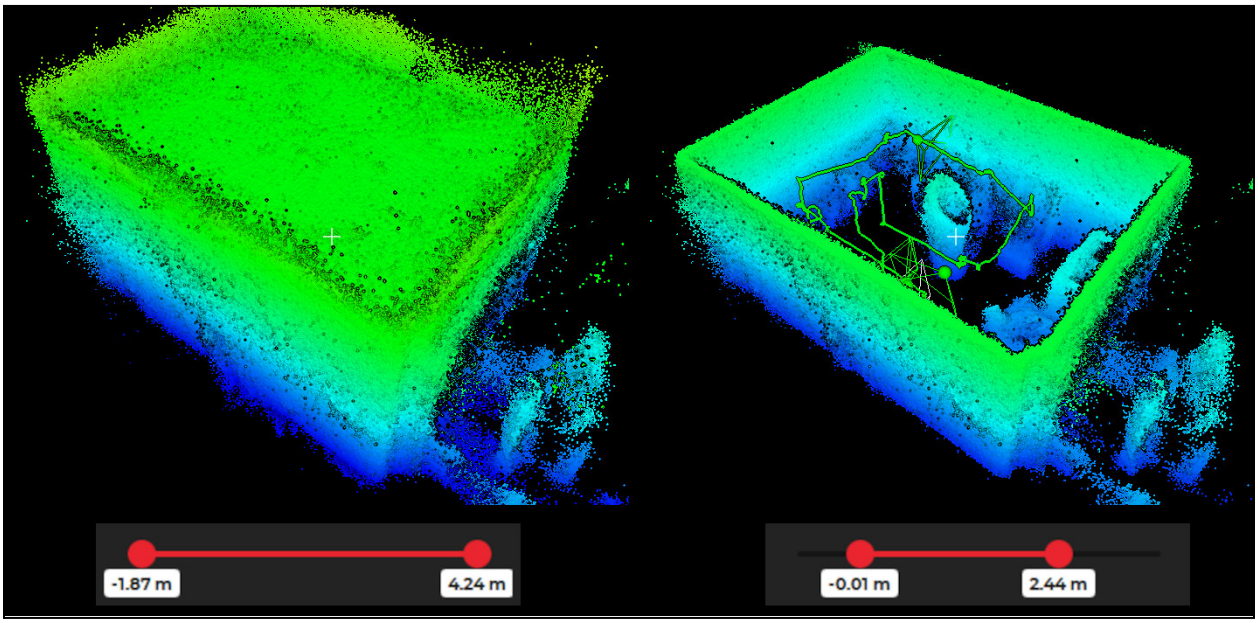



Figure 12.9: Point Slicing - Part 2

### Point size


Figure 12.10: Point Size

This slider can be used to modify the sizes of points relative to the default size. In Circle or Contour mode, points of larger sizes are better at filling space and give a more solid look to various structures, but are less accurate. In transparent mode, changing the size of points has a direct impact on the intensity of the point-cloud.

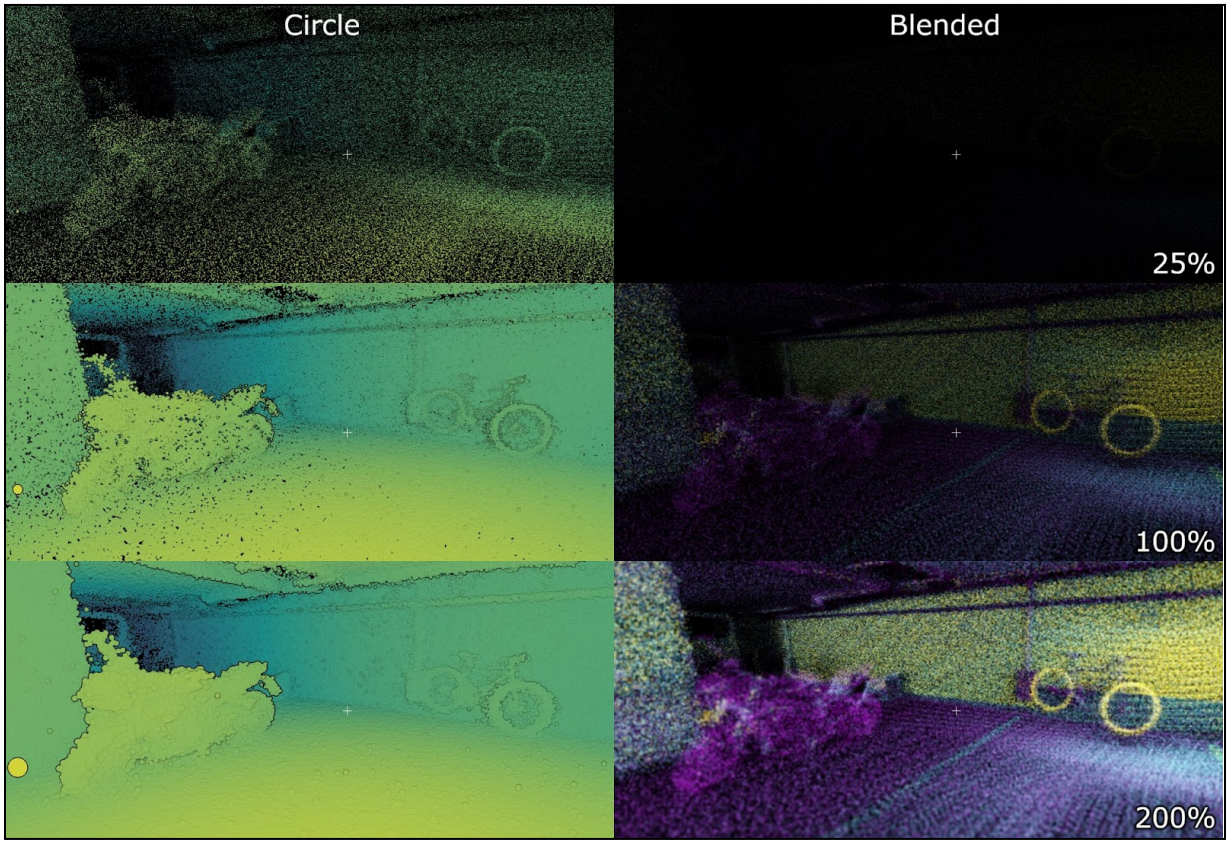



Figure 12.11: Point Size - Part 2

### Point opacity


Figure 12.12: Point Opacity

This slider changes the transparency of point-clouds. This can be used to see any objects (ex: drone, trajectory, points of interest) through the point-cloud.

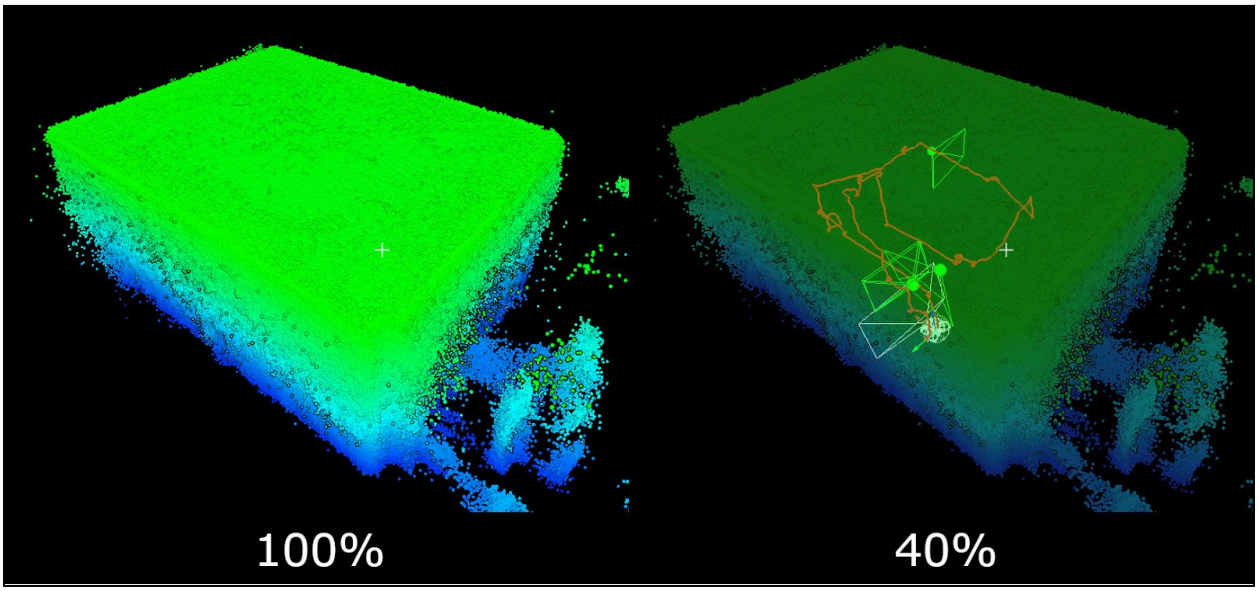



Figure 12.13: Point Opacity - Part 2

### Render quality

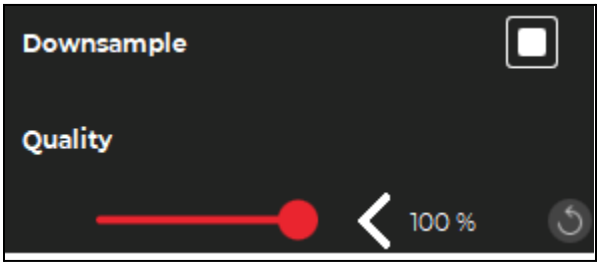



Figure 12.14: Render Quality

By default, Inspector is optimized to only show regions of the point-cloud with high density when close to the user's camera, while more distant regions are down-sampled to lower densities. This is mostly hidden from the user, and can only be seen when moving quickly through the dataset. The main goal of doing this is to be able to render the scene efficiently even with large and dense point-clouds. In the case that these transitions become too apparent for certain purposes (ex: recording a video), the Downsample checkbox can be unchecked, in which case all points of the dataset will be loaded at once. On the other hand, if the rendering is still laggy on lower-end machines, the quality of the visualization can be lowered to offer better performance.

### Objects in the scene


Figure 12.15: Objects in the scene

This panel can be used to show and hide different objects in the scene. This includes a flat grid structure of selectable size, as well as all point-cloud maps and trajectories that are currently available.

# 13 Flying tips for Mapping

## 13.1 Takeoff and landing - Loop closure

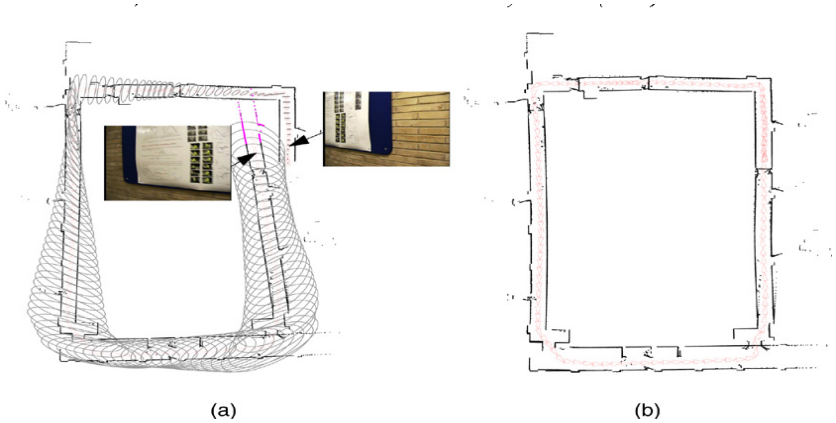



Figure 13: Takeoff & landing

### Mapping

Both Elios 2 and Elios 3 must land close to the take-off position. While landing, the drone should face the same direction as during take-off. The software should recognize the similarity in the video images and snap closed the flight path, reducing position errors that may have accumulated during the flight.

Try to close the loop in several places during the flight by retracing the same path, while looking in the same direction. For example, in tunnels this can be used to match outbound and inbound trajectories, reducing the probability of them appearing as double features in your model. You can also do a 360 degree turn before and after entering a manhole to reduce the chances of losing track while entering or exiting.

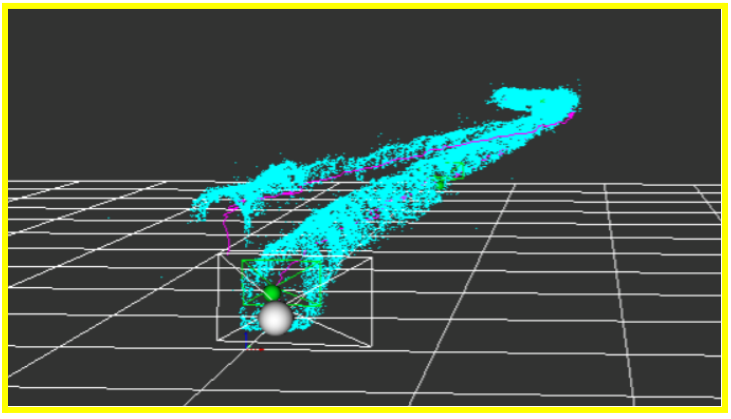


Figure 13.2: Flight Path

The image above shows a model with a ‘double feature’ error caused by improper loop closure.

## 13.2 Image Quality - Data Map Mapping

The software tracks visual features on the video images to estimate the velocity and direction of travel. It is important that the image is properly lit at all times. Also, it is easier to track features close to the drone than far away.

## 13.3 Image Quality

For better results, keep the LiDAR glass clean of dust as much as possible, as well as the 3 VIO cameras near the main video camera.

## 13.4 Cage

### Elios 3

The cage won't block the field of view of the camera.

### Elios 2

When looking too far up or down, the cage will block part of the field of view of the camera. This obstruction reduces the capability of the software to track visual features. Prefer flying with the "Cage free view" enabled or in "Photogrammetry mode". In no case should the camera be tilted below -30°.

## 13.5 Collisions

Collisions should be avoided as much as possible. Strong collisions will simultaneously saturate the IMU and create motion blur on the images.

## 13.6 Accuracy

The Accuracy of the model depends on the flying style, flight path and the environment. Typically, the accuracy is within 10% of the length of the flight path, but it can change from one flight to the next depending on the flight path, flight speed and dust conditions.

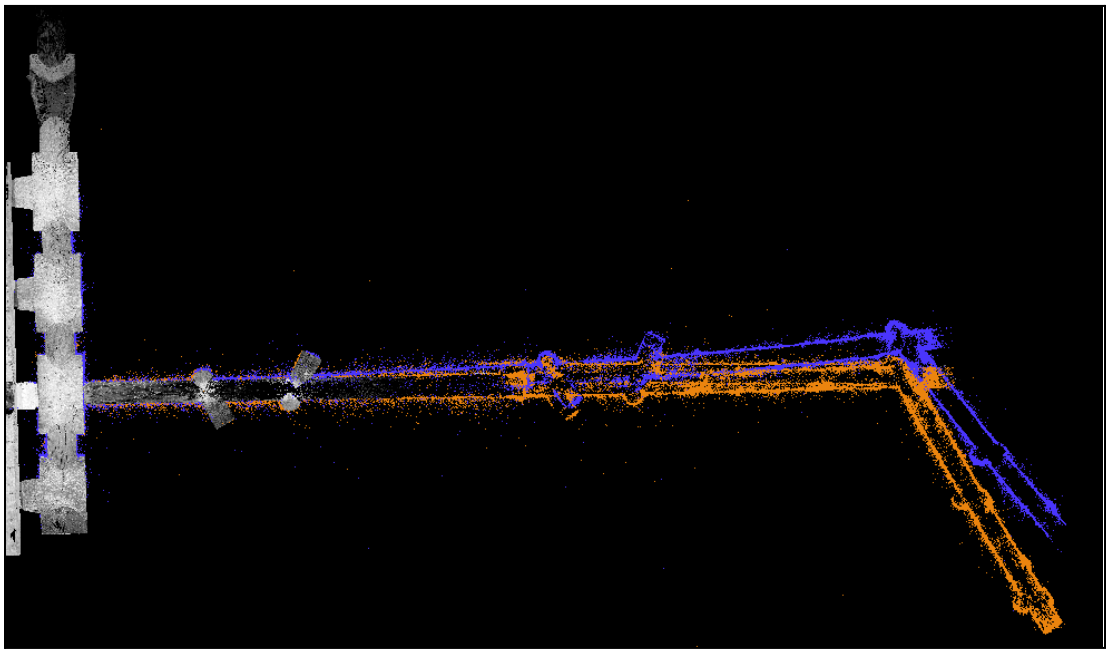


Figure 13.3: Accuracy

The image above compares the point clouds created by Inspector 4 from two separate flights (orange and blue) compared to measurements of a handheld SLAM LiDAR (white). It shows how errors can accumulate, especially in long linear environments.

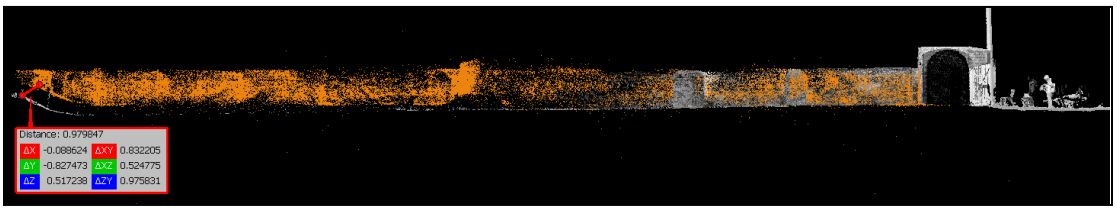



Figure 13.4: Accuracy - Part 2

In this side view the LiDAR point cloud seems to slightly pitch down, while the VIO point cloud does not. At the end of the tunnel (54m from take-off location) the error is about 1m or 2%. This error is mainly on the vertical axis

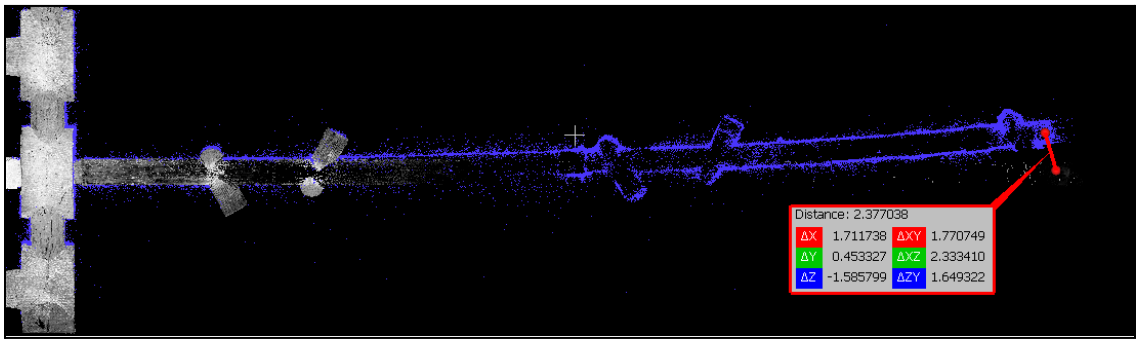



Figure 13.5: Accuracy - Part 3

This top view of the blue point cloud shows the extent of the deformation in the model. The error is 2.38m (4.4% of the gallery length).

To compare and evaluate the global accuracy and georeferenced accuracy of the Elios 3's point clouds, identical captures were processed using both FlyAware and GeoSLAM Connect. GeoSLAM 3D mapping experts and the Flyability product team carried out tests within an industrial factory. Here are its results:

### FlyAware ™ SLAM engine

For the FlyAware™ SLAM engine, the drone uses both the LiDAR and VIO (visual inertial odometry) to create the map. As it does not have a "loop closure" mechanism, it is better to not come back to the start location as it is not possible to realign the map and could result in a 2nd model slightly shifted. For those reasons, it is always better to land at the same position and orientation as the take off for all mapping methods.

### Elios 3 - GeoSLAM

On average, processing using GeoSLAM Connect improves global accuracy by 5.2 times compared to processing using FlyAware alone. By utilizing GeoSLAM Connect, the Elios 3 is able to meet survey requirements with minimal system accuracy of 35 mm (1.38 inches). Although the Live Model provides users with a real-time visualization of the environment for navigation, route planning, and scan coverage verification, the average accuracy of 182 mm (7.2 inches) does not make it fit for these applications.

To learn more about the comparison between the both, refer to this article.

# 14 Exporting data

## 14.1 Export Inspection Report

Inspector can generate a Microsoft Word document or a PDF with detailed pages for each point of interest.

A report includes the following information:

- Cover page with flight name and date.
- One page per point of interest with images and properties of that point of interest, including measurements, lines or markers.

To export an inspection report, click on the Export Flight Report button  just above the timeline.

## 14.2 Export multiple frames for photogrammetry

Expand the frame export menu to export frames at a constant frame rate over a specific range of the video. These frames can be used in photogrammetry software to reconstruct 3D models of the flight environment. Inspector 4 is optimized for use with Pix4Dmapper, but any other photogrammetry software can be used as long as it can handle image files without GEOtags. The following settings are available:

**Start/stop time (1)**
This specifies the range over which the frames are exported, you can enter this manually or select this range in the timeline by dragging the gray markers.

**Frequency (2)**
This parameter determines the rate at which images are exported in frames per second (FPS). Higher rates mean that more frames in total will be exported.

**Export Folder (3)**
The folder where the frames will be saved, along with any processing templates.

**Export Pix4D Project (4)**
This will automatically create a Pix4D project with the exported frames.

**Processing template (5)**
Flyability created two processing templates which are optimized for Elios 3 footage of indoor environments. The Fast template yields faster results but requires more overlap between images. The Robust template is computationally slower but will typically match more images from a given dataset. Check the Pix4D support site for more information on processing templates.

**Export project templates (6)**
This will export both Processing templates in .tmpl format. These can be manually imported into Pix4Dmapper.

**Export Frames (7)**
Press this to start exporting he frames, process templates, and Pix4D project into the target folder.

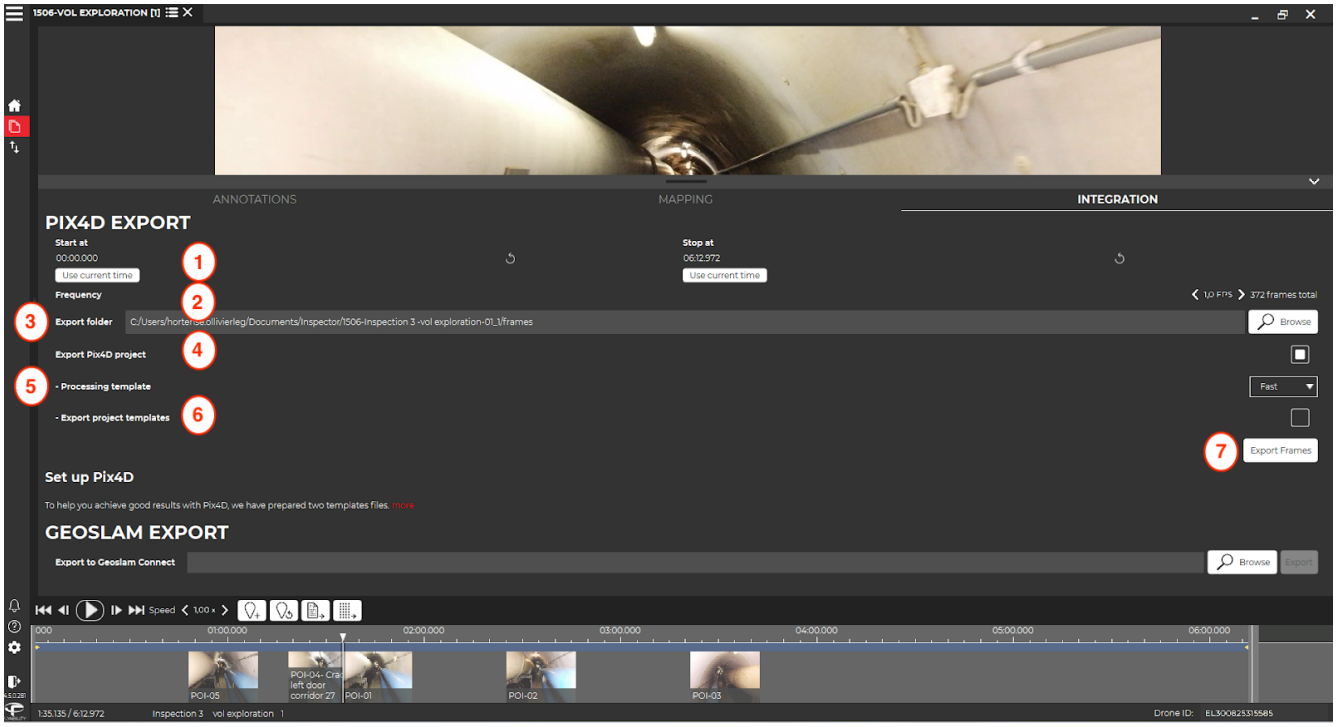



Figure 14: Inspector Export Frame

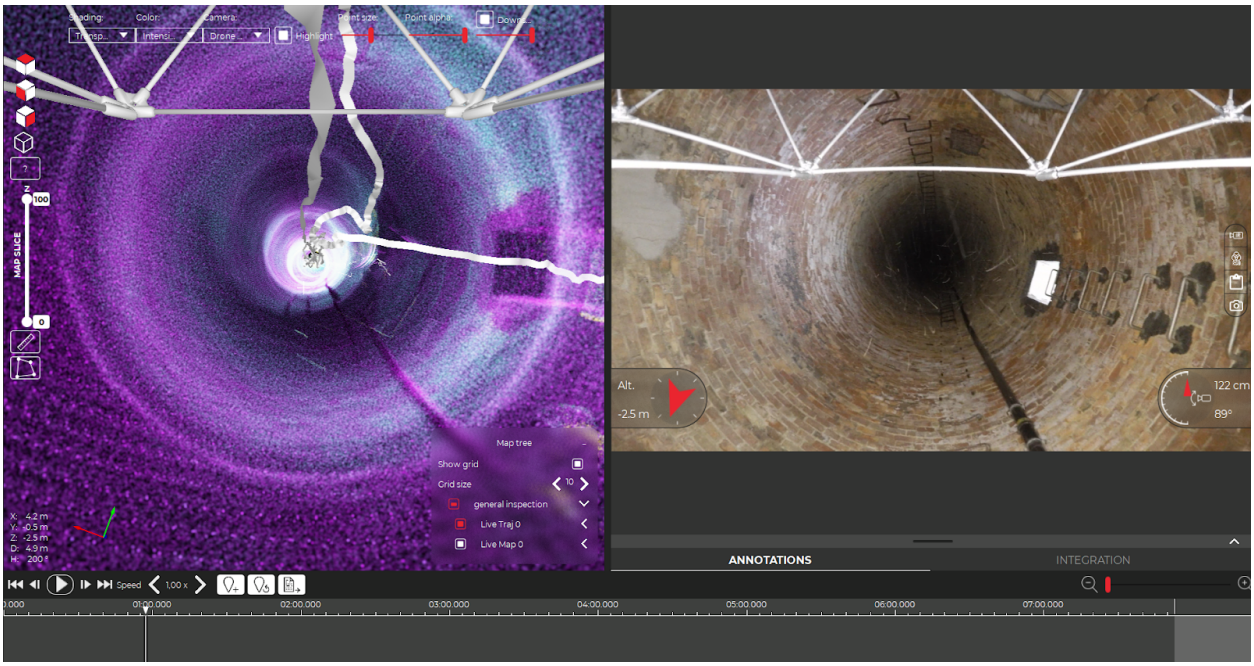
# 14.3 Export multiple frames for GeoSLAM

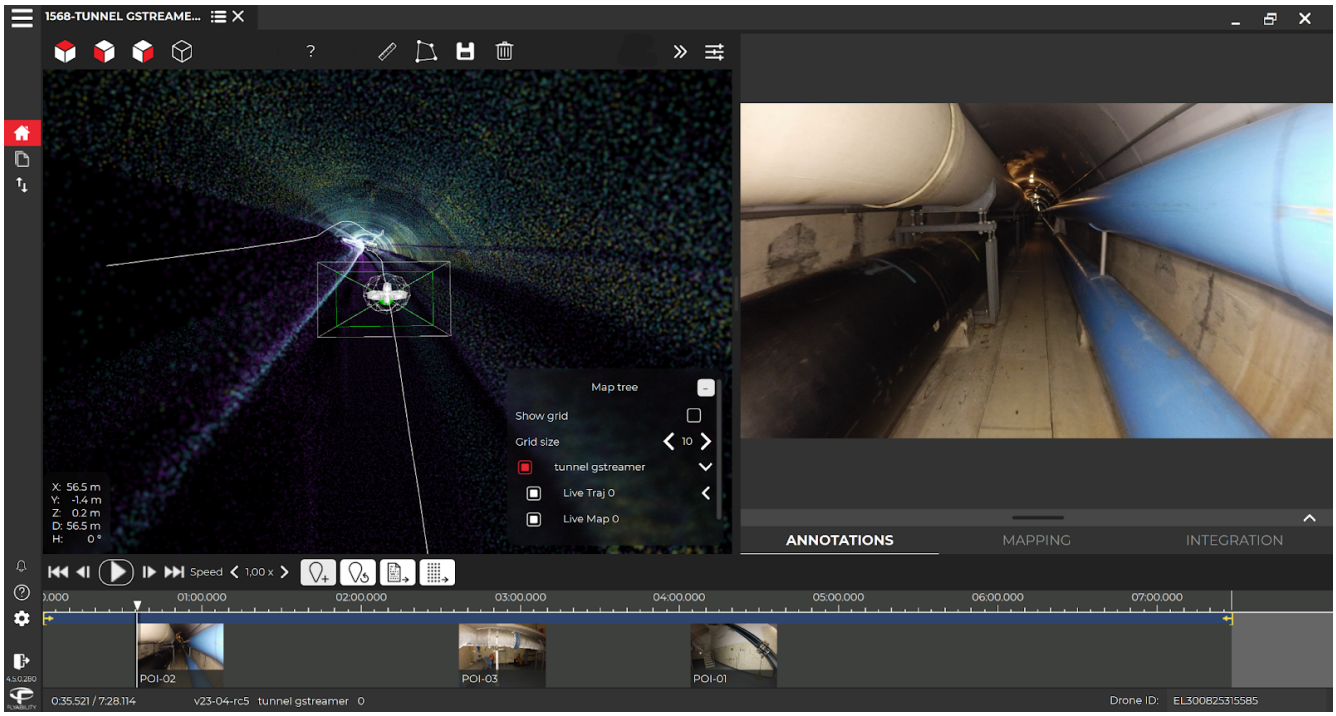
### ELIOS 3

Once we are done importing the flight, a BAG file will be created in the flight folder. Through the "**Export to GeoSLAM**" you will be able to take the BAG file, and copy it into the selected destination folder. Then it is up to you to load the file into GeoSLAM itself.

# Inspector has a new point cloud visualizer

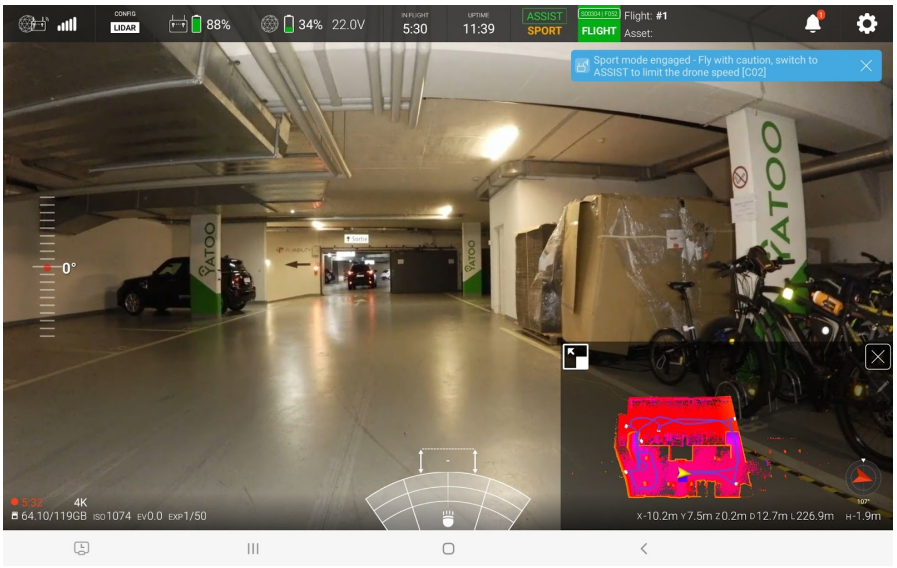
The new point cloud visualizer is a lot more versatile and feature rich. You can colorize the points in the pointscloud according to height, intensity, distance or time. The drone model is visualized for a better sense of scale and shading was added as well to improve the understanding of the scene.

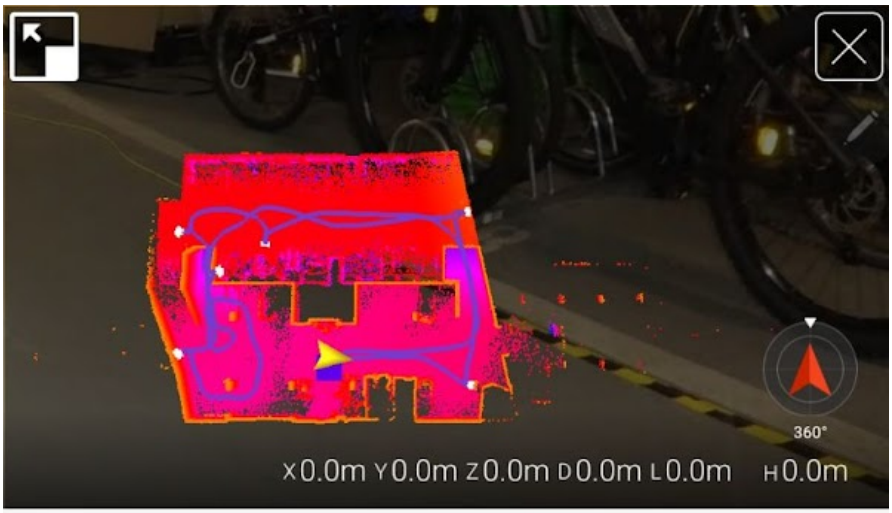





# User settable references available in 3D map

In both Cockpit and Inspector the position of the drone in x,y,z coordinates relative to the take-off location are now shown. This is in addition to the direct line of sight distance between the drone and take-off location and the total flight path length of the drone which were already shown in the previous release.. All these values can be reset by simply clicking on them at any point throughout the flight to set a new reference point. This feature is only available if the LiDAR payload is mounted. The values shown are only correct as long as the pointcloud remains coherent and does not drift or diverge.


CONFIG
LIDAR
88%
34% 22.0V
IN FLIGHT
5:30
UPTIME
11:39
ASSIST
SPORT
FLIGHT
Flight: #1
Asset:
Sport mode engaged - Fly with caution, switch to ASSIST to limit the drone speed [C02]
0°
4K
64.10/119GB ISO 1074 EV 0.0 EXP 1/50
X-10.2m Y 7.5m Z 0.2m D 12.7m L 226.9m H -1.9m


360°
X 0.0m Y 0.0m Z 0.0m D 0.0m L 0.0m H 0.0m

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