PHOENIX
LiDAR SYSTEMS

SPATIALEXPLORER

SpatialExplorer

SpatialExplorer can monitor and control the LiDAR mapping systems offered by Phoenix LiDAR Systems **in real-time** (see what you are scanning while you are scanning it) **and replay and visualize LiDAR mapping missions in post**.

SpatialExplorer enables **in-field quality control** and **analysis** and ensures obtaining a quality solution throughout the acquisition process. It enables the user to calibrate camera settings without needing to rely on sending in units for "vendor-only-calibration" or adjustments. It is an exceptional tool for training with how-to-fly visualizations. Furthermore, it allows for the creation of high quality marketing imagery of acquired scans.

SpatialExplorer Features

- Real-time, 3D, georeferenced point cloud visualization
- Real-time RGB colorization
- Real-time measurements and profile analysis
- Monitor a variety of LiDAR system parameters
- Real-time photo preview – with specific camera upgrades only
- Included flight-plan module
- Connect to a 3G/4G enabled Rover from anywhere and with as many Spatial Explorer sessions

Due to the heavy graphics intensity required to display LiDAR data, SpatialExplorer requires at minimum an NVIDIA GeForce GTX 850M with 2GB VRAM and a recent OpenGL driver installed.

Post-processing Features

- Fusing raw data from rover into .las or .laz point clouds.
- Creating accurate, georeferenced, colorized point clouds from real-time or post-processed trajectories.
- Intuitive manual extraction of flightlines, or fully automated processing.
- Exporting point clouds to more than 4000 coordinate systems.

SpatialExplorer

SpatialExplorer is designed to georeference data acquired by our LiDAR mapping systems into common mapping formats such as LAS/LAZ .

The to transform LiDAR/image sensor data into a georeferenced point cloud.

- Offers support for GNSS and INS navigation systems.
- Supports multiple remote sensing equipment configurations.

SpatialExplorer

Cuts down the wait time on extensive photogrammetry applications by creating colorized point clouds in about twice the time of the acquisition.

- Visualize and determine the quality of the navigation system trajectory data.
- Make post-processing adjustments to a subset of sensor settings and features.
- Apply quality control standards and use them to limit what data is considered in the final export and fusing process.
- Determine the final export settings for your data.

SpatialExplorer User Interface

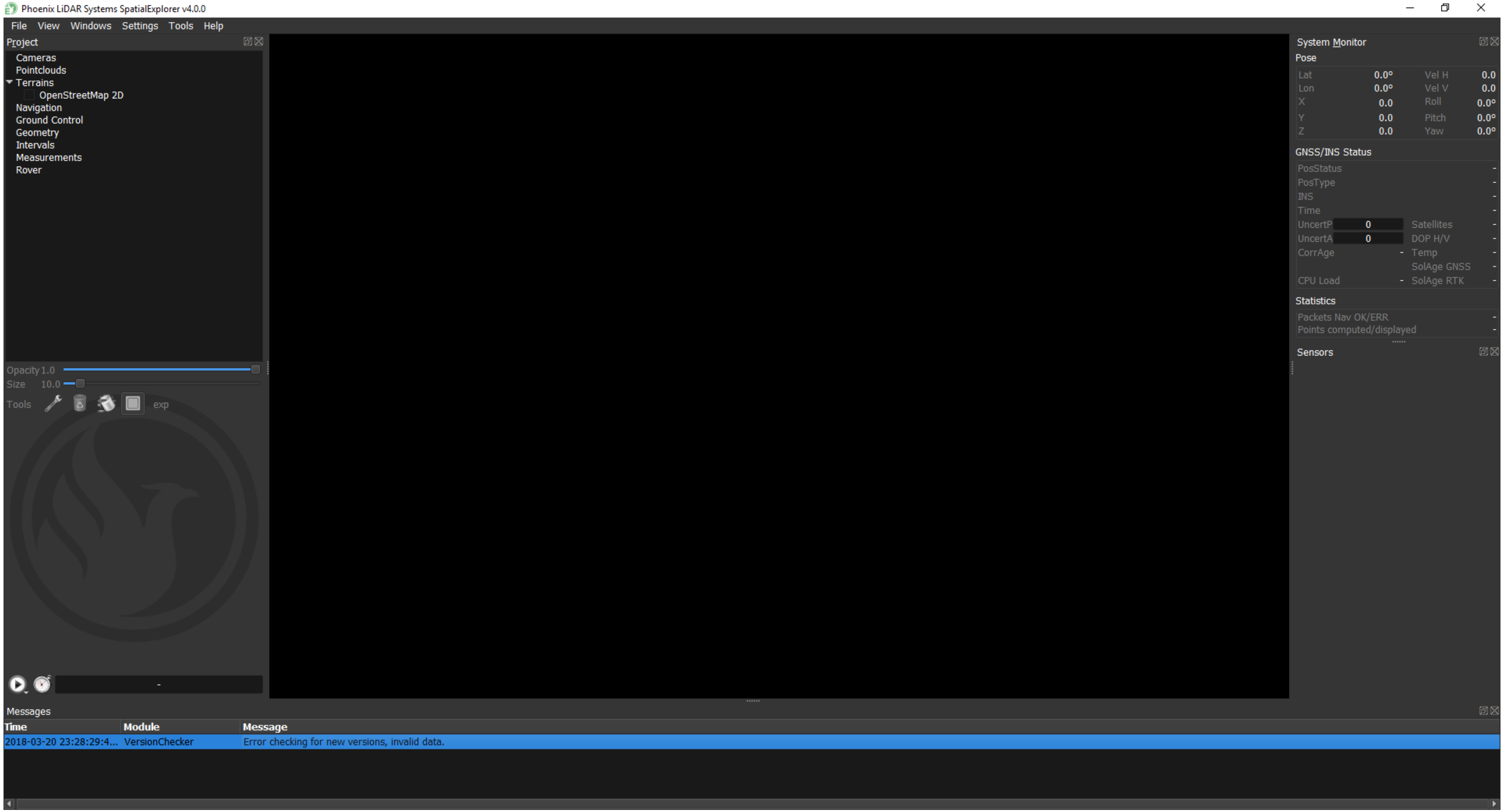
SpatialExplorer can be used in offline mode or can be connected to a rover for real-time scanning.

The user interface in SpatialExplorer is divided into three sections: **left, right, and bottom**.

The middle section is the main display area where the LiDAR point-cloud data is visually generated.

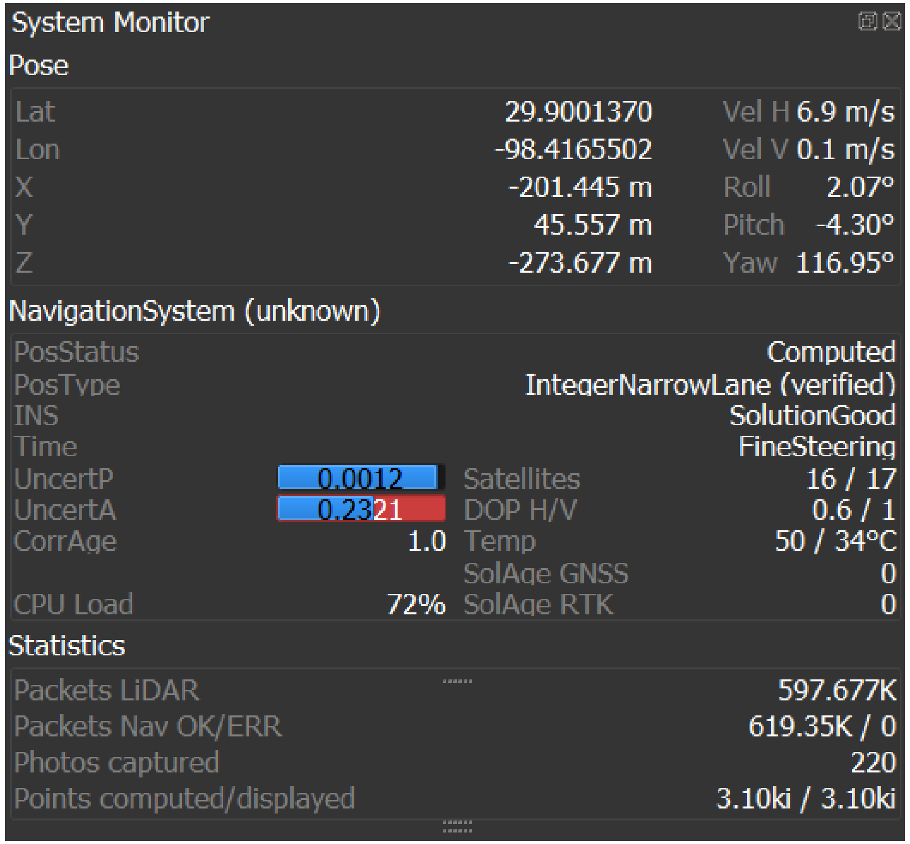
The left/right sections display numerous system parameters and options for configuring the main display area.

The bottom section is a log window where messages/errors are presented to the user. Important messages and errors will be printed with a yellow or red background color, respectively.


Phoenix LiDAR Systems SpatialExplorer v4.0.0
File View Windows Settings Tools Help
Project
Cameras
Pointclouds
Terrains
OpenStreetMap 2D
Navigation
Ground Control
Geometry
Intervals
Measurements
Rover
Opacity 1.0
Size 10.0
Tools
exp
System Monitor
Pose
Lat 0.0°
Lon 0.0°
X 0.0
Y 0.0
Z 0.0
Vel H 0.0
Vel V 0.0
Roll 0.0°
Pitch 0.0°
Yaw 0.0°
GNSS/INS Status
PosStatus
PosType
INS
Time
UncertP 0
UncertA 0
CorrAge
CPU Load
Satellites
DOP H/V
Temp
SolAge GNSS
SolAge RTK
Statistics
Packets Nav OK/ERR
Points computed/displayed
Sensors
Messages
Time
Module
Message
2018-03-20 23:28:29:4...
VersionChecker
Error checking for new versions, invalid data.

System Monitor

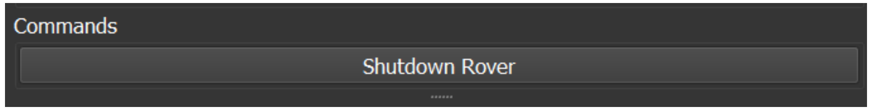
The **System Monitor** window displays various system parameters relating to the rover and sensors. The types of parameters monitored are **Pose** (latitude/longitude, roll/pitch/yaw, etc.), **GNSS/INS** (PosStatus, UncertaintyP, CorrAge, etc.), and **Statistics** (Packets, Points, etc.).

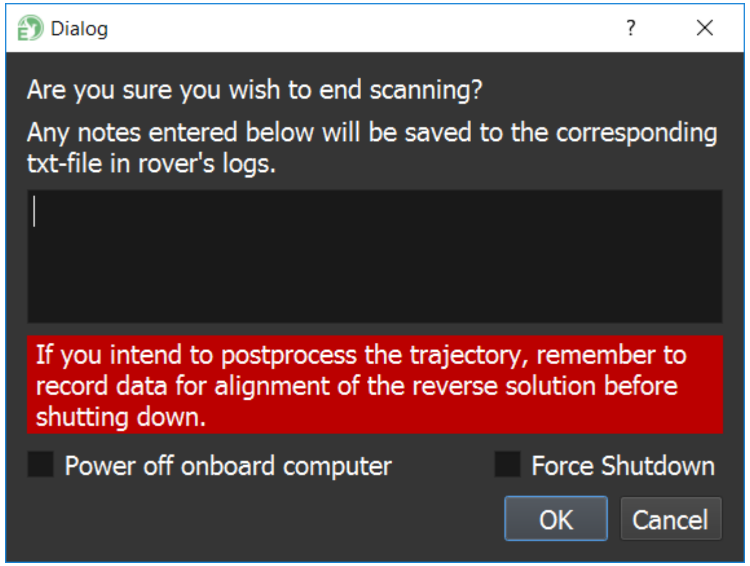


Commands

The Commands window displays a list of available commands that you can send directly to the rover.

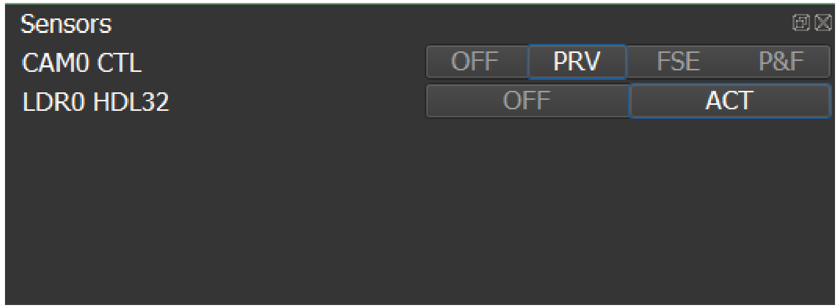
- Shutdown Rover: this command will end the connection between the rover and SpatialExplorer. There is a designated text box that will allow the user to enter any notes; the notes will be saved as a text file in the rover’s log directory. Additionally, you can select to power off the onboard computer as well as force a shutdown of the system.

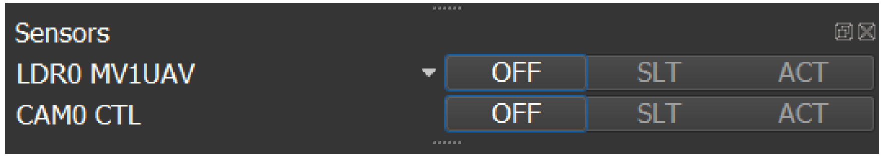




Sensor Controller

The Sensor Controller window allows you to configure the available cameras and sensors. When working offline, you can choose which sensors to display by toggling them ON/OFF during playback. When connected in real-time to the rover, this window will allow you to trigger the sensors ON/OFF during your scan.





Camera Sensor

SpatialExplorer Work Offline Camera Sensor Options	
OFF	Virtually deactivates the camera sensor.
PRV	Displays and overlays above the point cloud a preview of the images captured during scanning.
FSE	Fuses color captured from the images into the point cloud.
P&F	Preview and overlay above the point cloud the images captured and fuse color from the images into point cloud.

SpatialExplorer Real-time Camera Sensor Options	
OFF	Physically deactivates the camera sensor.
SLT	Activates the camera sensor, but does not display the photo preview frustum in the main viewing window.
ACT	Activates the camera sensor and displays the photo preview frustum in the main viewing window.

LiDAR Sensor

SpatialExplorer Work Offline LiDAR Sensor Options	
OFF	Deactivates the LiDAR sensor.
ACT	Activates the LiDAR sensor and displays the point cloud in the main viewing window.

SpatialExplorer Real-time LiDAR Sensor Options	
OFF	Deactivates the LiDAR sensor.
SLT	Activates the LiDAR sensor, but does not display the point cloud in the main viewing window.
ACT	Activates the LiDAR sensor and displays the point cloud in the main viewing window.

Measurements

The Measurements window allows you to perform various measurements on the active map layer. Depending on which map layer is selected, points can be picked from the point cloud layer, the trajectory layer, or other additional map layers. This can be used for plain position measurements, distances, profile viewing, flight planning, camera calibration etc.

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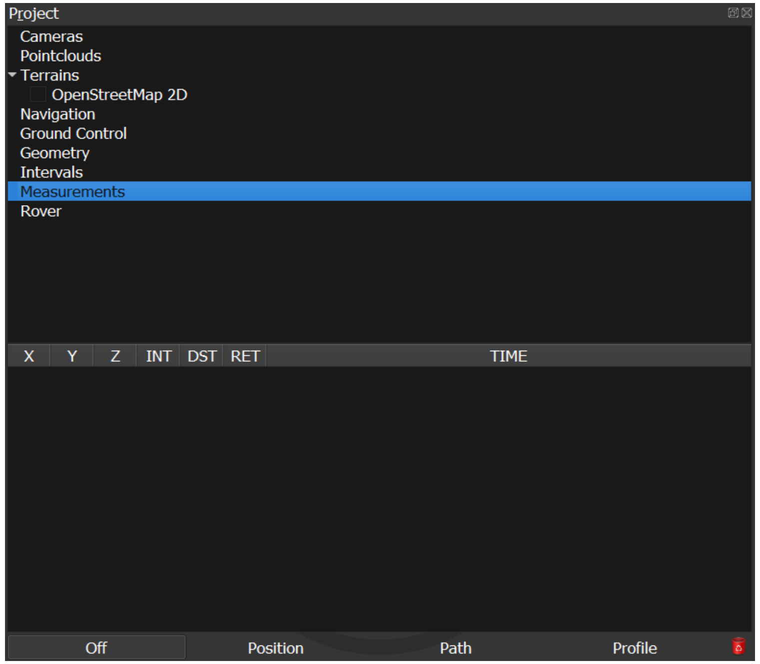
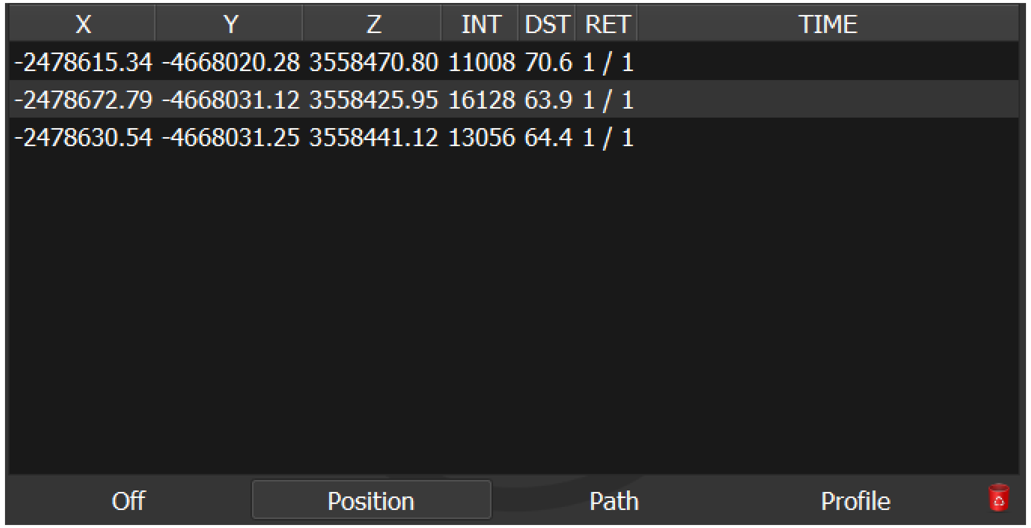


To clear the points from the Measurements window, click the radio button labeled **"Clear"** located in
the right bottom corner. Furthermore, clicking on the Time entry will step the Log Player to that specific time.

Measurements: Position

The POS option will identify the position of a point anywhere on the active map layer. It will extract the X, Y, and Z coordinates of any point as well as the capture time. To identify the position of a point on the active map layer, simply activate the POS tab and click anywhere on the active map layer. This will create an entry in the Measurements window. You can add multiple points into the Measurements window.

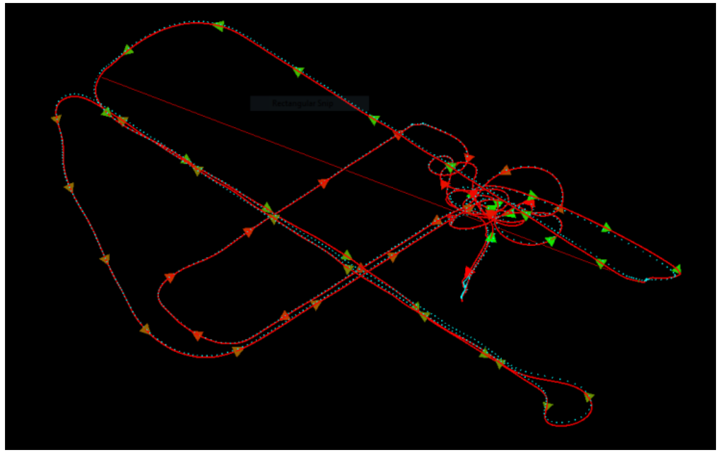


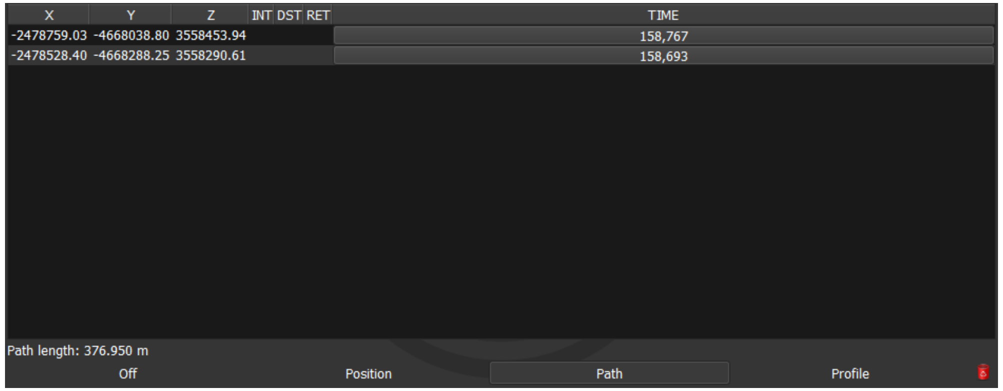
X	Y	Z	INT	DST	RET	TIME
-2478615.34	-4668020.28	3558470.80	11008	70.6	1 / 1	
-2478672.79	-4668031.12	3558425.95	16128	63.9	1 / 1	
-2478630.54	-4668031.25	3558441.12	13056	64.4	1 / 1	

Measurements: Path

The PTH option will measure the path distance between sequential points anywhere on the active map layer. Much like the POS option, it will also extract the X, Y, and Z coordinates as well as the capture time. To choose a point on the active map layer, simply activate the PTH tab and click on a point on the active map layer.

To define a path, a minimum of two points are required. The path length will be displayed in the lower left corner with units of meters. The path length is measured sequentially; this means that the length is calculated by adding the previous path length to the next path length. Adding three or more points to the path length will simply add the path distance between all points.

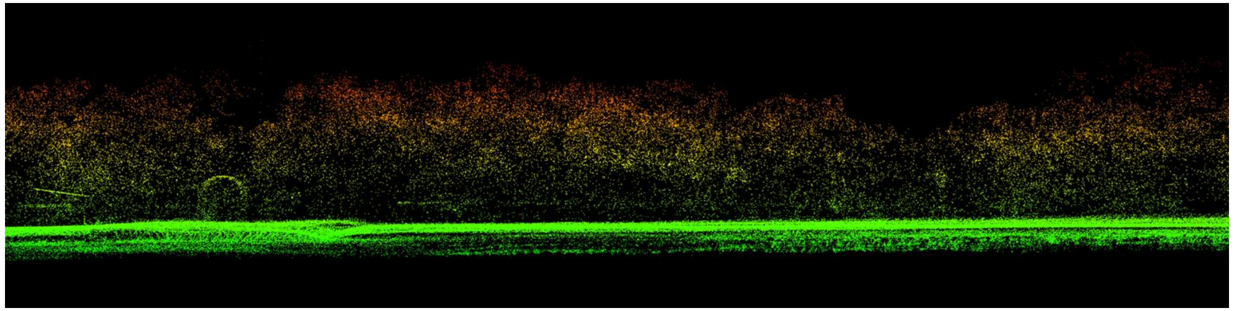




Measurements: Profile

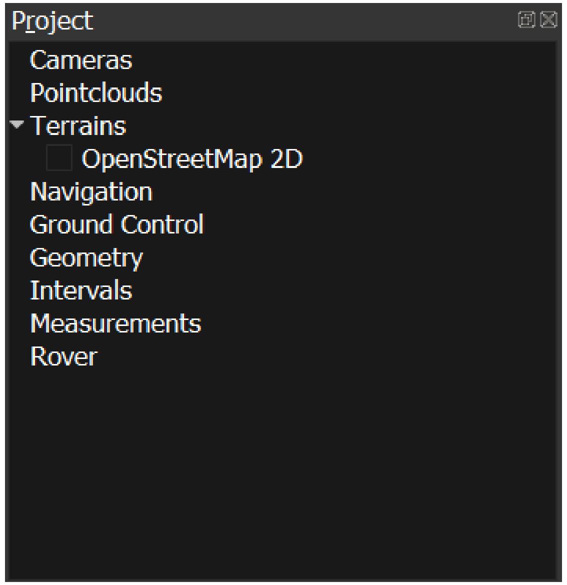
The PRF option will generate a horizontal profile section view of the points in a cloud as defined by a path created anywhere on the active map layer. It will extract the X, Y, and Z coordinates as well as other properties such as INT (Interval), DST (distance), and RET (return). The depth of the profile can be altered; enter the desired profile depth into the box located in the bottom right corner of the Measurements window (this is only visible when the PRF option is selected).

To view a profile of the point cloud, select the PRF tab in the Measurements window and click on two points in the active map layer to create a path. This will instantly generate a profile view in the main viewing window. Alternatively, you can use the POS tab (as long as two points are selected) and switch over to the PRF tab.



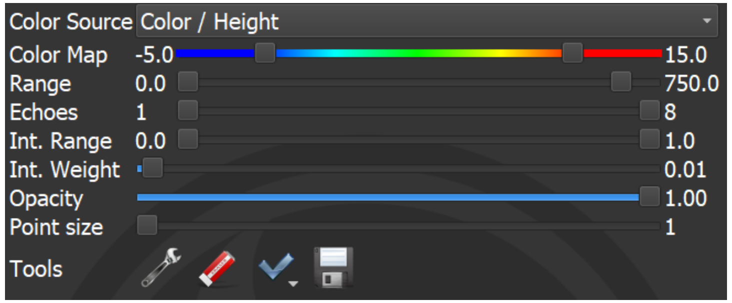
Project

The Project window displays the different types of layers available. There are four types of main map layers: Cameras, Pointclouds, Terrains, and Navigation. You can use layers to control the type of information displayed in the main display area. To enable or disable a layer, click the checkbox next to the name of the layer.



Customize Pointclouds

SpatialExplorer allows customization of the Pointclouds map layer. Simply right click on the desired point cloud layer and you will be presented with a pop-up menu where you can change various display parameters such as Point Size, Colorization, Intensity, etc.



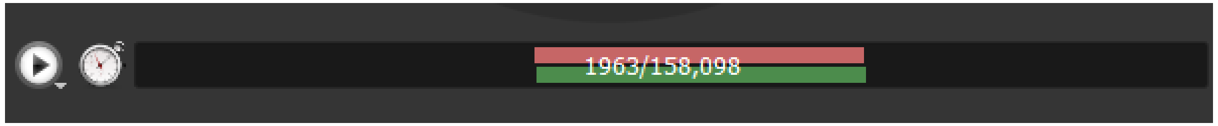
Trajectory Data

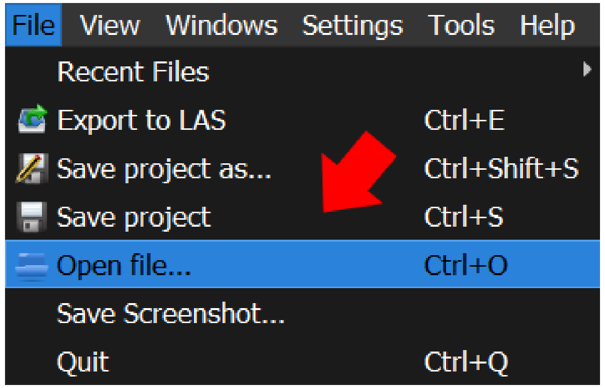
SpatialExplorer supports the following trajectory file formats:

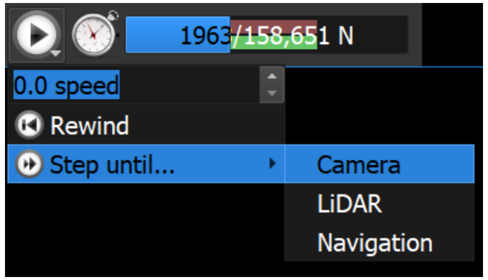
.nav	Unprocessed, low-rate real-time trajectory data computed during scanning..
.POF/.POQ	Riegl's post-processed high-rate trajectory data that contains absolute time. Manually exported from a NovAtel Inertial Explorer loosely-coupled or tightly-coupled trajectory.
.OUT	SBET (Smoothed Best Estimate of a Trajectory) high-rate trajectory data. Manually exported from a loosely-coupled or tightly-coupled trajectory processed by NovAtel Inertial Explorer. Only contains Time-of-Week information, therefore the correct GPS week and time system have to be specified when opening the file.
.cls	Combined Loosely-coupled Smoothed trajectory. Native high-rate post-processed trajectory created by NovAtel's Inertial Explorer starting with version 8.70. Contains absolute time and does not lead to ambiguities as to which solution (loosely-coupled or tightly-coupled) the file was exported from.
.cts	Combined Tightly-coupled Smoothed trajectory. Native high-rate post-processed trajectory created by NovAtel's Inertial Explorer starting with version 8.70. Contains absolute time and does not lead to ambiguities as to which solution (loosely-coupled or tightly-coupled) the file was exported from.

Playback (offline mode only)

You can load the data generated by the rover. Once the data is loaded, you can control the playback (Rewind, Step, Play) or select a specific time (GoTo). The GoTo option allows you to view the data at a specific point in various time formats. The desired time can be specified in many time systems. Conversion of leap seconds is done automatically. The Step option allows you to forward the scan to the first instance of either GNSS, LiDAR, or Camera data. To access the Step option menu, right long-click the Step button and select your option.



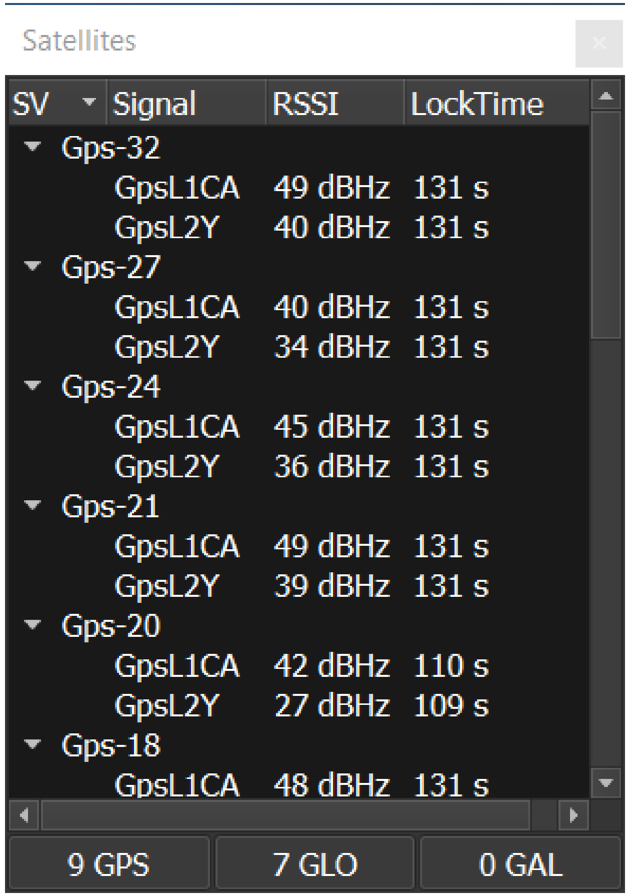




Satellites

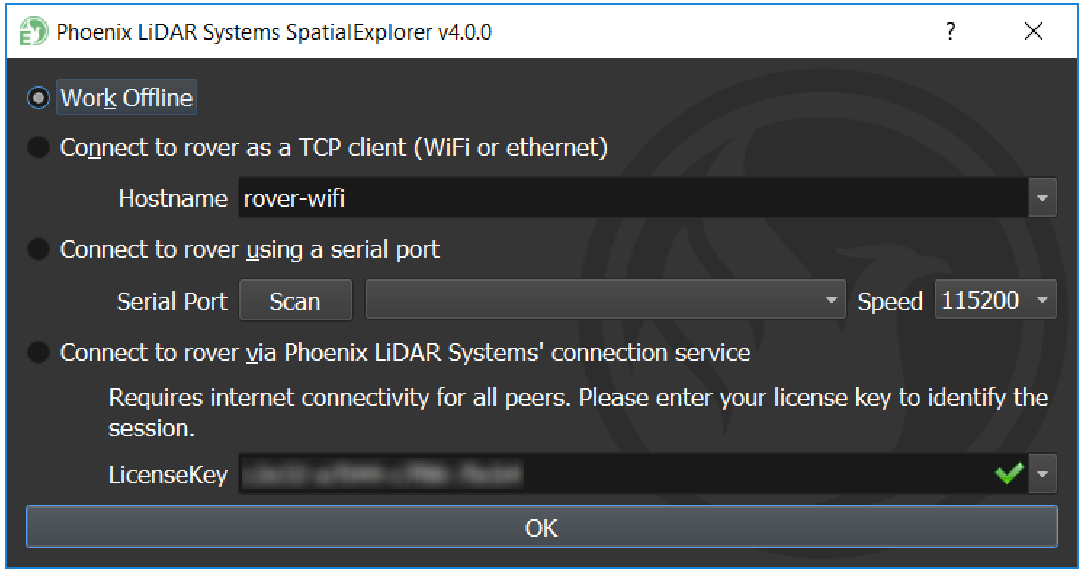
The Satellites window provides a list of the visible global navigational satellite systems connected to the rover's GNSS receiver. It displays several parameters such as space vehicle name, name of signal, signal strength, and locktime.

SV	Name of GNSS satellite. Acronym stands for Space Vehicle.
Signal	Name of the GNSS carrier band.
RSSI	Measurement of the power present in a received radio signal. Measured in dBHz.
LockTime	The amount of time since the satellite last obtained signal and navigation data. Max amount of time is 131s. Lower value indicates the satellite is constantly losing signal.



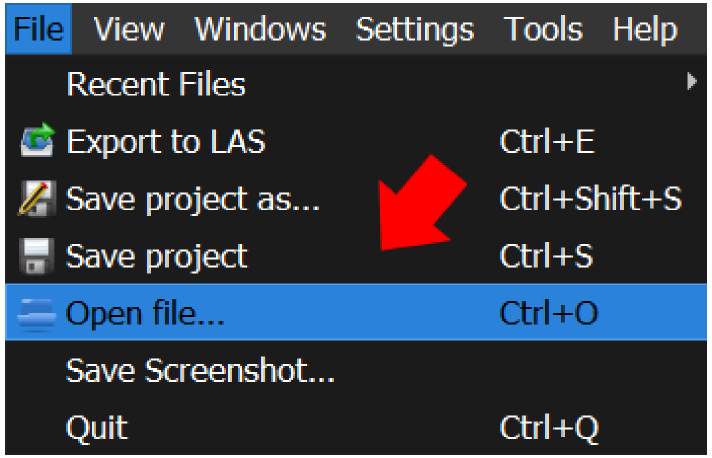
Work Offline

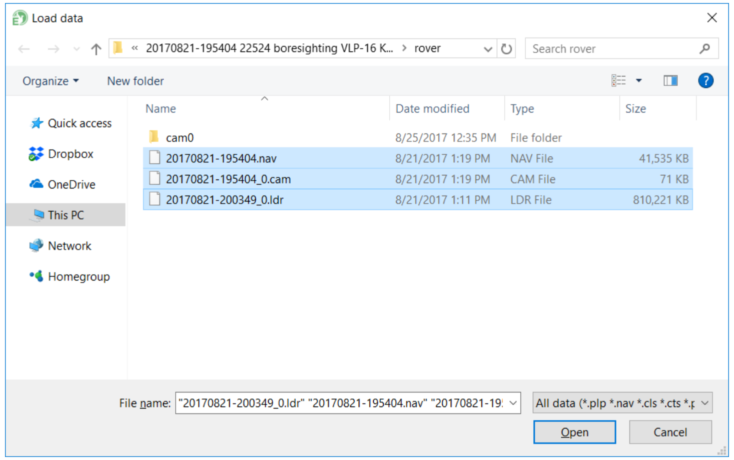
SpatialExplorer can be launched in offline mode. While in offline mode, you will not be able to view data or configure sensors in real-time, however you will be able to load and analyze your post-mission georeferenced point-cloud data.

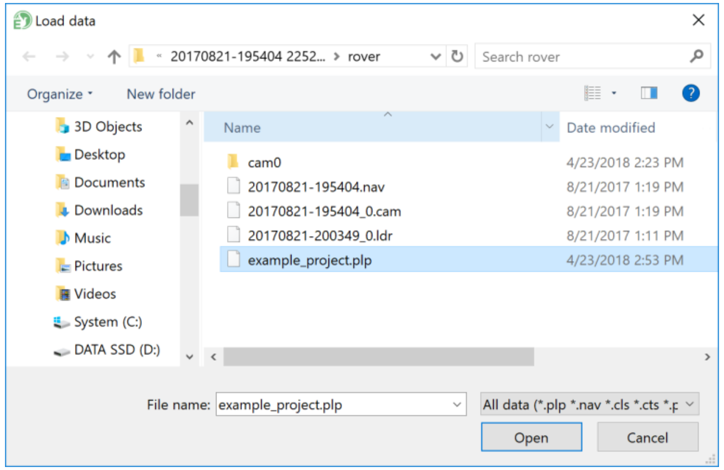


Work Offline: Open files

In order to view the data contained within the log files generated by the rover during a scan, you must click on the Open file button in the File Menu right of SpatialExplorer.







Work Offline: Open files

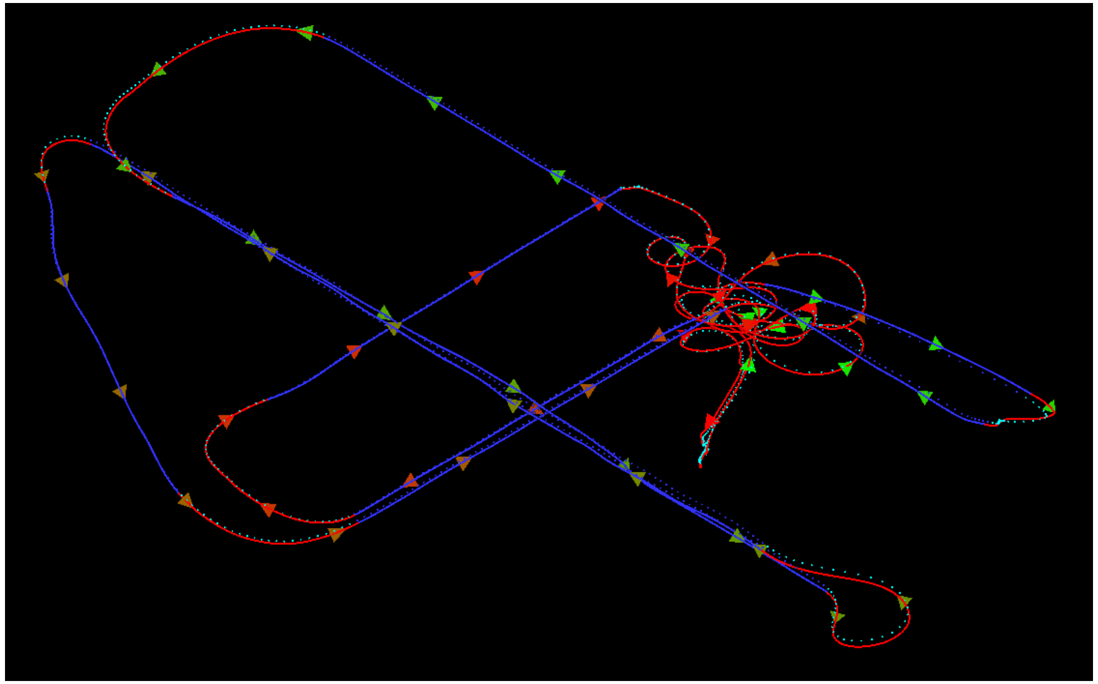
Once the data has been loaded, the trajectory data along with the initial system status data is displayed. **SpatialExplorer** allows viewing important system and mission values such as system voltage and temperature (only when using .nav files), or navigation system data like the vehicle's position and orientation, solution accuracy or the number of satellites tracked.

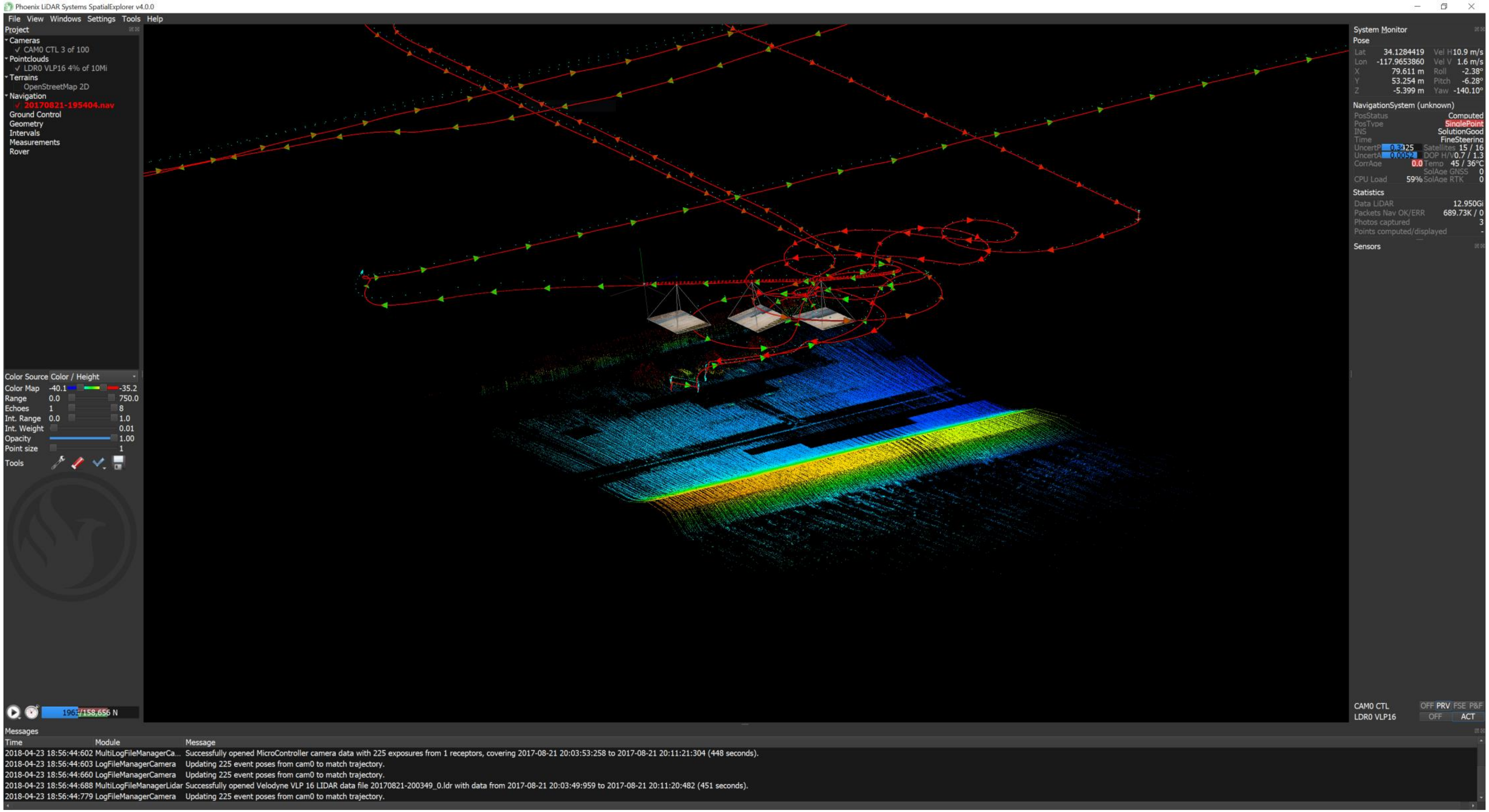
To view the recorded point cloud in real-time, you must hit the Play button located in the bottom left corner of the Project window. You can choose which sensors (camera, LiDAR, etc.) are activated in the main display area by toggling them from within the Sensors window.

Trajectory Map

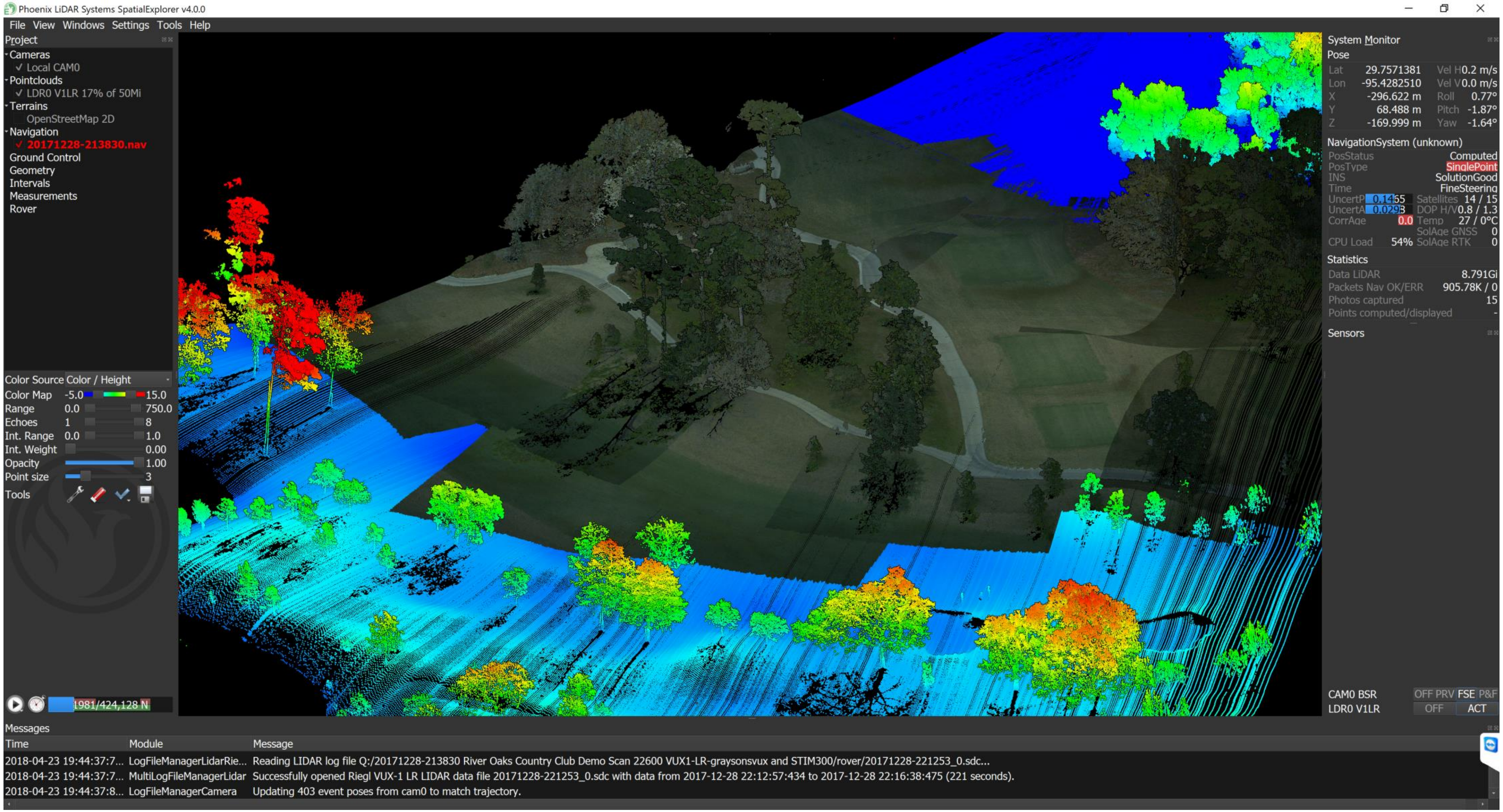
The rover's trajectory can also be analyzed using a map view.

- The Map view allows panning and zooming using the mouse.
- The color of the track fades indicate the beginning (green) and the end (red) of the mission.





Phoenix LiDAR Systems SpatialExplorer v4.0.0
File View Windows Settings Tools Help
Project
Cameras
CAM0 CTL 3 of 100
Pointclouds
LDR0 VLP16 4% of 10Mi
Terrains
OpenStreetMap 2D
Navigation
20170821-195404.nav
Ground Control
Geometry
Intervals
Measurements
Rover
Color Source Color / Height
Color Map -40.1 -35.2
Range 0.0 750.0
Echoes 1 8
Int. Range 0.0 1.0
Int. Weight 0.01
Opacity 1.00
Point size 1
Tools
System Monitor
Pose
Lat 34.1284419
Lon -117.9653860
X 79.611 m
Y 53.254 m
Z -5.399 m
Roll -2.38°
Pitch -6.28°
Yaw -140.10°
NavigationSystem (unknown)
Statistics
Data LiDAR 12.950Gi
Packets Nav OK/ERR 689.73K / 0
Photos captured 3
Sensors
CAM0 CTL
LDR0 VLP16
Messages
Time Module Message
2018-04-23 18:56:44:602 MultiLogFileManagerCa... Successfully opened MicroController camera data with 225 exposures from 1 receptors, covering 2017-08-21 20:03:53:258 to 2017-08-21 20:11:21:304 (448 seconds).
2018-04-23 18:56:44:603 LogFileManagerCamera Updating 225 event poses from cam0 to match trajectory.
2018-04-23 18:56:44:660 LogFileManagerCamera Updating 225 event poses from cam0 to match trajectory.
2018-04-23 18:56:44:688 MultiLogFileManagerLidar Successfully opened Velodyne VLP 16 LIDAR data file 20170821-200349_0.ldr with data from 2017-08-21 20:03:49:959 to 2017-08-21 20:11:20:482 (451 seconds).
2018-04-23 18:56:44:779 LogFileManagerCamera Updating 225 event poses from cam0 to match trajectory.



PHOENIX LiDAR SYSTEMS

Connect to Rover

SpatialExplorer can be launched to connect to a Phoenix LiDAR Systems rover via TCP/IP or via a Connection Service. Both of these configurations will allow you to view your georeferenced point-cloud data and configure sensors in real-time while scanning.

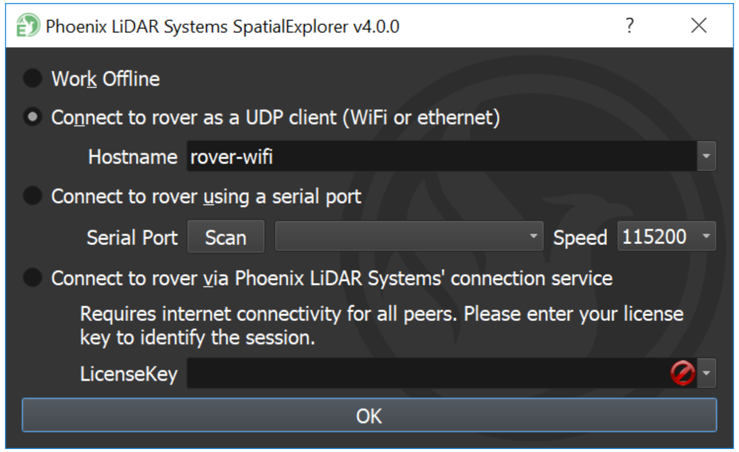
- Connect to rover as a TCP client
- Connect to rover via Phoenix LiDAR Systems Connection Service

Connect to Rover as TCP Client

Select the "Connect to rover as a TCP client (WiFi or ethernet)" option to establish a direct connection to the rover via TCP/IP. All Phoenix LiDAR Systems rovers come preconfigured with a default hostname for both Wi-Fi or Ethernet connections.

In order to connect to the rover via Wi-Fi, the laptop running SpatialExplorer and the rover itself must be connected to the same wireless network.

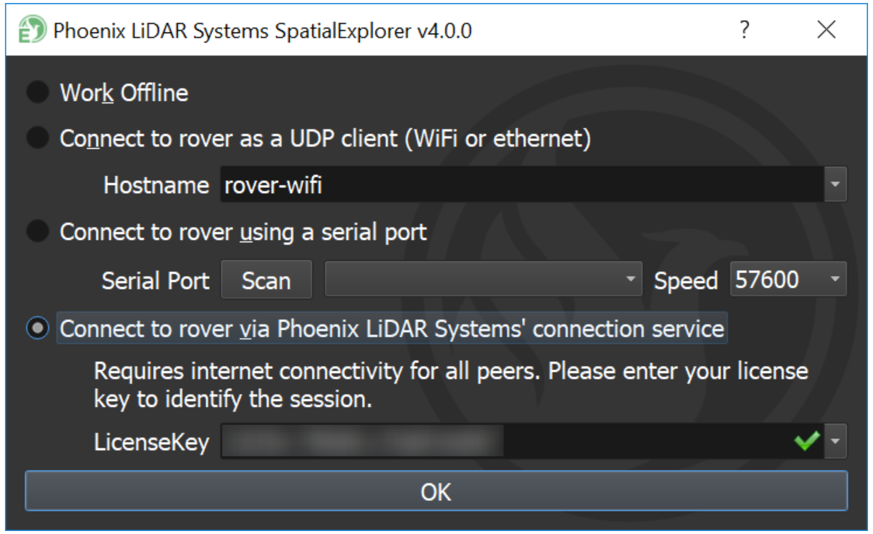
Connect to Rover as TCP Client



Wi-Fi	rover-wifi	192.168.20.10
Ethernet	rover-wire	192.168.200.10

Connect to Rover via Connection Service

Select the "Connect to rover via Phoenix LiDAR Systems' connection service" option to establish a connection to the rover via a private server. This option is primarily used through cellular communication (3G/4G data). Both the rover and the base station (laptop) must have internet connectivity.

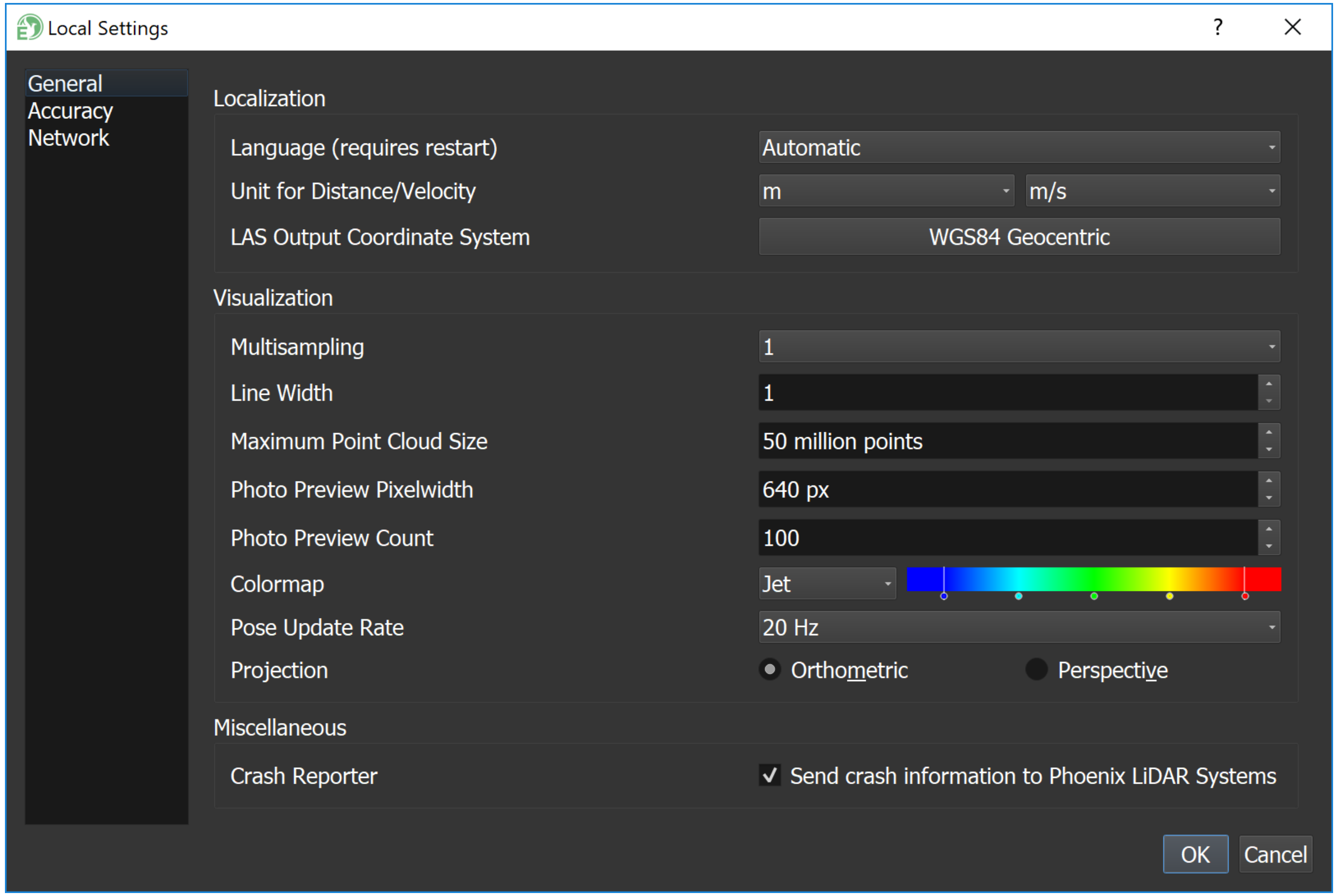


LicenseKey	Every system is configured and associated with a unique alphanumeric key that must be entered to associate the base station with the rover on the server.

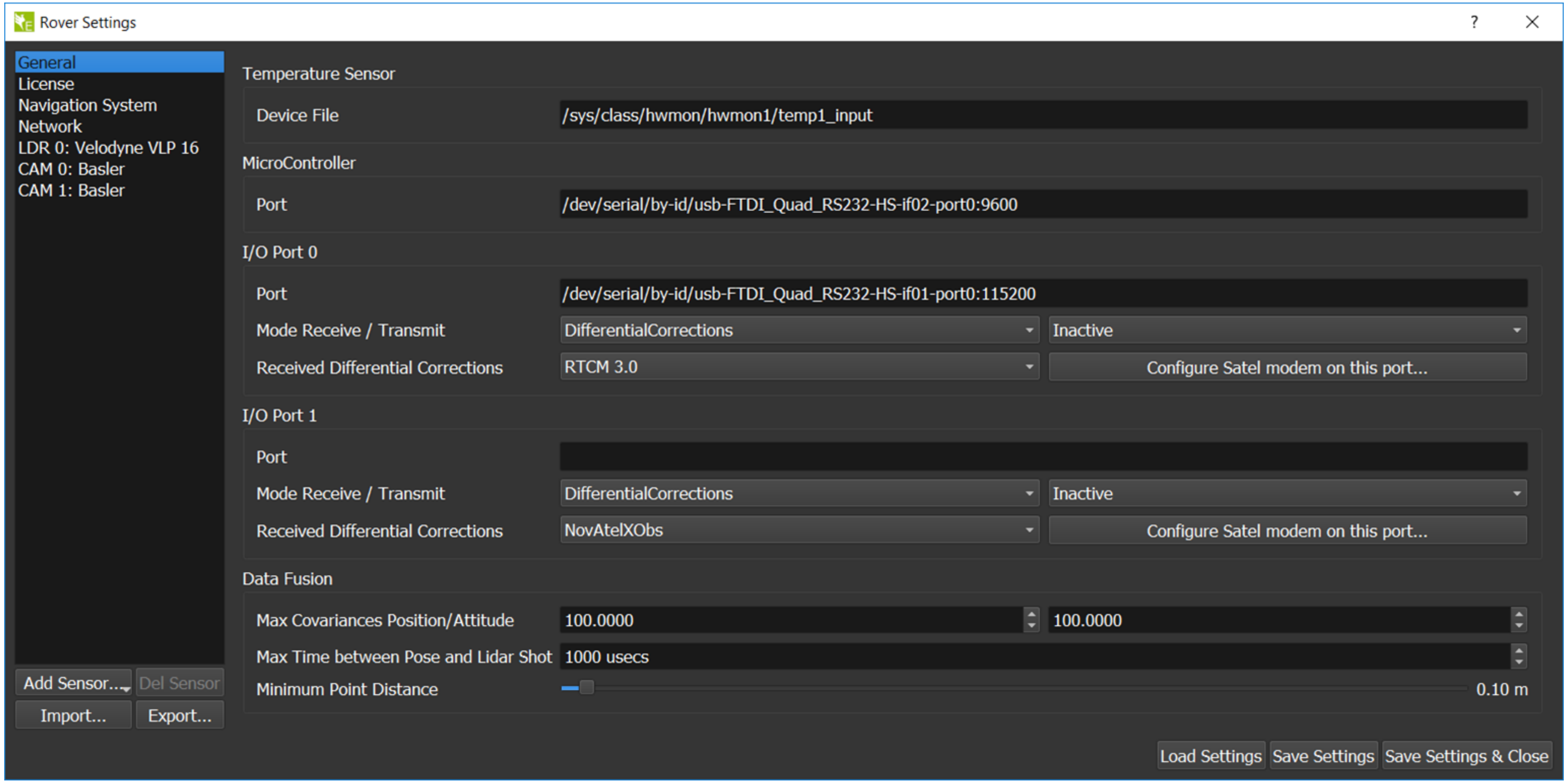
Settings

SpatialExplorer provides customization of local and rover (when connected to rover) parameters. You can configure default local settings, such as language or visualization settings, or you can configure default rover settings, such as antenna offsets and IMU orientation

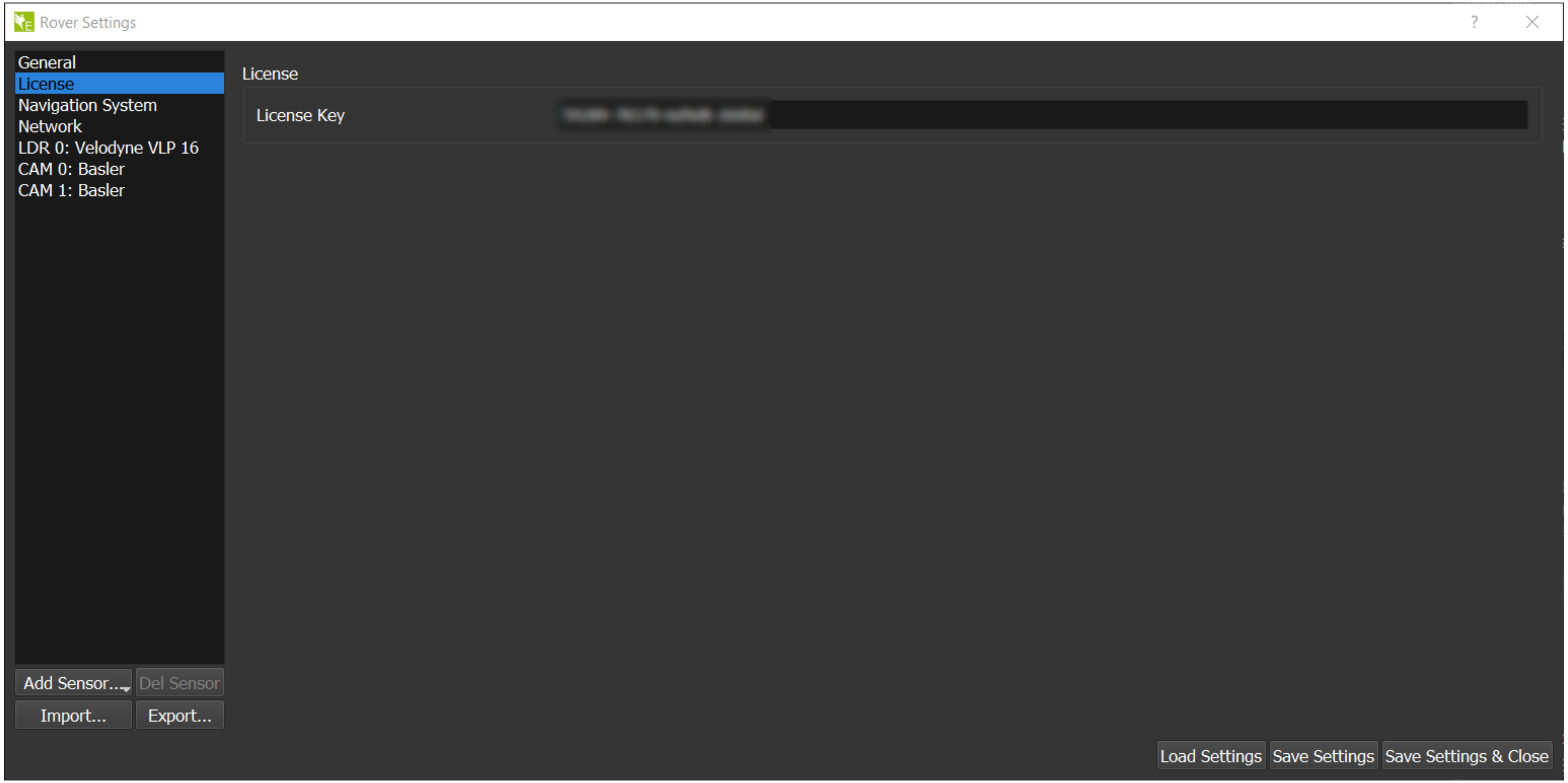
Local Settings



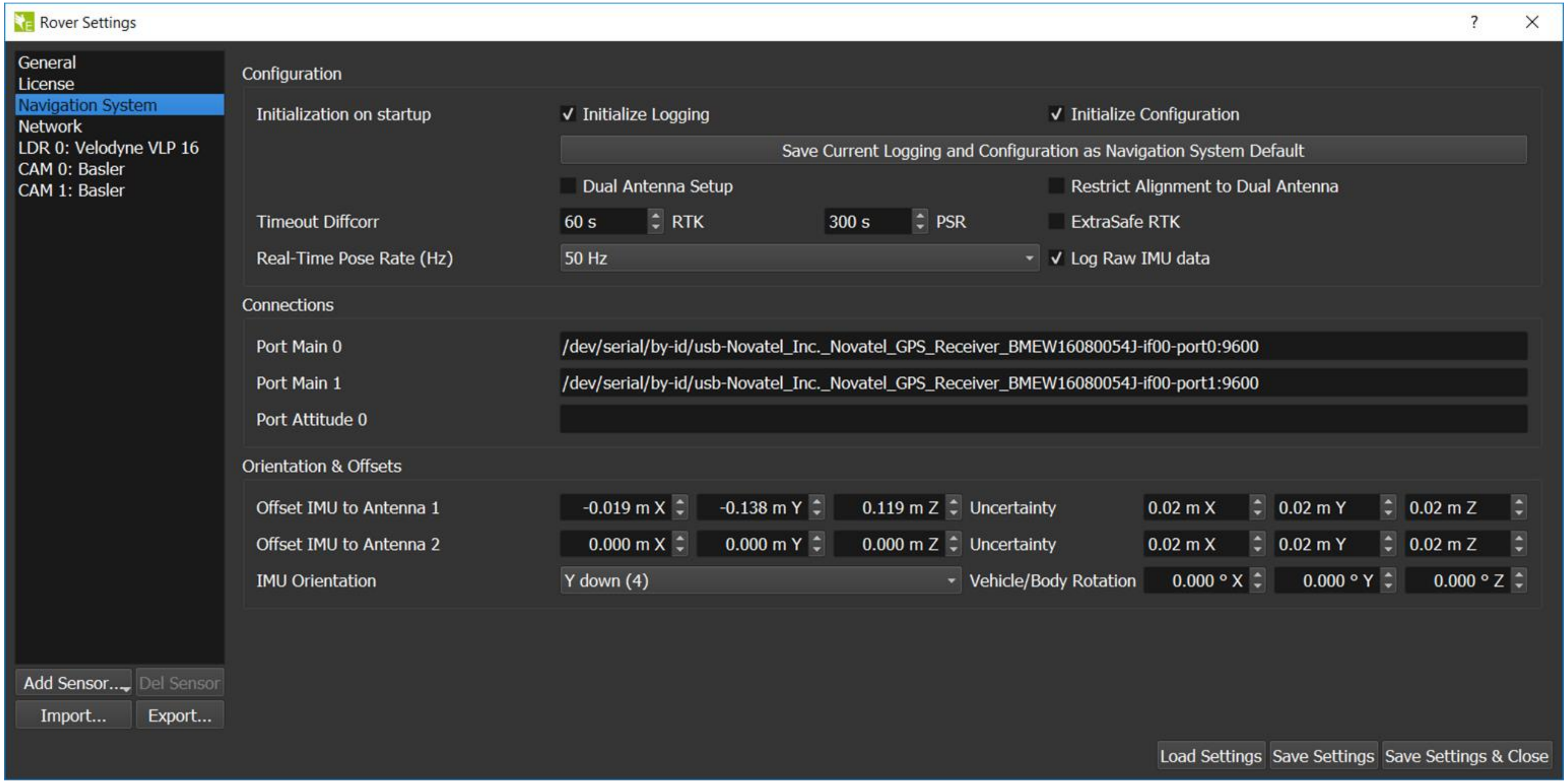
Rover Settings: General



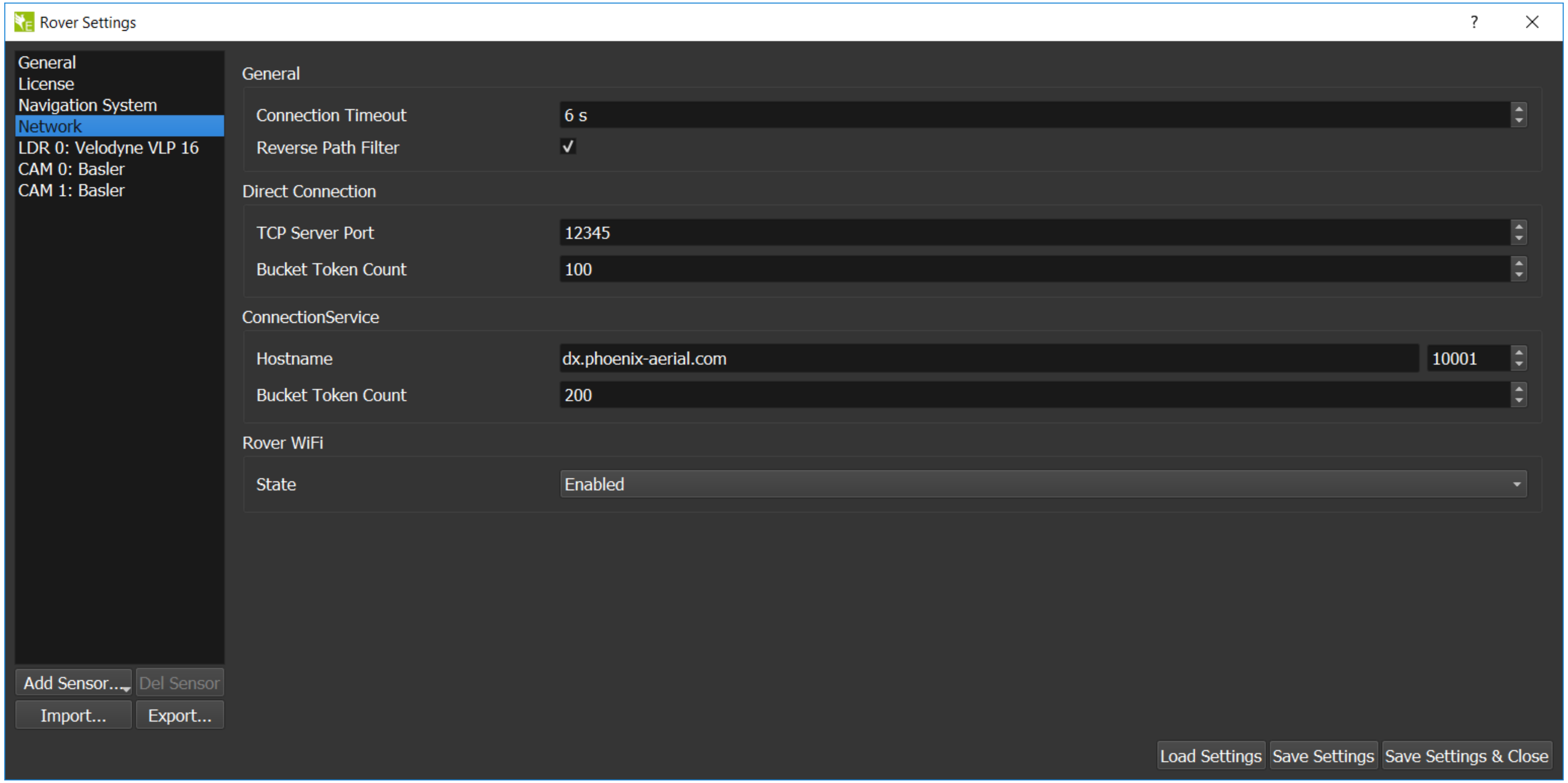
Rover Settings: License



Rover Settings: Navigation System

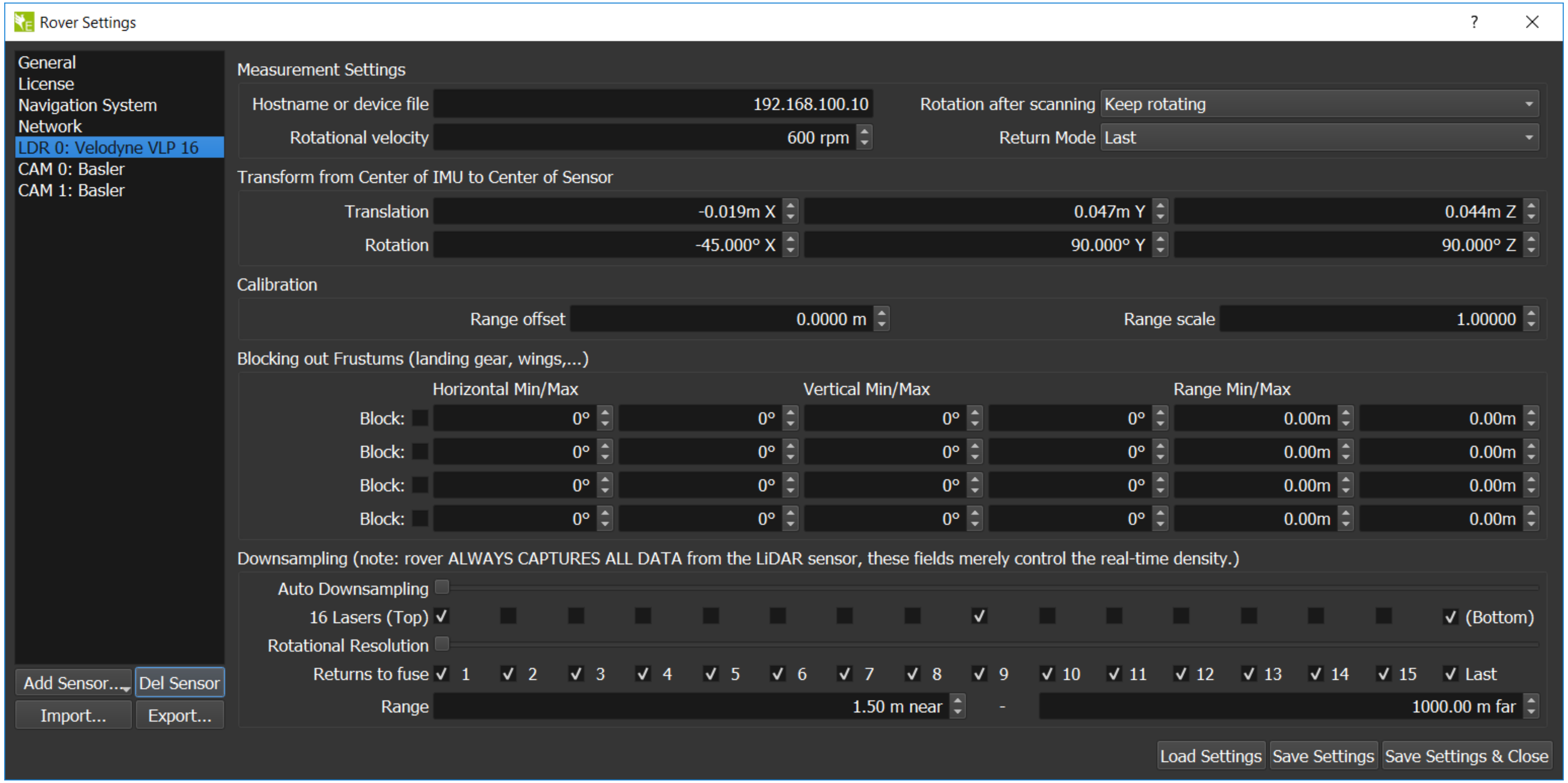


Rover Settings: Network

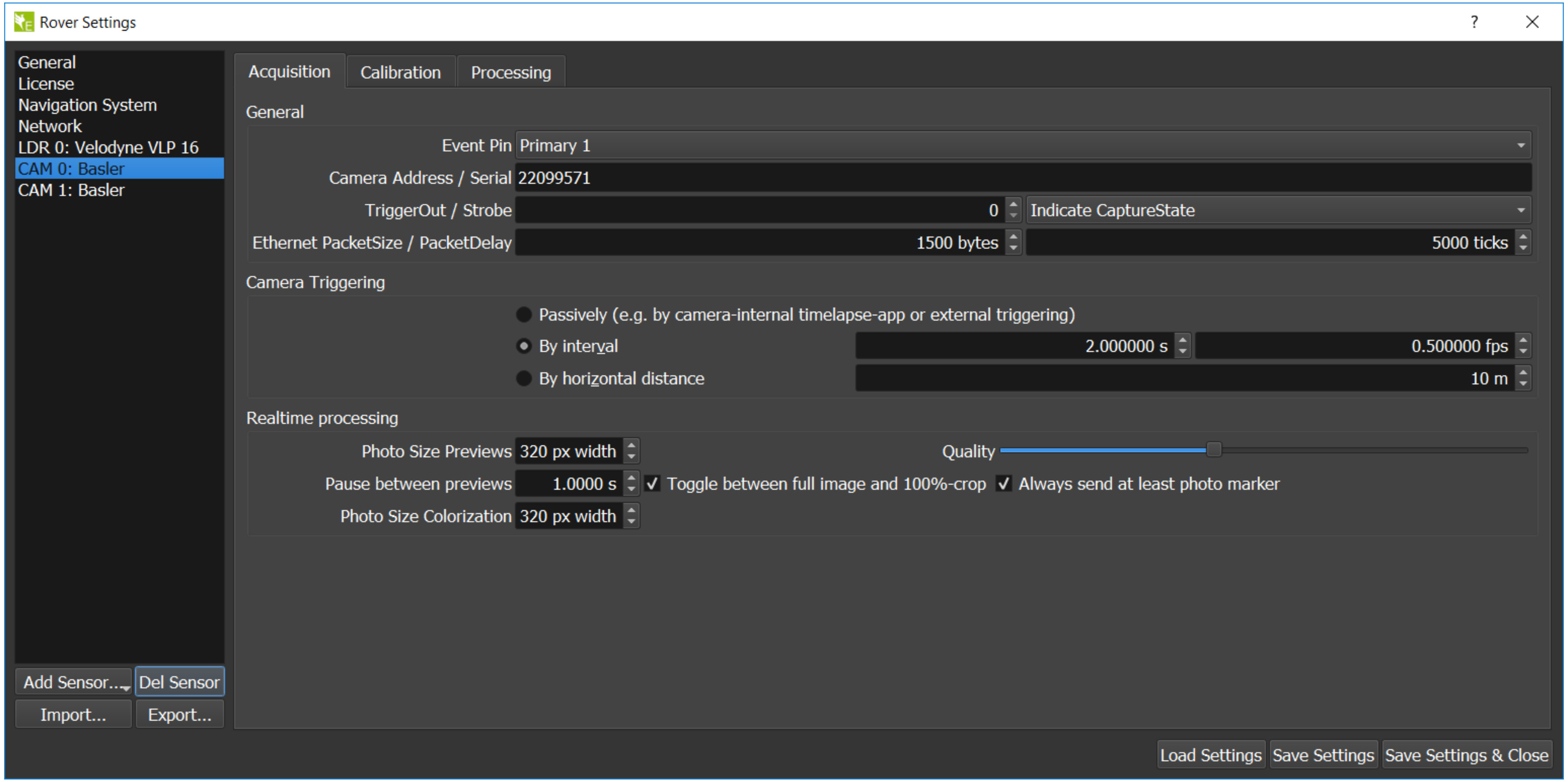


PHOENIX LiDAR SYSTEMS

Rover Settings: LDRX

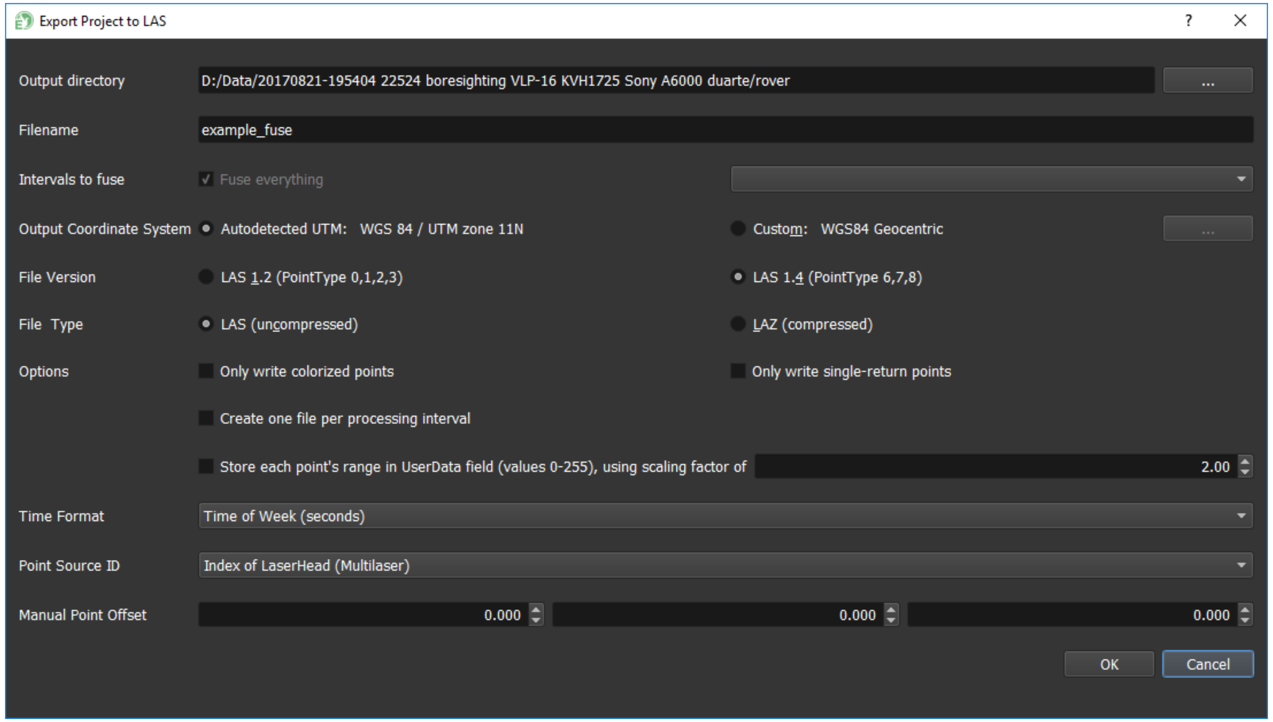


Rover Settings: CAMX



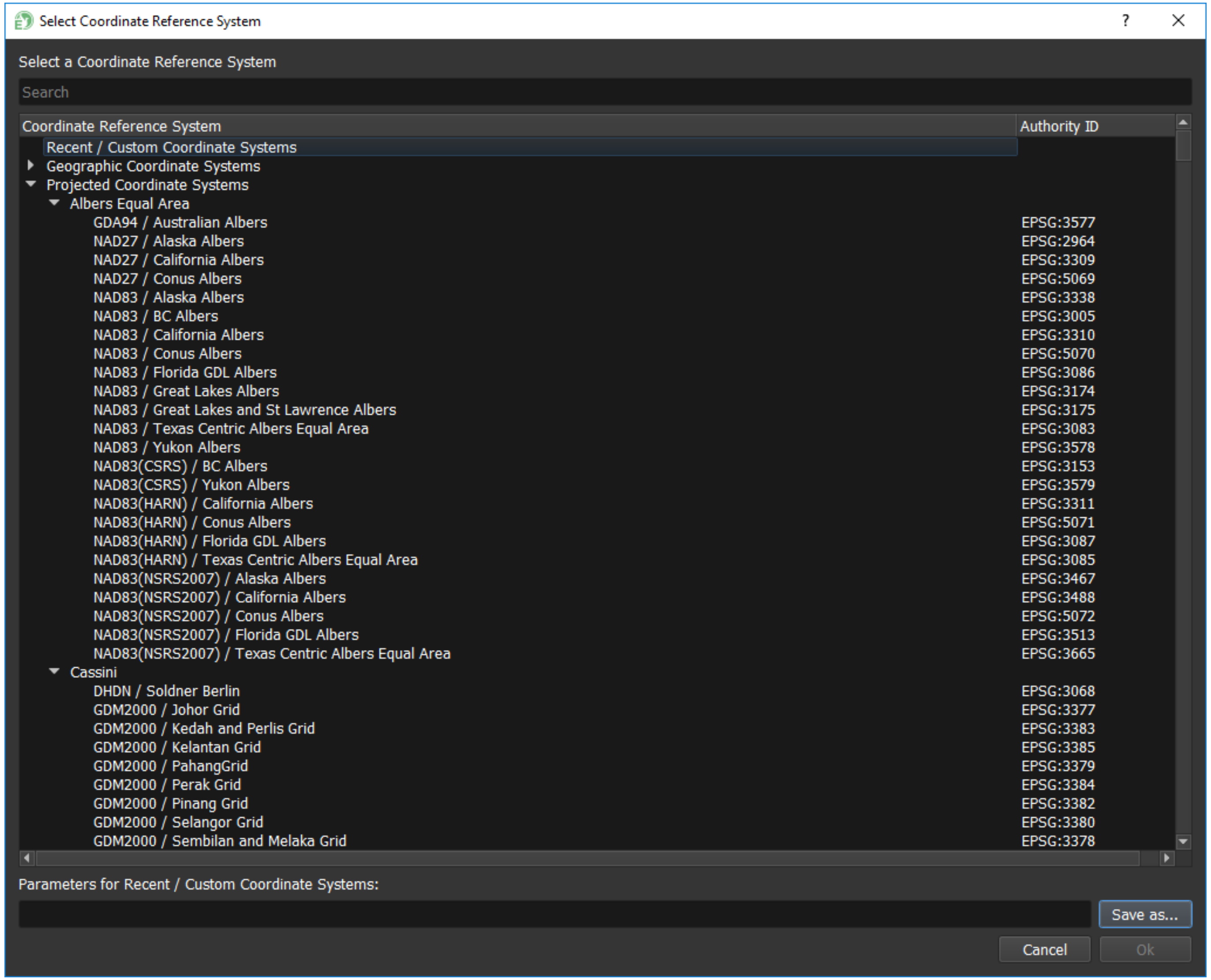
Export to LAS

The Output module allows you to configure the various parameters associated with exporting the data into common mapping formats such as LAS/LAZ or GPX.



Output: Output Coordinate System

- When you add a trajectory file to SpatialExplorer, it will automatically determine the correct coordinate system. However, if you want to change the output coordinate system you can do so from within SpatialExplorer by clicking the "..." radio button located to the right of the Output Coordinate System indicator.
- From the Select Coordinate Reference System window, you can search for a Coordinate System or you can select a Coordinate System from the available list


Select Coordinate Reference System
?
Select a Coordinate Reference System
Search
Coordinate Reference System
Authority ID
Recent / Custom Coordinate Systems
Geographic Coordinate Systems
Projected Coordinate Systems
Albers Equal Area
GDA94 / Australian Albers EPSG:3577
NAD27 / Alaska Albers EPSG:2964
NAD27 / California Albers EPSG:3309
NAD27 / Conus Albers EPSG:5069
NAD83 / Alaska Albers EPSG:3338
NAD83 / BC Albers EPSG:3005
NAD83 / California Albers EPSG:3310
NAD83 / Conus Albers EPSG:5070
NAD83 / Florida GDL Albers EPSG:3086
NAD83 / Great Lakes Albers EPSG:3174
NAD83 / Great Lakes and St Lawrence Albers EPSG:3175
NAD83 / Texas Centric Albers Equal Area EPSG:3083
NAD83 / Yukon Albers EPSG:3578
NAD83(CSRS) / BC Albers EPSG:3153
NAD83(CSRS) / Yukon Albers EPSG:3579
NAD83(HARN) / California Albers EPSG:3311
NAD83(HARN) / Conus Albers EPSG:5071
NAD83(HARN) / Florida GDL Albers EPSG:3087
NAD83(HARN) / Texas Centric Albers Equal Area EPSG:3085
NAD83(NSRS2007) / Alaska Albers EPSG:3467
NAD83(NSRS2007) / California Albers EPSG:3488
NAD83(NSRS2007) / Conus Albers EPSG:5072
NAD83(NSRS2007) / Florida GDL Albers EPSG:3513
NAD83(NSRS2007) / Texas Centric Albers Equal Area EPSG:3665
Cassini
DHDN / Soldner Berlin EPSG:3068
GDM2000 / Johor Grid EPSG:3377
GDM2000 / Kedah and Perlis Grid EPSG:3383
GDM2000 / Kelantan Grid EPSG:3385
GDM2000 / PahangGrid EPSG:3379
GDM2000 / Perak Grid EPSG:3384
GDM2000 / Pinang Grid EPSG:3382
GDM2000 / Selangor Grid EPSG:3380
GDM2000 / Sembilan and Melaka Grid EPSG:3378
Parameters for Recent / Custom Coordinate Systems:
Save as...
Cancel
Ok

Output: Point Source ID

The Point Source ID option allows you to associate each point in a cloud with its corresponding laser of origin.

- Amplitude (Riegl)
- Deviation (Riegl)
- Index of Interval starting at 0
- Index of Interval starting at 1, with all curves set to 0
- Index of Laser Log
- Index of LaserHead (Multilaser)
- Zero

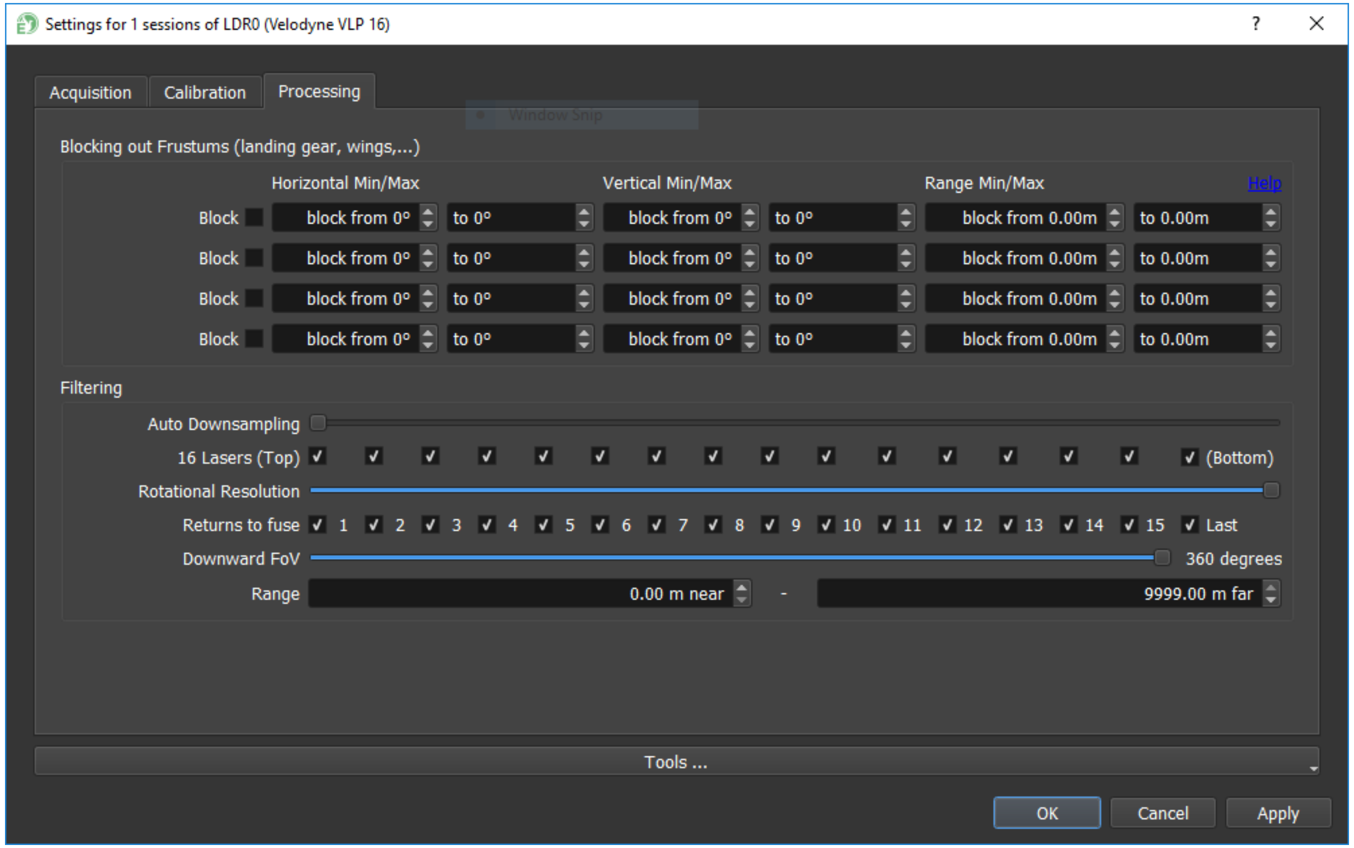
Sensor Customization

- You can configure the numerous parameters associated with the sensors or cameras from this interface.

LiDAR Sensor Customization

- Calibration: allow changing the LiDAR's range-sensing calibration values, such as range offset (in meters) and range scale. Options should not be altered unless necessary.
- Blocking Out Frustums: some configurations allow LiDAR sensor to be mounted such that it might constantly scan parts of the vehicle or craft creating reflections in the resulting 3D point cloud. This will allow you to block certain frustums, which are angular regions. Up to four regions can be blocked at the same time.

LiDAR Sensor Customization



LiDAR Sensor Customization

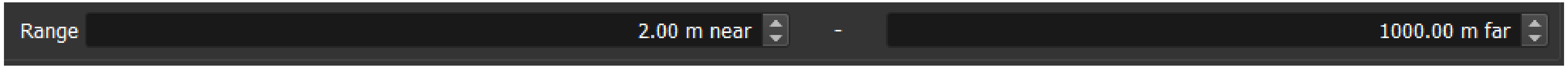
The fields in the Downsampling group box control which data from the LiDAR will be fused.

- Each single laser can be included or excluded by checking the corresponding boxes.
- The Rotational Resolution slider allows skipping entire firing sequences.
- The last row can be used to fuse only certain echoes/returns.

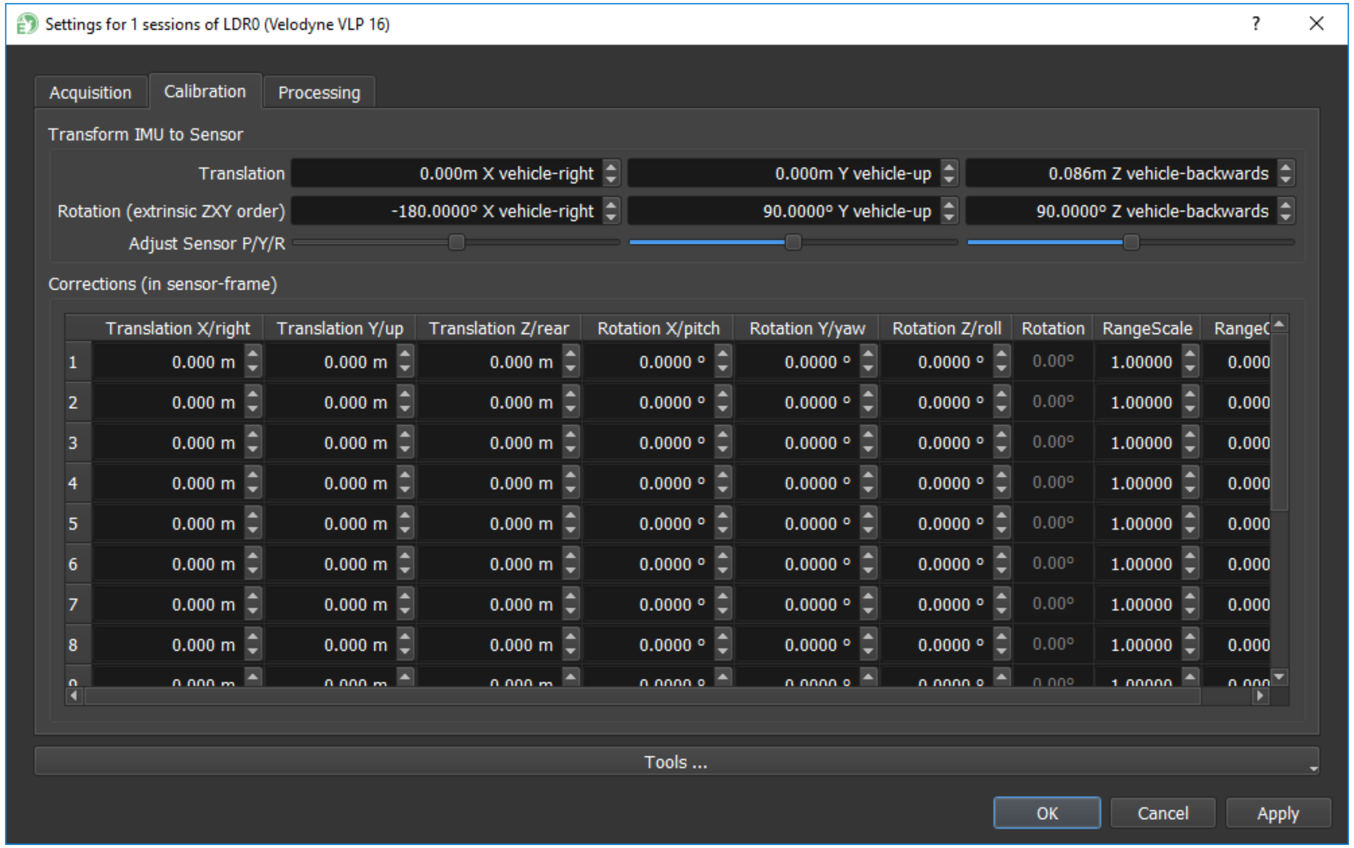
LiDAR Sensor Customization

The Range option will impose bounds on the fusable data based on two conditions, near and far.

- The near option will exclude any points captured within the specified range during fusing.
- The far option will include any points captured within the specified range during fusing.



LiDAR Sensor Customization

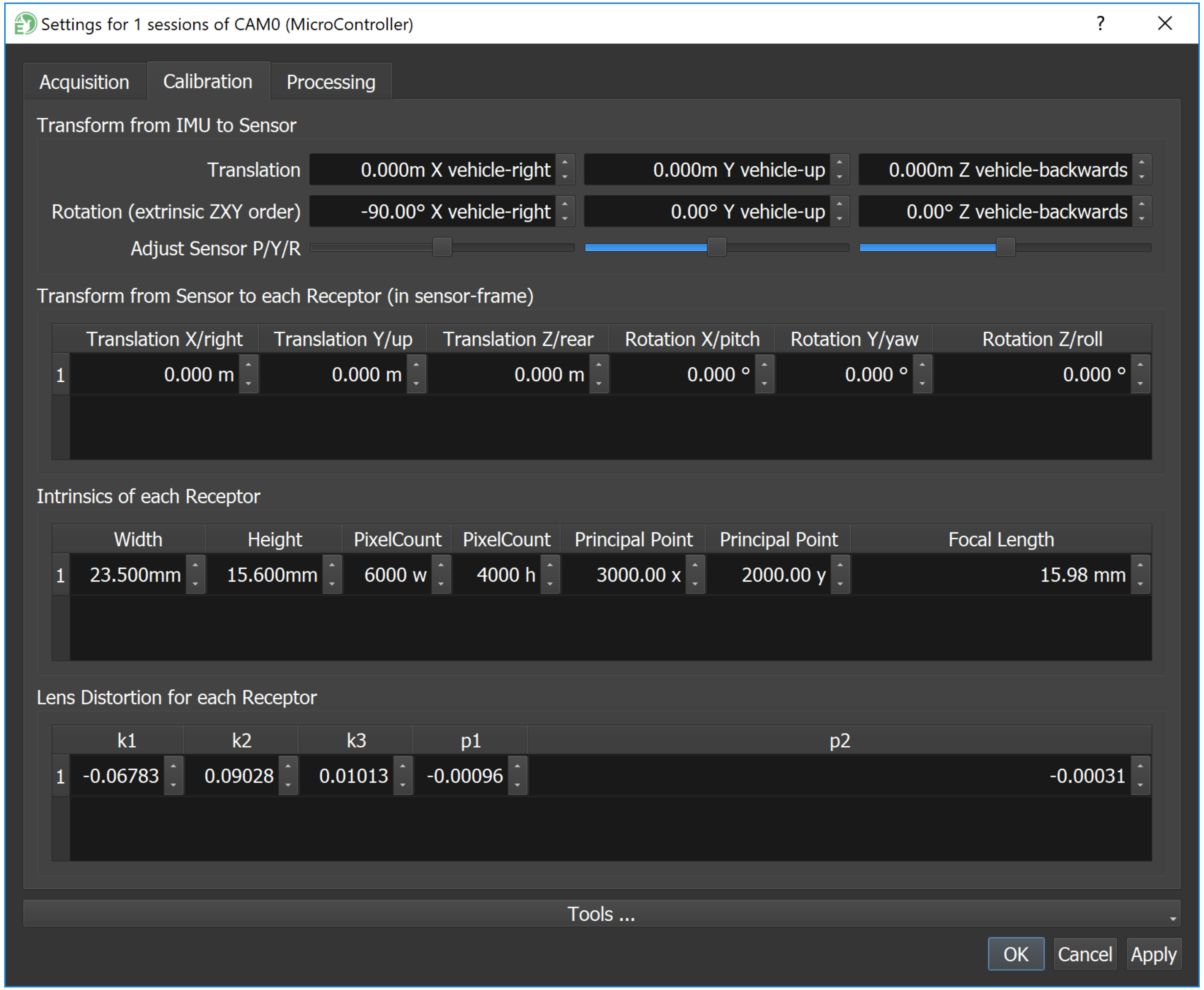


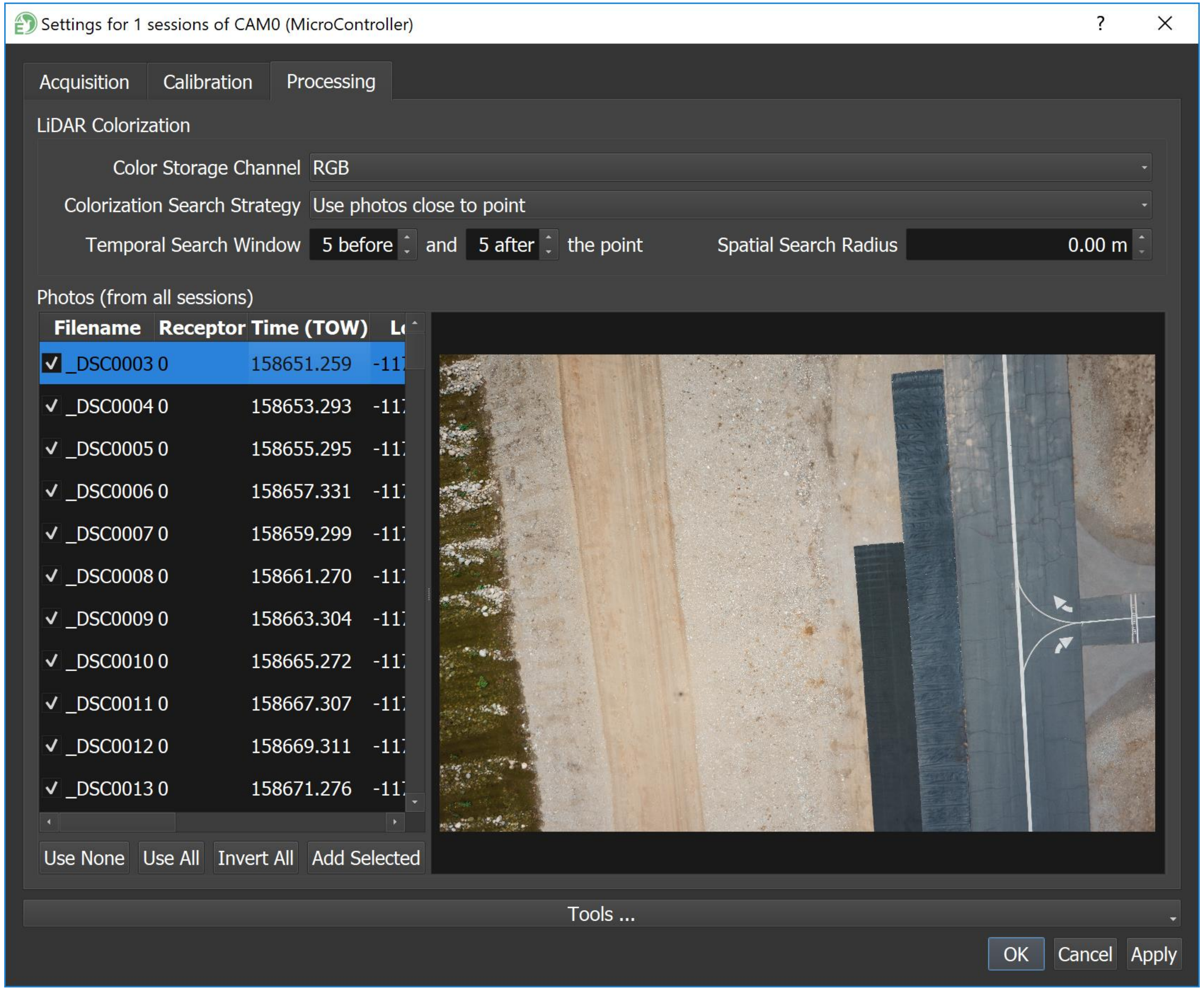
LiDAR Sensor Customization

- **Transforms:** apply a transformation from the center of the IMU to the center of the LiDAR sensor. The Translation fields define the offset from the center of the IMU to the LiDAR's optics. The Rotation (extrinsic ZXY order) fields define how the LiDAR sensor is oriented relative to the IMU.

Camera Sensor Customization

- **Calibration:** These fields allow changing the Camera's calibration values, such as sensor size (in mm), pixel size (in px), as well as camera position and camera orientation. These options should not be altered unless necessary, and only then should be used in very special cases.


Settings for 1 sessions of CAM0 (MicroController)
Acquisition
Calibration
Processing
Transform from IMU to Sensor
Translation
0.000m X vehicle-right
0.000m Y vehicle-up
0.000m Z vehicle-backwards
Rotation (extrinsic ZXY order)
-90.00° X vehicle-right
0.00° Y vehicle-up
0.00° Z vehicle-backwards
Adjust Sensor P/Y/R
Transform from Sensor to each Receptor (in sensor-frame)
Translation X/right
Translation Y/up
Translation Z/rear
Rotation X/pitch
Rotation Y/yaw
Rotation Z/roll
1
0.000 m
0.000 m
0.000 m
0.000 °
0.000 °
0.000 °
Intrinsics of each Receptor
Width
Height
PixelCount
PixelCount
Principal Point
Principal Point
Focal Length
1
23.500mm
15.600mm
6000 w
4000 h
3000.00 x
2000.00 y
15.98 mm
Lens Distortion for each Receptor
k1
k2
k3
p1
p2
1
-0.06783
0.09028
0.01013
-0.00096
-0.00031
Tools ...
OK
Cancel
Apply



PHOENIX LiDAR SYSTEMS

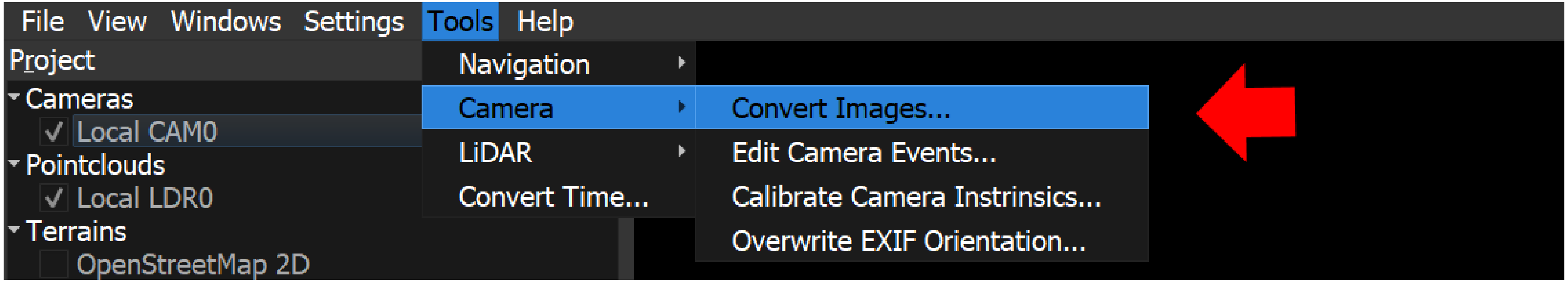
SpatialExplorer Tools

Convert Images

- Images taken with a digital camera must be converted to JPG, TIF, or PNG before either SpatialExplorer can use them. Raw images from Basler cameras are automatically decoded.

- Must place converted images in the camX/ folder. This will ensure that SpatialExplorer is able to properly load the images. If using .JPG formatted images, you can copy them directly into the camX/ folder.

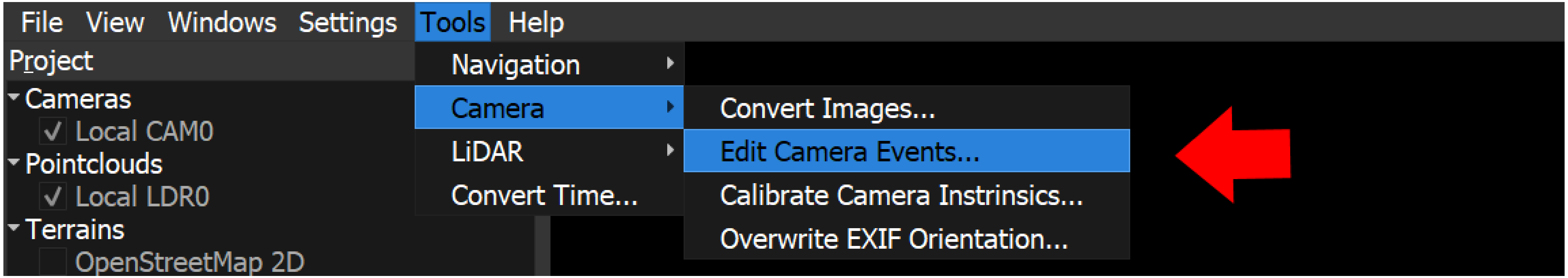
Convert Images



Edit Camera Events

The Edit Camera Events option in SpatialExplorer provides a detailed list view of the position and time metadata of all the images in a .cam file.

Edit Camera Events



Edit Camera Events

Camera: Camera 0 (MicroController) with 1 sessions and 225 exposures on each of 1 receptors

Trajectory: 20170821-195404.nav - NovAtel realtime trajectory

Receptor 0

	Filename	Vehicle Latitude	Vehicle Longitude	Vehicle Altitude	Vehicle Yaw	Vehicle Pitch	Vehicle Roll	Receptor Latitude	Receptor Longitude	Receptor Altitude	Receptor Yaw	Receptor Pitch	Receptor Roll	Time GNSS Week	Time GNSS TOW
1	_DSC0003.JPG	34.128790196	-117.965807814	150.937	-139.993	-3.312	-3.078	34.128790196	-117.965807814	150.937	-2.934	-85.480	-137.148	1963	158651.258750
2	_DSC0004.JPG	34.128655073	-117.965629720	155.463	-139.753	-11.131	-2.844	34.128655073	-117.965629720	155.463	25.816	-78.515	-165.846	1963	158653.292990
3	_DSC0005.JPG	34.128506041	-117.965457009	159.629	-140.163	-3.447	-1.912	34.128506041	-117.965457009	159.629	10.795	-86.059	-151.015	1963	158655.295167
4	_DSC0006.JPG	34.128355666	-117.965293864	163.427	-140.209	-11.653	-1.365	34.128355666	-117.965293864	163.427	33.064	-78.268	-173.413	1963	158657.330820
5	_DSC0007.JPG	34.128194769	-117.965122881	167.079	-139.026	-12.342	-1.046	34.128194769	-117.965122881	167.079	36.091	-77.614	-175.230	1963	158659.298958
6	_DSC0008.JPG	34.128029535	-117.964942815	169.318	-143.049	16.368	-3.503	34.128029535	-117.964942815	169.318	-130.794	-73.271	-11.752	1963	158661.269872
7	_DSC0009.JPG	34.127919576	-117.964846981	170.222	154.701	13.366	-21.043	34.127919576	-117.964846981	170.222	-146.299	-65.234	-56.506	1963	158663.303612
8	_DSC0010.JPG	34.127874308	-117.964879848	170.629	84.921	-23.172	-5.759	34.127874308	-117.964879848	170.629	-109.456	-66.161	-166.805	1963	158665.272034
9	_DSC0011.JPG	34.127864149	-117.965007979	170.864	38.763	9.638	-16.260	34.127864149	-117.965007979	170.864	98.905	-71.165	-58.762	1963	158667.307493
10	_DSC0012.JPG	34.127862736	-117.965029245	170.963	53.944	-0.196	-0.249	34.127862736	-117.965029245	170.963	-177.792	-89.683	-128.264	1963	158669.310899
11	_DSC0013.JPG	34.127858937	-117.965037876	170.962	54.122	-0.813	0.546	34.127858937	-117.965037876	170.962	-91.987	-89.021	146.113	1963	158671.276411
12	_DSC0014.JPG	34.127856828	-117.965043803	170.795	41.620	-0.253	0.950	34.127856828	-117.965043803	170.795	-63.320	-89.017	104.942	1963	158673.312315
13	_DSC0015.JPG	34.127856076	-117.965044933	170.993	41.659	-0.176	0.914	34.127856076	-117.965044933	170.993	-59.226	-89.069	100.886	1963	158675.280298
14	_DSC0016.JPG	34.127854749	-117.965046494	171.033	41.936	-0.316	0.842	34.127854749	-117.965046494	171.033	-68.633	-89.100	110.571	1963	158677.314849
15	_DSC0017.JPG	34.127852873	-117.965049129	170.929	42.016	-0.771	0.758	34.127852873	-117.965049129	170.929	-93.502	-88.919	135.523	1963	158679.284997
16	_DSC0018.JPG	34.127851363	-117.965052926	170.776	42.212	-0.455	0.735	34.127851363	-117.965052926	170.776	-79.526	-89.136	121.742	1963	158681.252384
17	_DSC0019.JPG	34.127849945	-117.965056712	170.587	42.436	-0.124	1.191	34.127849945	-117.965056712	170.587	-53.525	-88.802	95.963	1963	158683.289760
18	_DSC0020.JPG	34.127847477	-117.965061432	170.504	42.585	-0.173	0.828	34.127847477	-117.965061432	170.504	-59.227	-89.154	101.814	1963	158685.292673
19	_DSC0021.JPG	34.127845294	-117.965065416	170.388	42.644	-0.235	0.907	34.127845294	-117.965065416	170.388	-61.865	-89.063	104.510	1963	158687.328643
20	_DSC0022.JPG	34.127843807	-117.965068778	170.109	42.765	-0.190	1.136	34.127843807	-117.965068778	170.109	-56.724	-88.848	99.491	1963	158689.296737
21	_DSC0023.JPG	34.127842101	-117.965070946	169.979	42.825	-0.920	1.723	34.127842101	-117.965070946	169.979	-75.261	-88.047	118.100	1963	158691.264518
22	_DSC0024.JPG	34.127852032	-117.965092774	168.874	50.511	-12.839	2.297	34.127852032	-117.965092774	168.874	-119.258	-76.961	170.028	1963	158693.299055
23	_DSC0025.JPG	34.127889769	-117.965164284	167.569	53.902	5.289	-0.125	34.127889769	-117.965164284	167.569	55.252	-84.709	-1.345	1963	158695.268361
24	_DSC0026.JPG	34.127942561	-117.965238500	166.658	47.364	-21.379	-2.499	34.127942561	-117.965238500	166.658	-139.464	-68.482	-173.644	1963	158697.303597
25	_DSC0027.JPG	34.128067192	-117.965379537	166.472	44.682	-8.507	2.588	34.128067192	-117.965379537	166.472	-118.327	-81.111	163.202	1963	158699.305469
26	_DSC0028.JPG	34.128182429	-117.965516026	166.280	45.671	8.260	1.117	34.128182429	-117.965516026	166.280	37.946	-81.665	7.645	1963	158701.273170
27	_DSC0029.JPG	34.128253262	-117.965598188	166.151	45.914	-4.639	2.623	34.128253262	-117.965598188	166.151	-104.551	-84.672	150.572	1963	158703.309367
28	_DSC0030.JPG	34.128316314	-117.965670271	166.200	45.878	-9.518	1.174	34.128316314	-117.965670271	166.200	-127.059	-80.411	173.035	1963	158705.277894
29	_DSC0031.JPG	34.128396537	-117.965760950	166.195	45.588	-6.324	2.389	34.128396537	-117.965760950	166.195	-113.669	-83.241	159.389	1963	158707.312429

Load photos | Remove Single Event | Export...

Edit Camera Events

- You can also remove camera events from the .cam file with the “Remove single event” button.
- Removing camera events destroys the association between images and events. photos and events.
- After removing events from the .cam file you will need to export the resulting data into a new .cam file. This can be done via the “Export CAM” button.

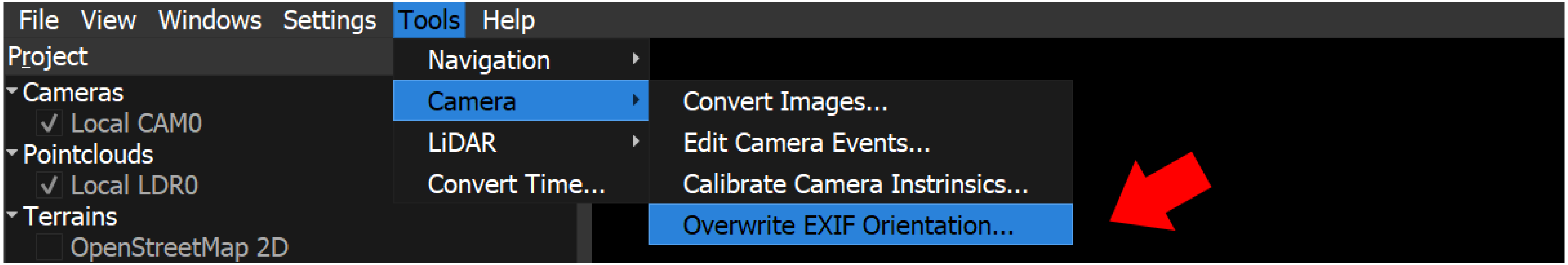
Overwrite EXIF Orientation

- SpatialExplorer allows the user to indicate the orientation manually without actually transforming the image data itself via the "Overwrite EXIF Orientation" option.

- EXIF specification defines an Orientation Tag to indicate the orientation of the camera relative to the captured scene.

- Can be used by the camera to indicate the orientation automatically with an orientation sensor.

Overwrite EXIF Orientation

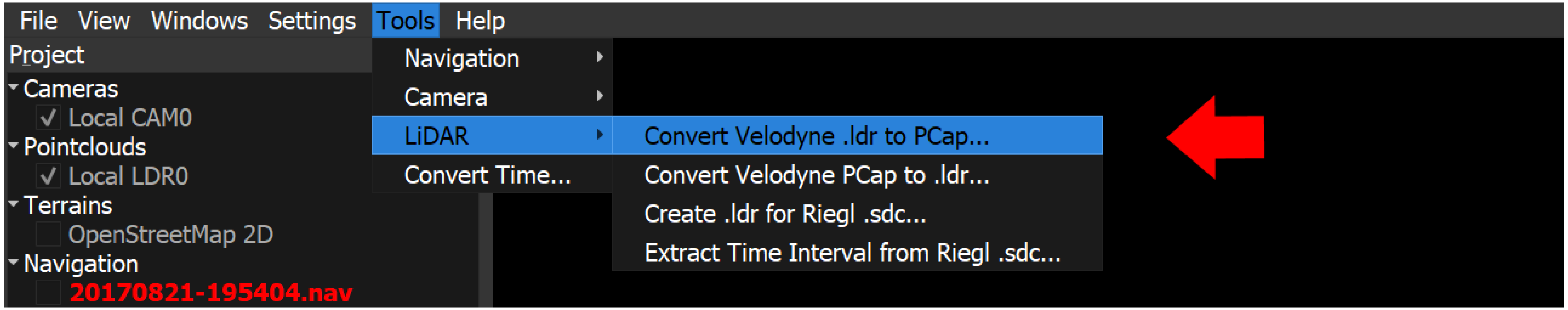


Overwrite EXIF Orientation

- Before proceeding you must backup the images. Any changes to the EXIF orientations will be permanent.
- Once you've created a backup of the images, select the header angle and direction by which the images will be rotated. Click the "OK" button to overwrite the EXIF orientation metadata

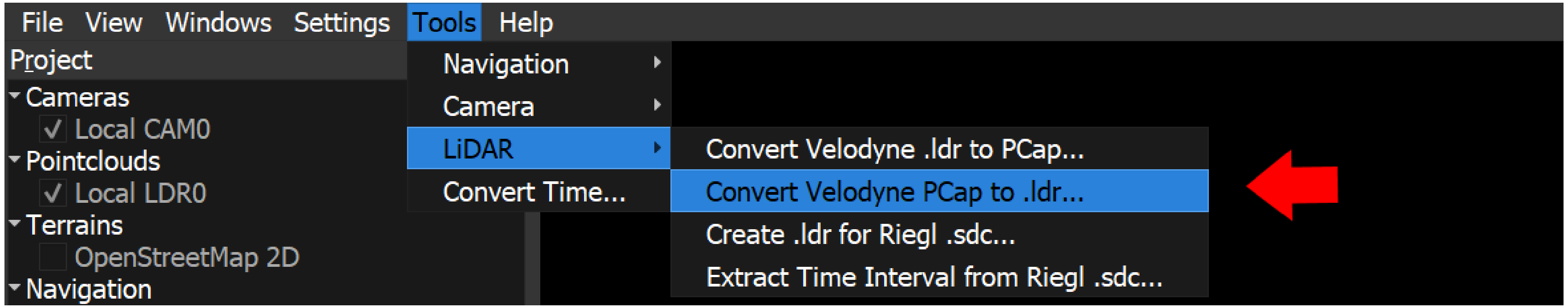
Convert .ldr to PCAP

- Convert a Velodyne .ldr file to a de facto standard network packet capture file format called a .pcap file. Many publicly available Velodyne HDL packet captures use this PCAP file format as a means of recording and playback.



Convert PCAP to .ldr

- Convert a .pcap file to an .ldr file. You can obtain .pcap files from Network Packet Analyzer Programs such as Wireshark which is available for most platforms, including Linux, MacOS and Windows



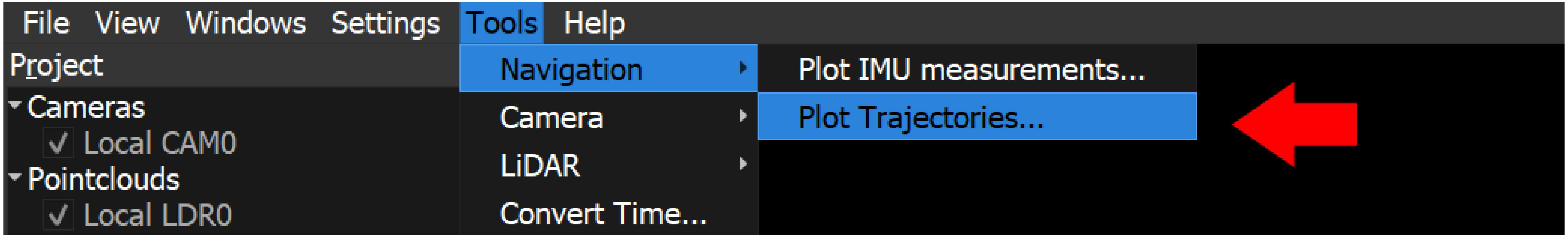
Plot Trajectories

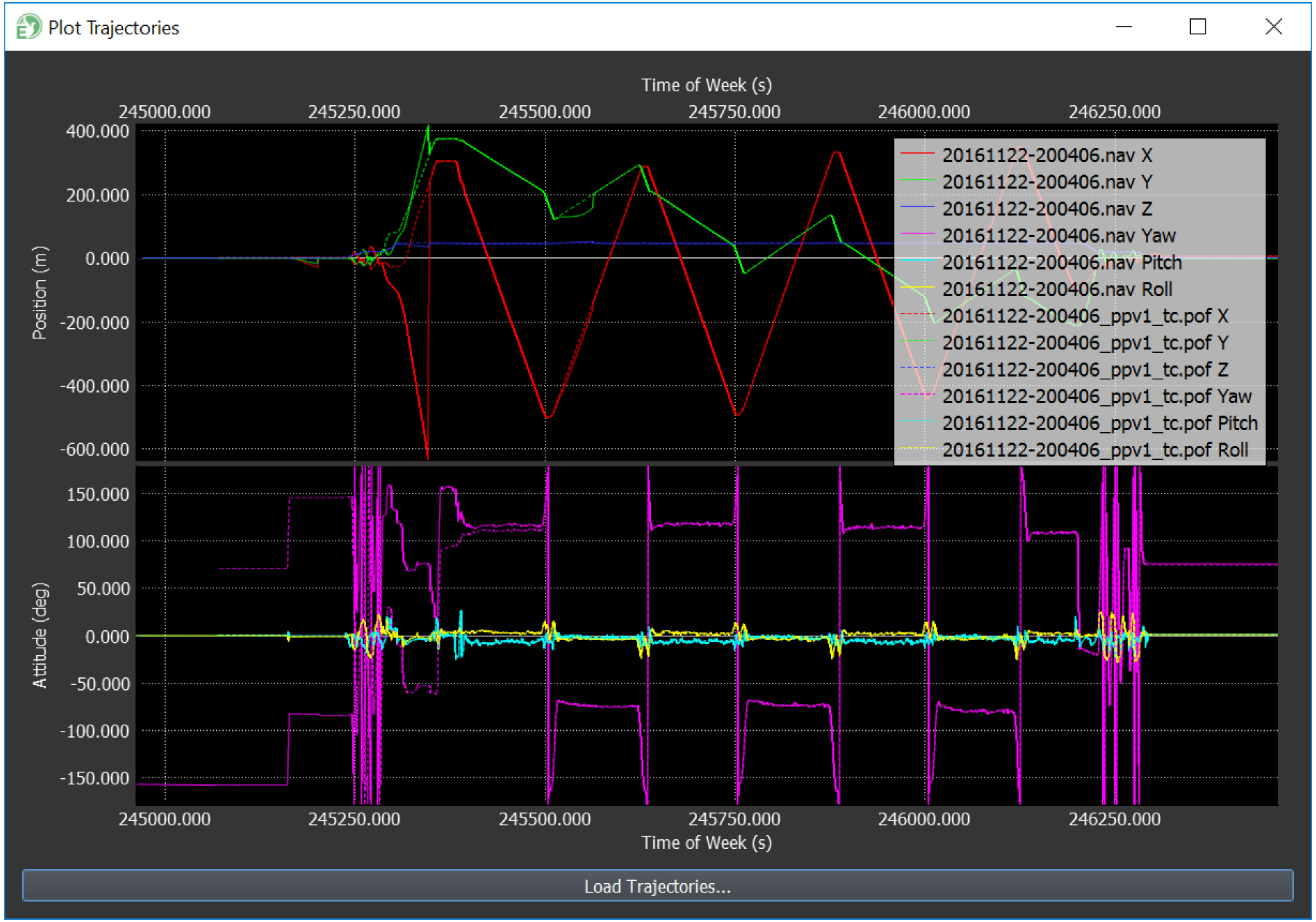
- Load and compare several real time trajectories.

- Useful for debugging and comparing trajectories.

- Load as many trajectories you wish to compare and it will display the data of each graph on one single plot interface

Plot Trajectories





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