VOYIS

Product Training

Insight Nano

Version: A

WELCOME

Agenda

1. Laser Safety
2. Principles of Operation
3. Maintenance & Care
4. ViewLS Software
5. Pre-Dive Test
6. Best Practices

Tim Scott
Voyis Technical Support

Laser Safety

LASER SAFETY

Warning

Caution! Laser light, avoid direct eye exposure, class 3R laser product

CLASS-3R LASER as per “IEC 60825-1: Safety of Laser Products”

Guidance offered herein, however, your local safety guidelines and standards always take precedent

Laser Type: Laser Line Generator
Wavelength: 450nm OR 520nm
Laser Power for Classification: <15mW
Emission Type: Pulsed
Pulse Width: 0.1 mSec to CW
Pulse repetition frequency: 0.001 Hz to 150 Hz
Beam Diameter: <3mm x 26mm at NPHA
Divergence: <1.5mrad x 80 degrees

Laser Function and Control

Control 1: Protective Housing

The laser is fully enclosed in a housing to prevent human access to radiation, other than access through the clearly labeled aperture. This housing should never be opened or disassembled.

Control 2: Remote Control

The computer-based control software enables the user to control the laser at a distance significantly away from the laser aperture, such that the user does not need to have direct eye exposure to laser emissions to operate the device. The user should never need to be in front of the laser aperture to control the laser scanner.

Laser Controls Diagram – Insight Nano

LASER SAFETY

Instructions for Safe Use

1) Review Safety Labels & Warnings outlined in this manual.

2) Establish a Laser Safety Warden.

a) Ensure all personnel within the area of operation have appropriate personal protective equipment and are informed on the hazards of this system.

b) If indoors, access to area of operation should be controlled and have appropriate warning signs posted on all entrances indicating a laser is in use.

3) Ensure the unit is unpowered and disconnected.

4) Identify the location of Laser Hazards on the unit.

a) Ensure Laser is directed away from personnel to prevent accidental laser exposure.

b) The Laser Exit aperture is clearly marked with yellow laser hazard signs. Personnel should not go in front of the Laser during its operation.

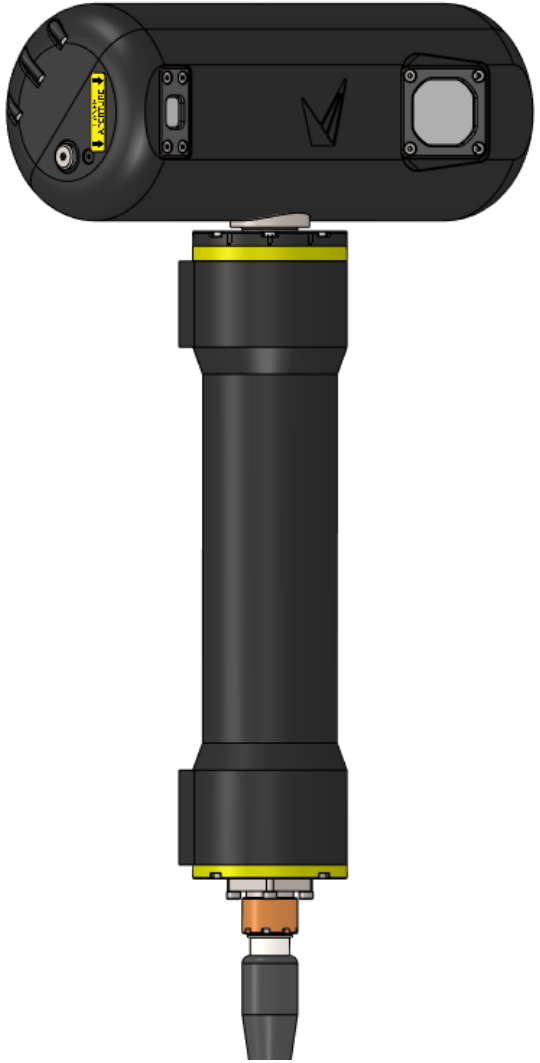
5) Review Laser Controls and ensure they are in place.

6) Proceed to power the unit and begin using the laser scanner product, monitoring for the below risks.

a) Ensure everyone in the area of operation is wearing appropriate laser safety glasses.

b) If placed in water: Ensure there are no divers in the vicinity of the laser aperture

c) If placed in air: Ensure no one enters the area in front of the laser aperture



LASER SAFETY

Good Practice

- Ensure all personnel involved in product use have read the User Manual sections relating to Laser Safety
- Have a controlled entrance/exit to exposed laser areas (locked room or marked off)
- Avoid being in front of the laser when scanning
- Avoid directing looking at the laser reflections when scanning in air

Product Overview

PRODUCT OVERVIEW

Nano Models

Insight Nano

Scan Range
0.13m – 1.0m

Insight Nano XR

Scan Range:
0.4m – 2.5m

Effective Resolution (points/mm) is higher at closer ranges

As range increases, depth resolution decreases

Overview

What's inside the Box?

Insight Nano – Laser Scanner Product

Deck Lead – Subsea cable with topside junction box

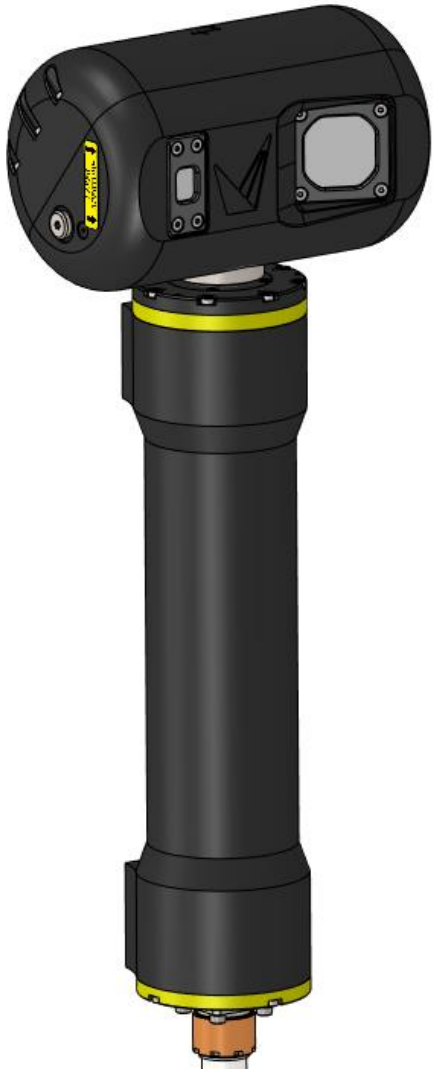
AC Power Adapter – Provides DC power into Deck Lead

Ethernet Cable – Connection to Laptop

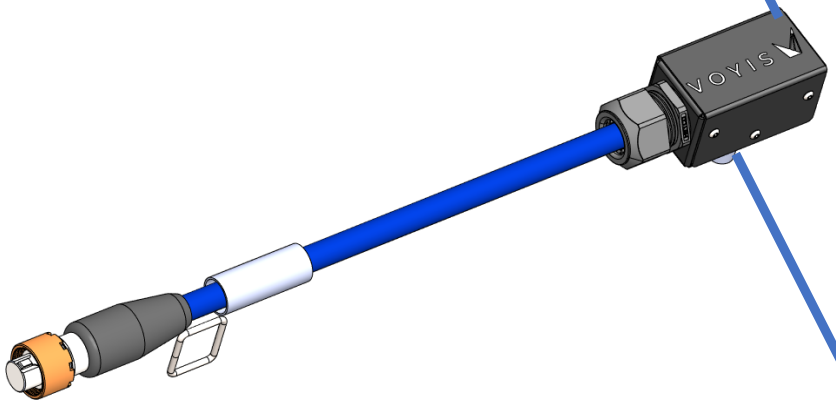
USB Drive – User Manual, Software

Overview

Components

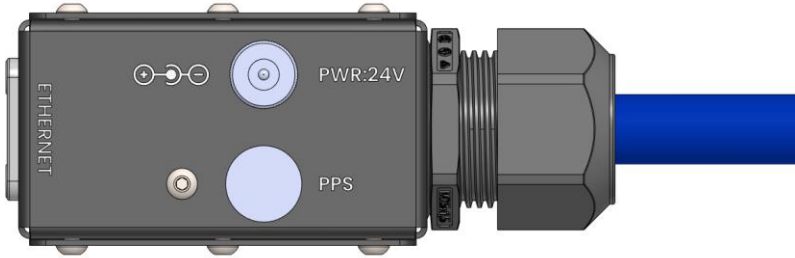


Ethernet
Control



Power Input from AC Supply

Subsea Cable



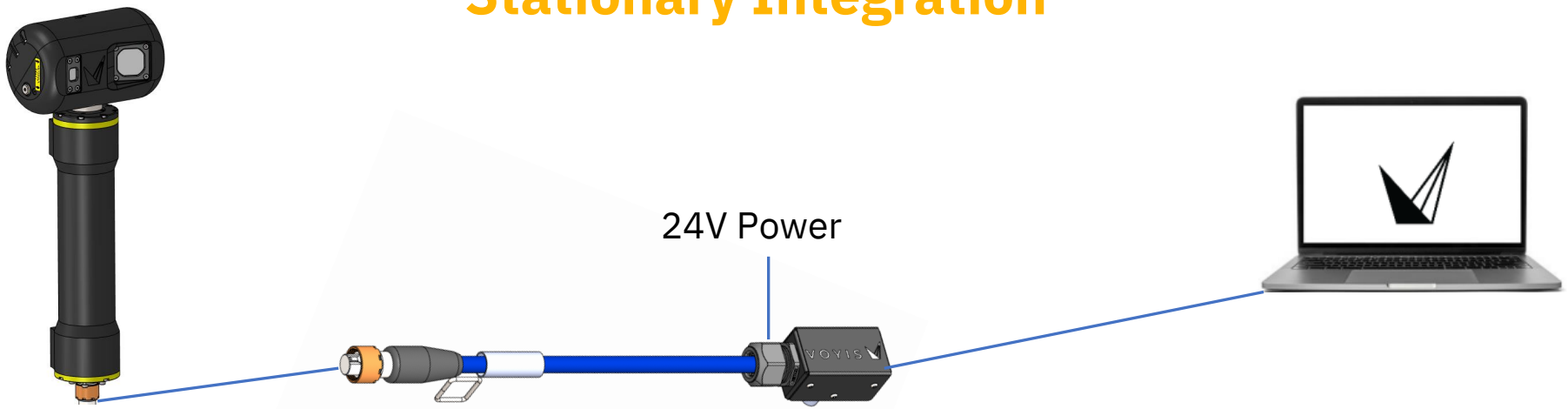
Deck Testing Cable with:

- PPS Time Synchronization Input (optional)
- Power Input
- Ethernet Connection

SYSTEM CONTROL

Connections

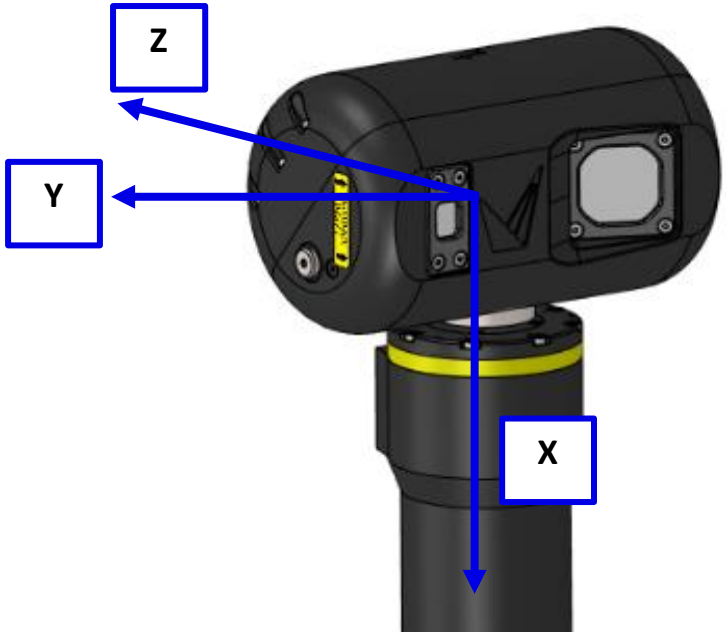
Stationary Integration

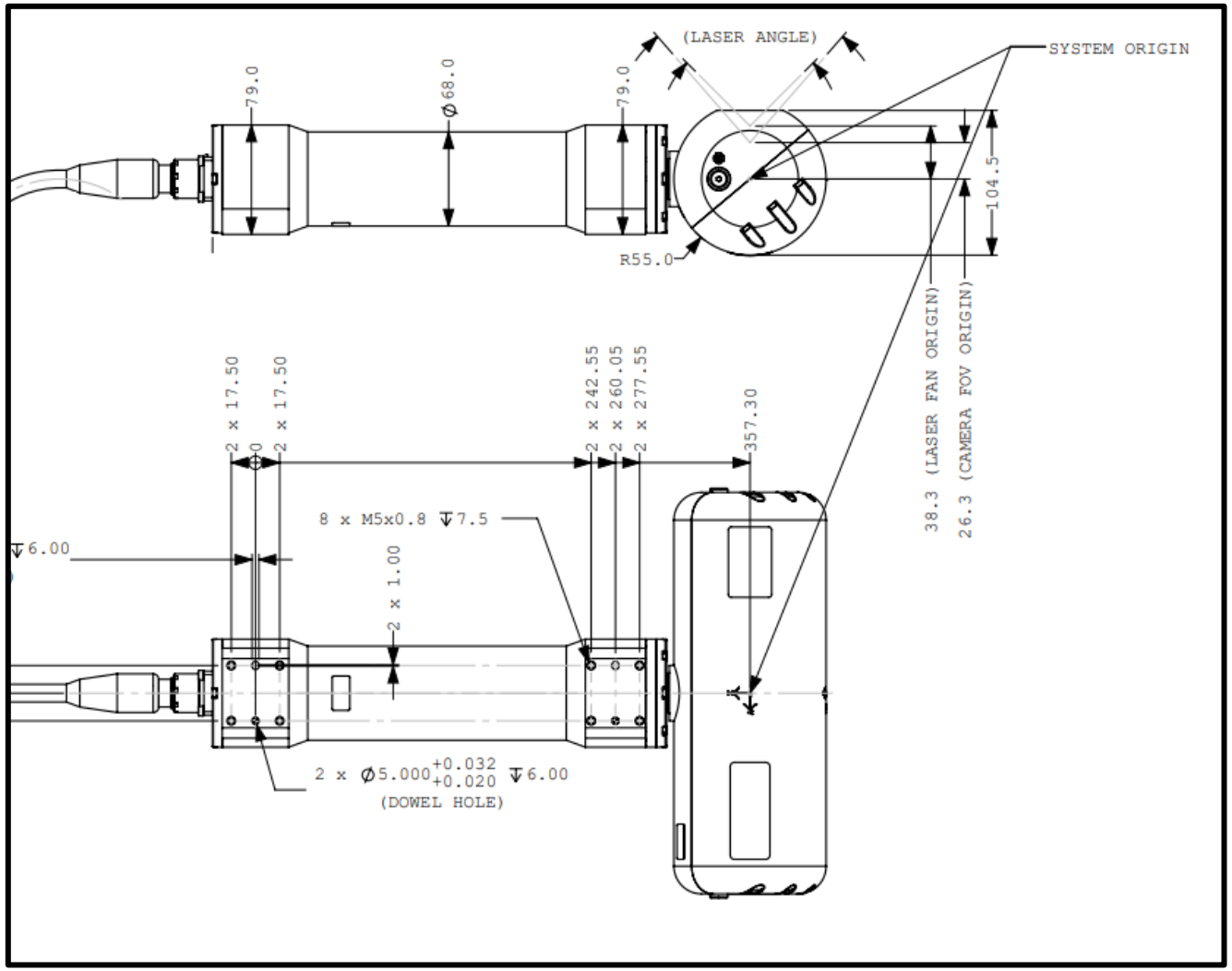


ROV Integration

Orientation

- Coordinate System for 3D Point Cloud Data captured
- **Home Position** is the 0° position of actuator
- Y and Z orientation shown below. Note Z direction is negative in front of scanner face

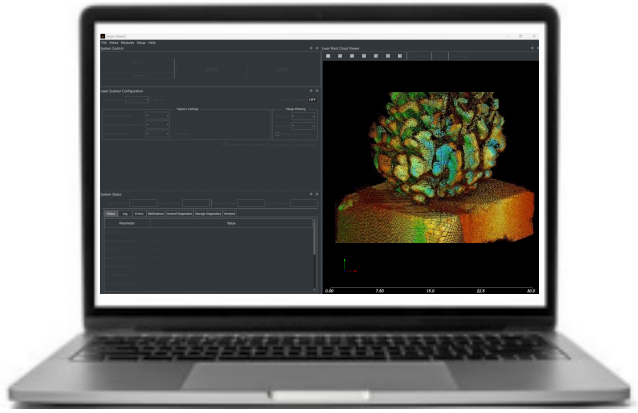




Overview

Laser Scanning

- The product is controlled by the **ViewLS** software, which runs on a laptop (control PC)
  - See ViewLS Manual for complete details
- Mount the Insight Nano with the **actuator** held fixed/stationary
- When you “start” a scan, the **scanner head** will begin to rotate around, capturing laser profiles at each “step”
- Laser data is viewed in real-time in **ViewLS**
- Laser data is saved to a **Data File** that can be viewed in third party **Point Cloud viewing software**



Actuator Held Stationary

Deployment Example

Actuator Mounted Stationary
Scanner Head Free to Rotate

Scanning Operation

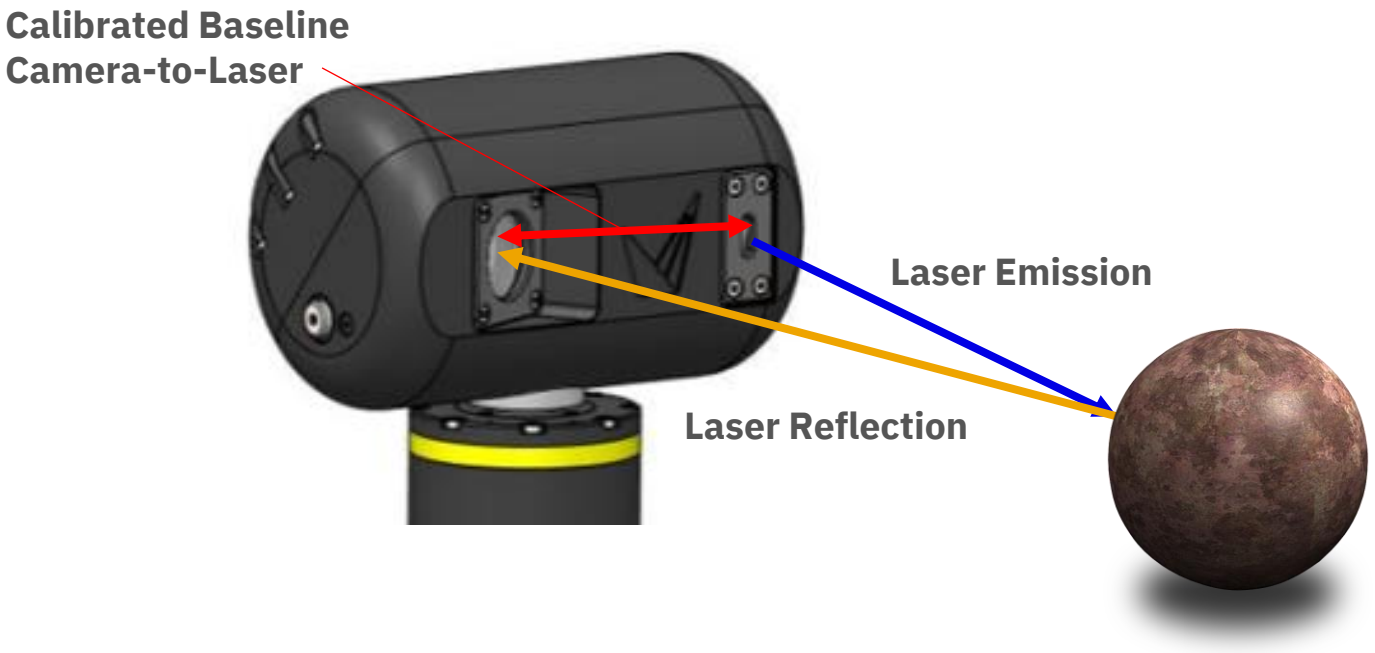
Data Result

Principals of Operation

PRINCIPALS OF OPERATION

Basic Principals

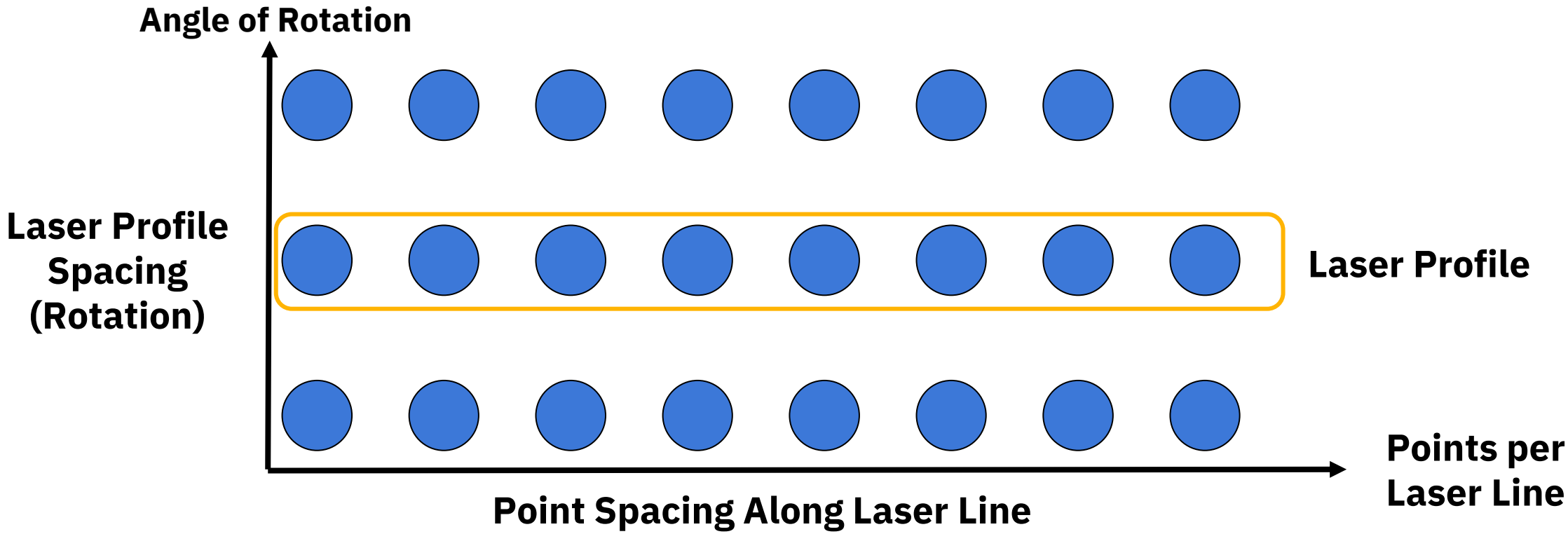
- The system uses a method of Triangulation to calculate data points on the target
- Factory calibration defines the relative position of the Camera & Laser
- Laser projects a laser line onto the target (50° swath)
- Camera captures an image of the laser line, calculating 2064 data points along it



PRINCIPALS OF OPERATION

Laser Data Resolution

- Insight Nano captures a "**Laser Profile**" of 2064 data points on the target at each angular position, as it rotates the scan the target
- Effective resolution reduces as range increases, 2064 data points are spread over a longer line
  - Note: Laser points are not evenly spaced along the laser line due to refraction. Spacing decreases towards edge.



PRINCIPALS OF OPERATION

Control

LASER Toggle

ON

OFF

CAMERA EXPOSURE

50ms

1ms

***Note: Although ViewLS shows a percentage, the Nano Laser can only be toggled to ON (100%) or OFF (0%).**

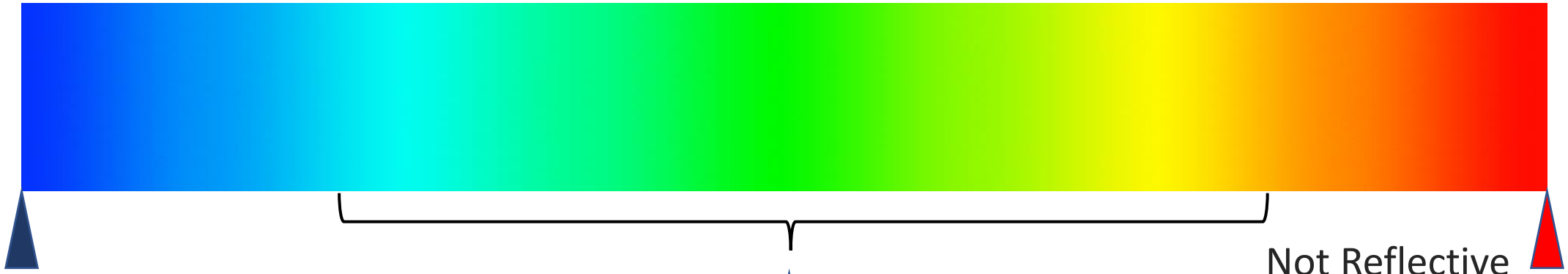
Camera Exposure is the length of time the camera is collecting light

***Note: Camera Exposure is the primary mechanism used to control intensity (brightness) of the captured points.**

PRINCIPALS OF OPERATION

Data Point Intensity

- 3D points captured on the target have an “intensity” that represents laser reflection strength
- Intensity is used to “colour” the data points, using the below scale
- Ideal intensity is in the “middle” of the range, to allow both bright & dark areas to be observed



Low Intensity Reflection

- Use a higher Camera Exposure

Ideal Intensity Reflection

- Correct Camera Exposure used

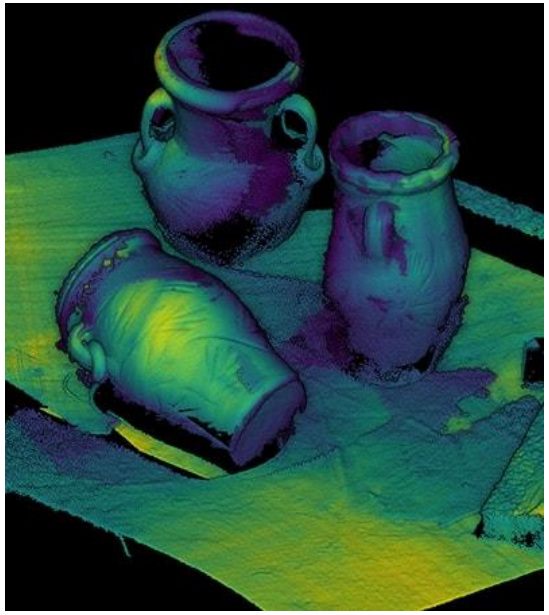
Not Reflective

- Consider Using:
  - High Camera Exposure

PRINCIPALS OF OPERATION

Data Point Intensity

Good target intensity (green)
Some shiny areas are over-saturated (red)
Consider another scan with lower camera exposure

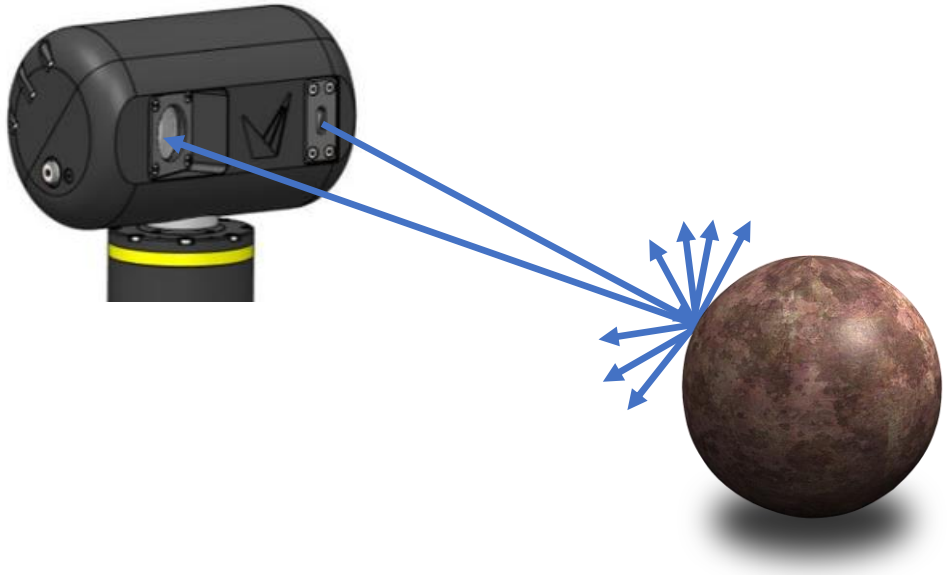


Good target intensity (green)
Some dull areas are under-saturated (blue)
Consider another scan with higher camera exposure

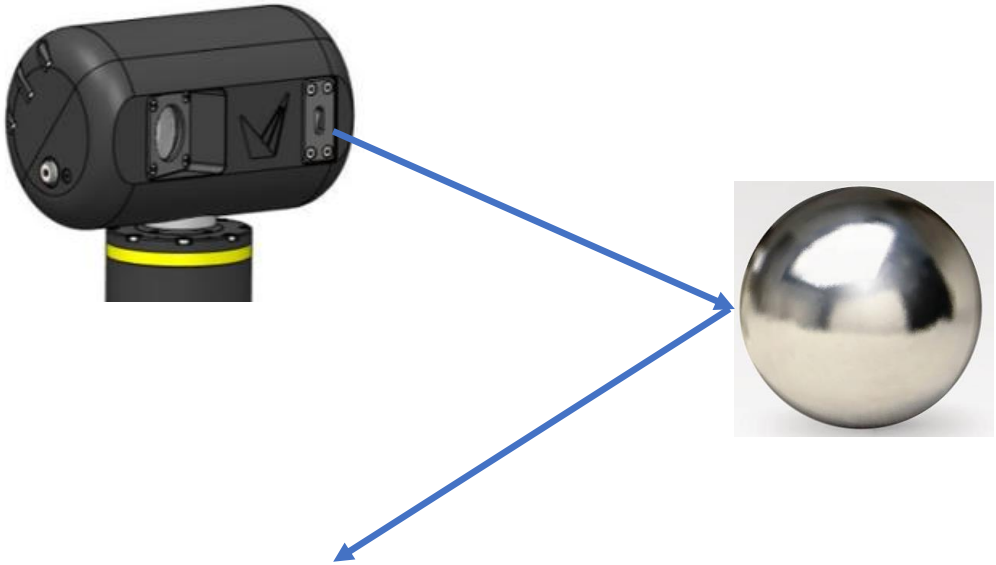
PRINCIPALS OF OPERATION

Target Diffusivity

- **Dull/Matte/Diffuse** materials are best to scan since they reflect light back in all directions



- **Shiny Materials** are more challenging to scan as reflections can have a specific direction



Camera Exposure Recommendations

- Recommended initial exposure times (milliseconds) for various target materials

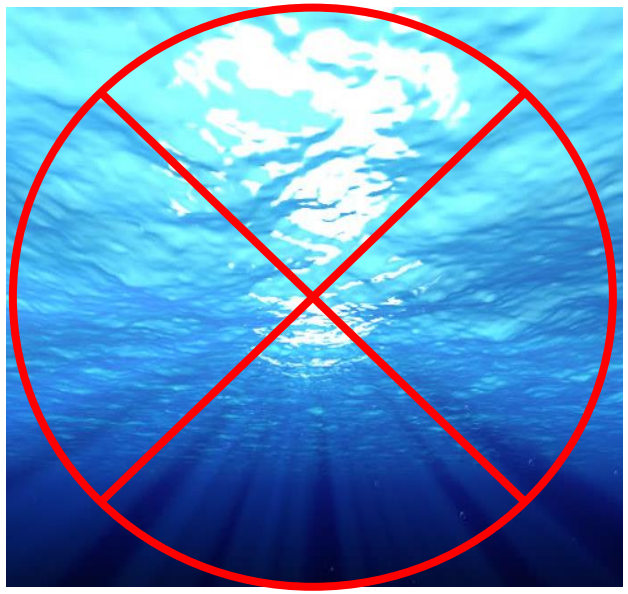
	Material Characteristics		
Range (m)	**Light/Dull** White Paint	**Light/Matte** Concrete	**Dark/Dull** Black Paint
0.2m	0.5ms	0.5ms	0.5ms
0.4m	0.5ms	1.0ms	1.5ms
1.0m	1.5ms	5.0ms	30ms
1.5m	2.0ms	20ms	50ms
2.0m	3.0ms	35ms	50ms
2.5m	5.0ms	50ms	50ms

- These are recommended starting points. Then adjust exposure to optimize target intensity.
- For most scans, an **initial camera exposure of 5ms (0-1m) and 10ms (1-2.5m)**
  - Data will be effectively collected at these starting points, it may just not be optimized
- For very shiny target, particularly at <1m distance, exposure times as low as 1ms are common
- Scanning in water or air require a similar exposure

PRINCIPALS OF OPERATION

Ambient Light

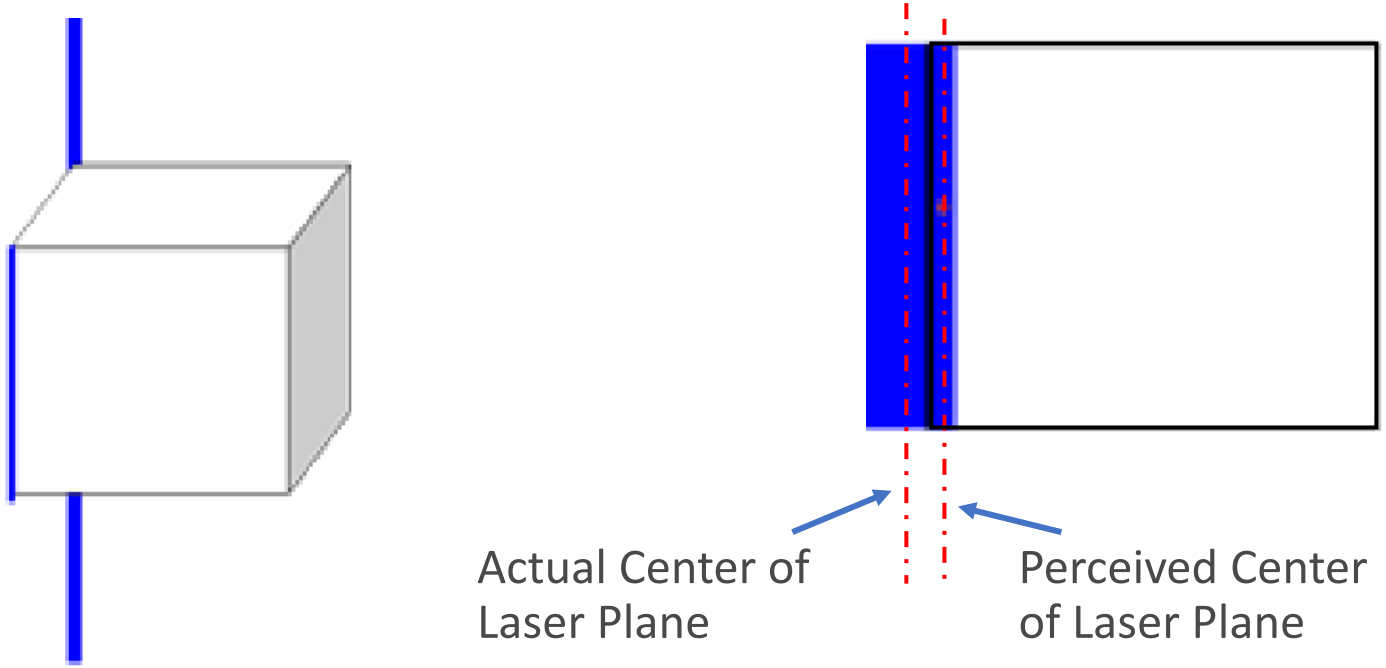
- The Insight Nano must be able to observe the laser line to function effectively
- External Light Sources (Sun, ROV Lights) will “wash out” the laser line and make it more challenging to detect. This causes noise in the laser data, or in some cases not produce any usable data
- The Insight Nano has an Ambient Light filter to reduce this effect
- **Scan in as dark of an environment as possible for the best results**



PRINCIPALS OF OPERATION

Edge Effect

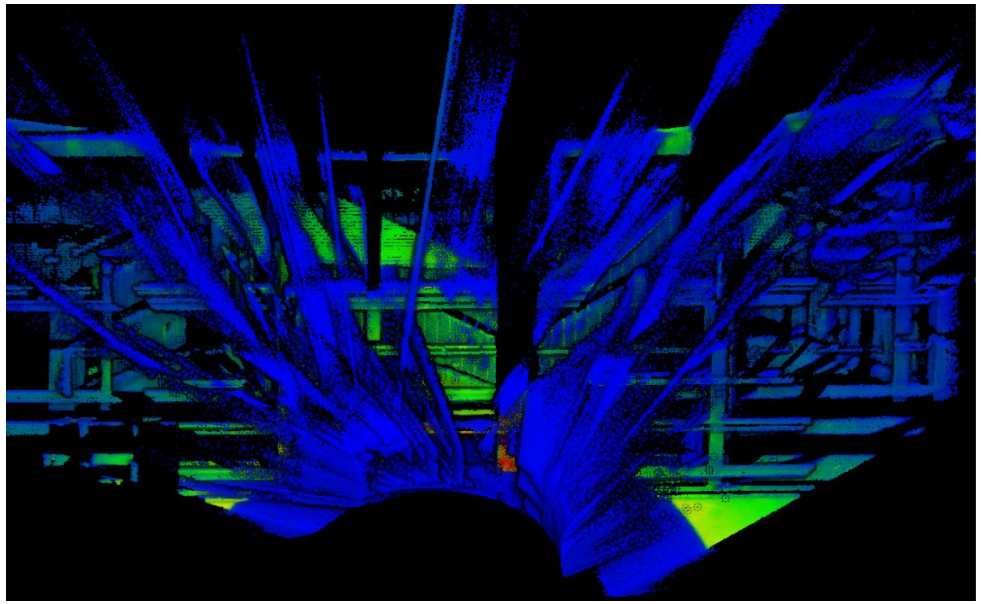
- When the laser line is parallel to and located on a sharp edge, the system may have a hard time determining the exact position of the laser line.
- Resulting data points may appear to “shear” off the edge toward or away from the edge
- Scan with the laser line perpendicular to the “edge” of interest to minimize effect



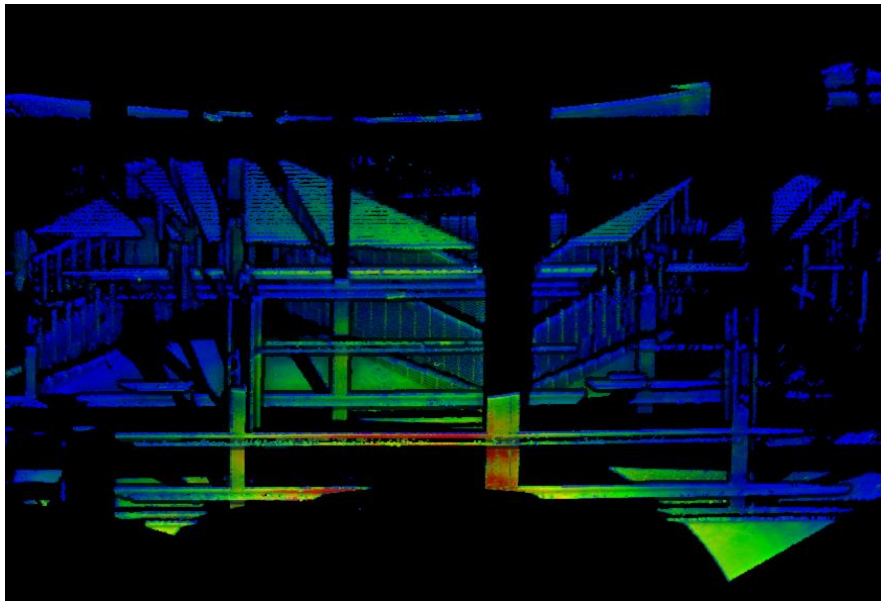
PRINCIPALS OF OPERATION

Data Quality & Noise

- **Noise** can appear in the scan data for numerous reasons such as: turbid water, ambient light, edge effect, etc.
- Noise is typically returned with low intensity (blue) and quality values and can be filtered out of the result.
- The **ViewLS Data Module** can be used to autonomically filter/remove this noise



Resulting Scan data with Noise



Nosie filtered out

PRINCIPALS OF OPERATION

Water Turbidity

- Water Turbidity – Particles in the water – Will block laser line from reaching the target
- If the Insight Nano cannot observe the laser line on the target, it cannot scan it
- **Rule of Thumb** – If an underwater camera can “see” the target, then it can be scanned
- The type of turbidity will affect performance:
  - Fine dispersed particulate can fully block the laser line
  - Large particulate can block portions of the laser line, causing noise
  - Algae can absorb the blue laser light, even if you can see through it

PRINCIPAL OF OPERATION

Data Output Format

- Collected Laser Data is saved in an .XYZ format
- Each data point is represented as a ‘row’ in the .xyz file.
- 2064 consecutive rows form laser line worth of data
- Each data point has 6 values (metadata) as shown below

Item	Description
Time Synchronization	External Time Source Connected: Absolute time in microseconds from connected time source (UNIX EPOCH) No External Time Source Connected: Absolute time in microseconds from when system powered on
X	Point X coordinate (meters)
Y	Point Y coordinate (meters)
Z	Point Z coordinate (meters)
Intensity	Data point intensity (0 – 4095, 0 = low) → Strength of laser return
Data Quality	Data point quality (0 – 4095, 0 = low) → Measure of confidence in the data point based on the detected data point intensity compared to the background intensity (noise)

PRINCIPALS OF OPERATION

Dynamic or Static Scanning?

Stationary Scanning

- Using the Actuator to move the Laser Line across the target
- Actuator held stationary, the head is slowly rotated
- **Examples:** Mounted on Tripod, or Stationary Pipe Crawler

Dynamic Scanning

- Using an external device to move the entire Insight Nano across the target → **Laser Profiling**
- Requires External Navigation Data to define the relative position of the laser profiles.
- **Examples:** Deployment on an ROV, or Robotic Arm

Maintenance & Care

MAINTENANCE & CARE

Sealed Housings & Calibrated Components

Do not open the housing or remove any bolts

The internal pressure is held at vacuum to detect possible leaks

Removal will VOID Warranty and Break the Calibration

Re-Calibration will be required at Voyis facility

MAINTENANCE & CARE

Optical Ports

- Take special care of the camera and laser ports.
- **Clean with water and a soft, lint-free cloth prior to use. Take care to avoid scratching or scuffing. Never use abrasives or chemical cleaners on the viewports.**
- Replacement of Optical ports requires re-calibration at Voyis

MAINTENANCE & CARE

Care

- **Before Use**
  - Inspect subsea connectors and bulkheads – Ensure it is Dry and Pins are straight
  - Inspect and/or wipe all viewports (see previous slide)

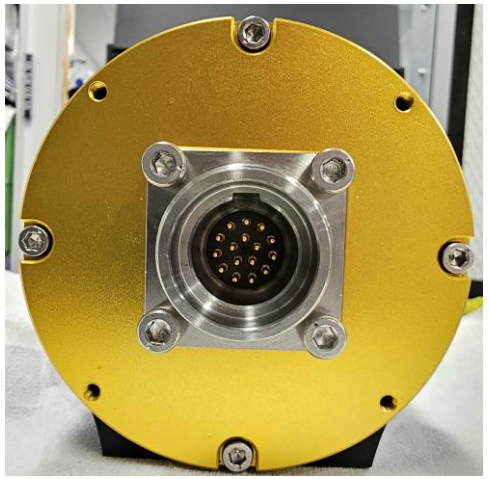
- **After Use**
  - Rinse the product with fresh water
  - Focus on the connection between scanner head & actuator to insure it is free of any debris
  - Inspect all components for wear or damage
  - Inspect bulkhead connections. If any show corrosion, clean with alcohol

MAINTENANCE & CARE

Cables & Connectors

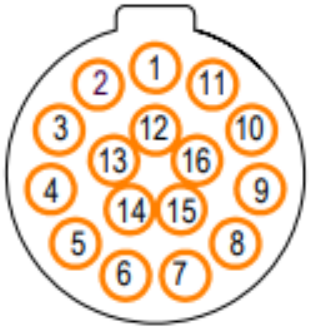
- Insight Nano uses a **CRE P-size 16pin** underwater connector on the bottom of the actuator. This is a Dry-Mate connector (o-ring seal).
  - **Do not submerge the cable end or scanner connector in water without cable installed.**
  - **If either the cable or scanner connector becomes wet, use clean compressed air to dry the pins & sockets thoroughly before use**
- **Inspection:** Visually inspect the connector pins to ensure they are not bent or damaged. Even a slightly bent pin may result in damage when mating with the sockets.
- **To Install:** The cable and scanner connectors have a keyway. Look at the scanner connector first to identify the keyway location. Line up the keyway between the cable and connector
  - Carefully engage the cable and connector
  - Thread on the locking collar until fully engaged. You may gently adjust the cable position to ensure a straight connection while threading. **You should never need a tool to install or remove the cable collar**

Scanner Connector



Cable Connector

CRE 16 Socket Face View

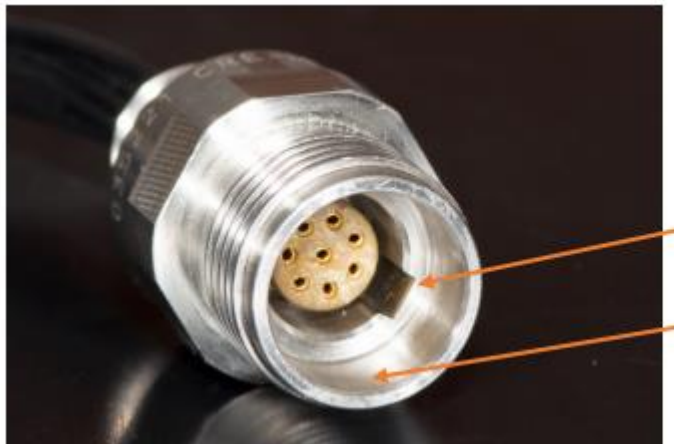


16 WAY
600 VDC

MAINTENANCE & CARE

Cables & Connectors

- **Keyway** must be aligned between Cable & Connector
- The **O-ring** seals on the inside surface of the Bulkhead
  - Verify there are no scratches on o-ring surface
- **Rubber O-rings** are installed on the Cable Connector
  - To inspect the O-rings, remove the Locking Collar
  - Spirolox retaining ring needs to be removed to slide back the locking collar
  - Lubricate with Silicon Grease such as Corning Molykote 111
  - Replace o-rings carefully with a proper tool



MAINTENANCE & CARE

Connector Installation

- Before making the connector up to the bulkhead,
  - Inspect the seal bore of the bulkhead to ensure that it is clean and free of damage
  - Visually inspect the pins for any sign of damage or misalignment in the connector / bulkhead
  - Visually inspect the location key and keyway for any sign of damage
  - Lightly grease the seal bore of the bulkhead with the Dow Corning Molykote 111

- Check the alignment of the key and the keyway and make up the connector to the bulkhead
- The connector should make up with bulkhead by hand without the use of significant force
- It may be necessary to gently move the connector up/down relative to the bulkhead to assist make up
- Once the locking collar is fully made up, the thread should not be visible
- If a connector has been made up for some time it may be necessary to use a suitable sized C spanner in the locking collar castellations to start unloosening the collar.
- DO NOT use mole grips, pipe wrenches etc. during make up or break out of the locking collar!

MAINTENANCE & CARE

Calibration

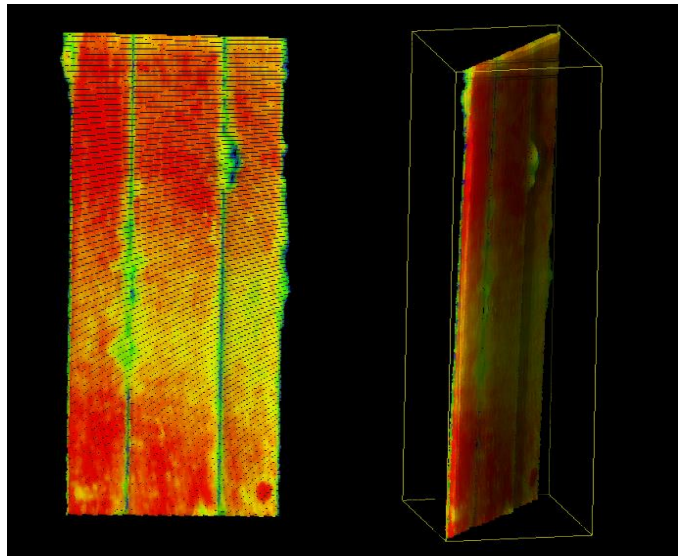
- With careful use, the product does not need to be recalibrated.
- Most common cause of a “broken” calibration is High Impact to the scanner, causing the camera and laser to move/shift in the housing.
- Customers can request calibration verifications and renewed certificates as required. This is conducted at the Voyis Facility

Is your scanner calibration damaged?

The quickest way to check calibration is to scan a flat surface.

Scan in air and with Index of Refraction set to ‘1’

If the surface appears curved or warped, then your Insight may require re-calibration at Voyis



System Control

VIEWLS

Computer IP Network Setup

All scanners will come with a sticker on the back of the Scanner Head indicating the **set IP address.** This is the IP address that will need to be input into ViewLS to connect to the scanner.

You will have to set your computer to the same **subnet** mask to match the Nano. (see next slide). Eg: “192.168.**50**”. The last three digits of your computers IP address can be anything between 001 and 255, as long as it's not in use by another device on the network.

Incorrect Setup

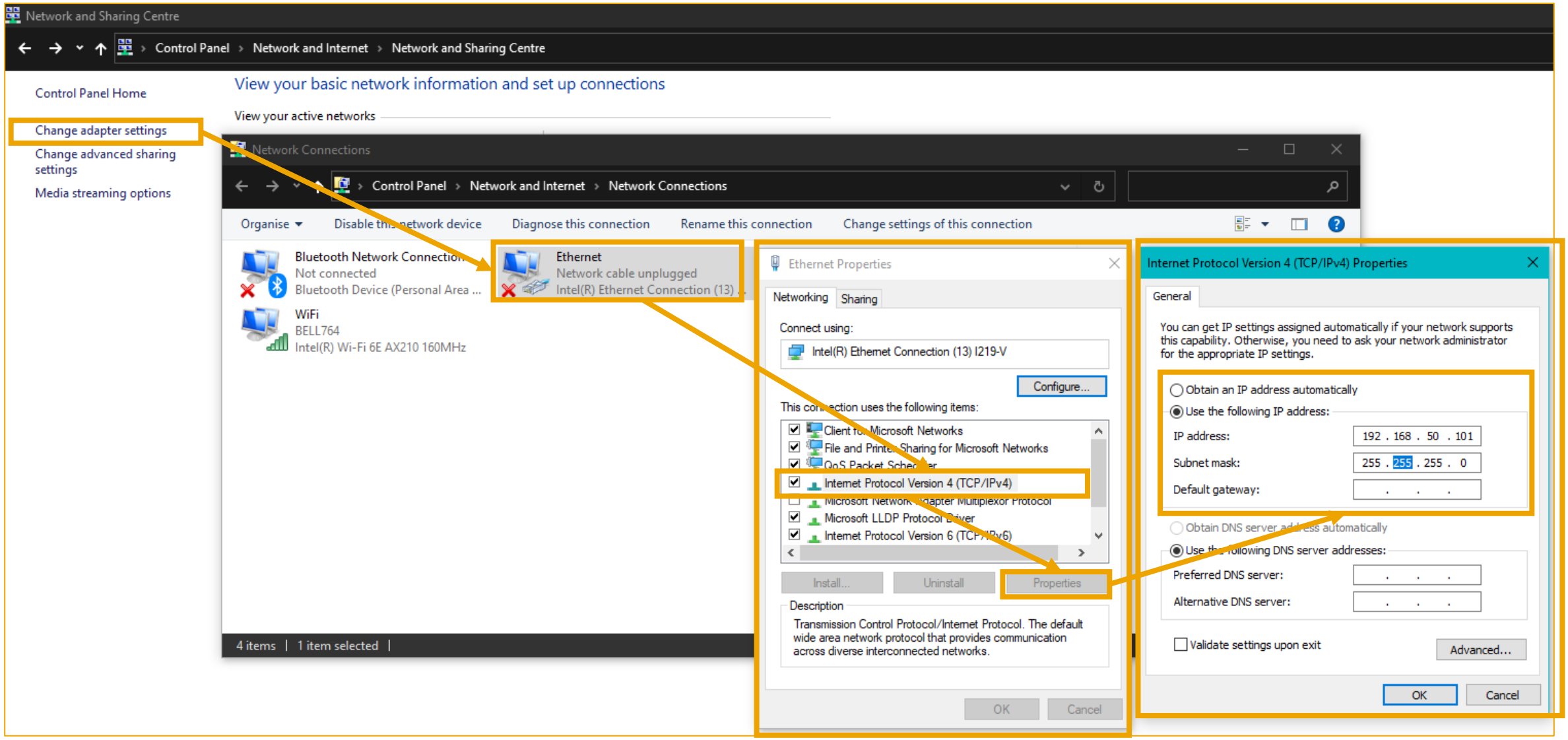
System	IP Address
Nano Scanner	192.168.50.103
Computer - ViewLS	192.168.14.101

Correct Setup

System	IP Address
Nano Scanner	192.168.50.103
Computer - ViewLS	192.168.50.101

VIEWLS

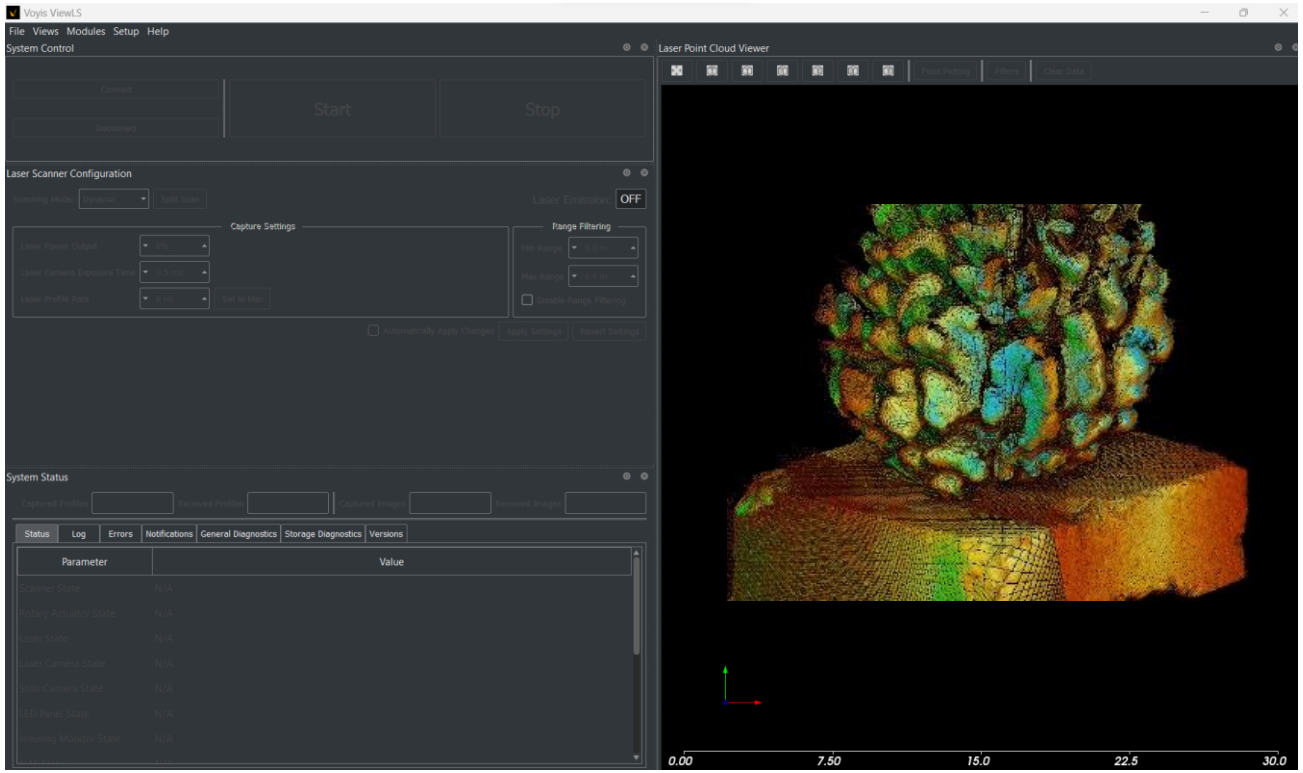
Computer IP Network Setup

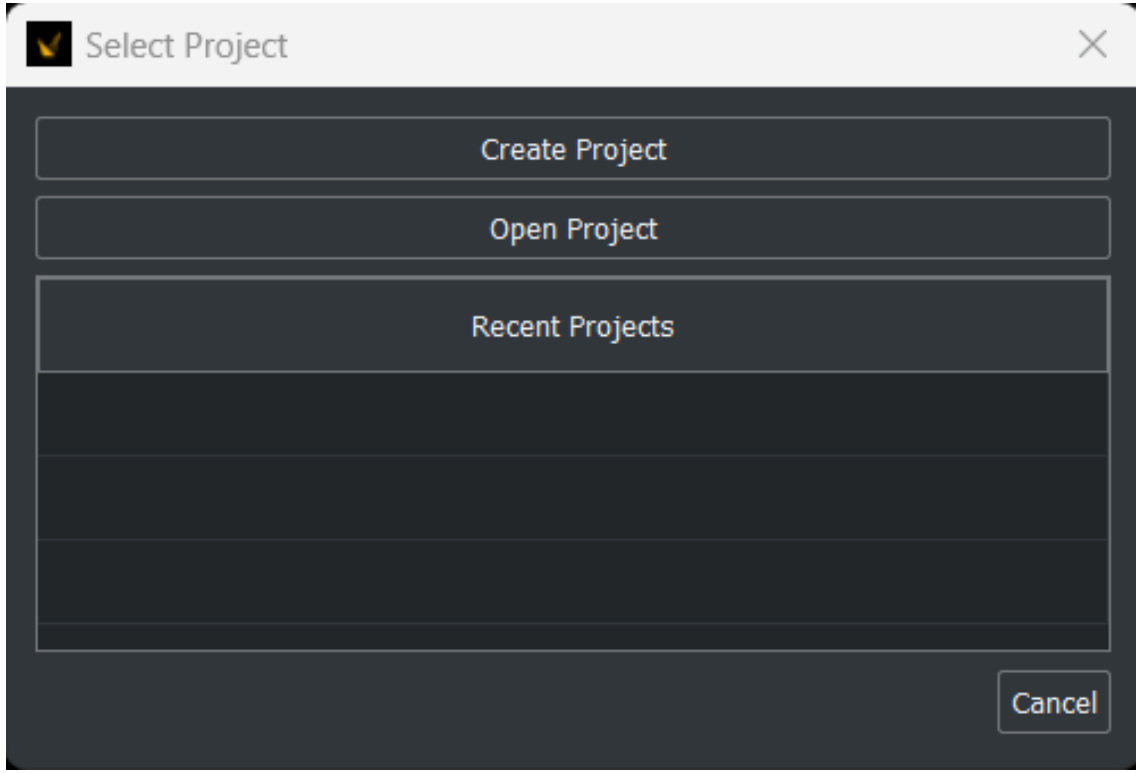


VIEWLS

Getting Started

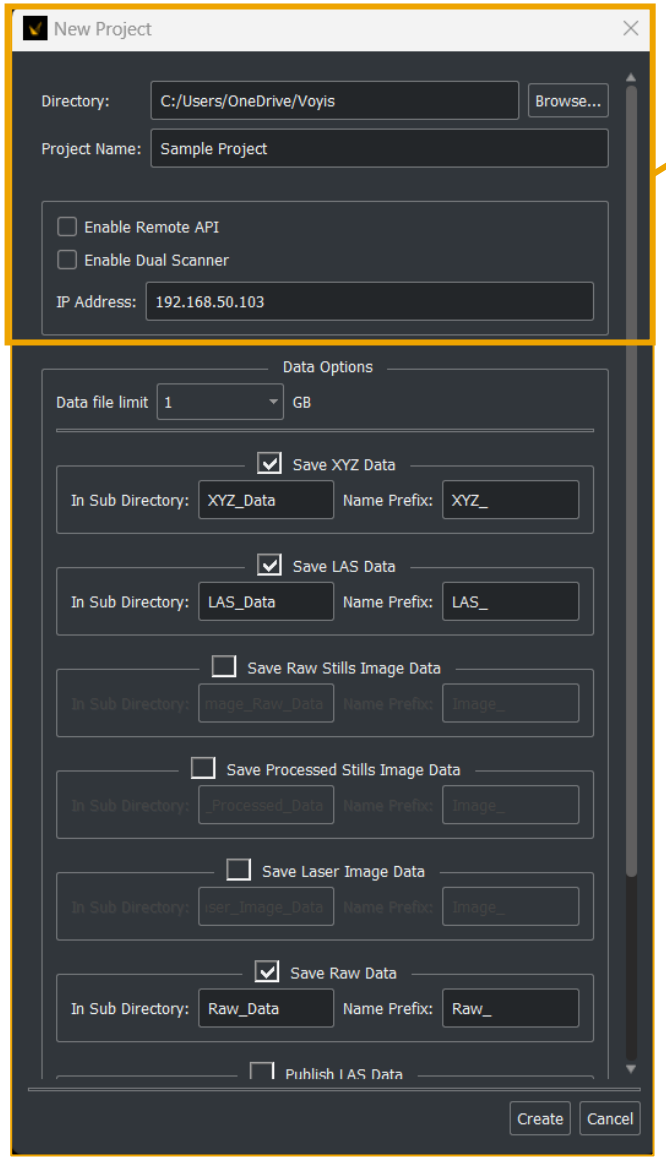
- Read the **ViewLS Manual** for a complete understanding of the software
- Install the Software on a compatible Windows computer
- Launch the ViewLS software, and Create or Open a “Project”
- In order to run ViewLS you will need Windows 7 or newer

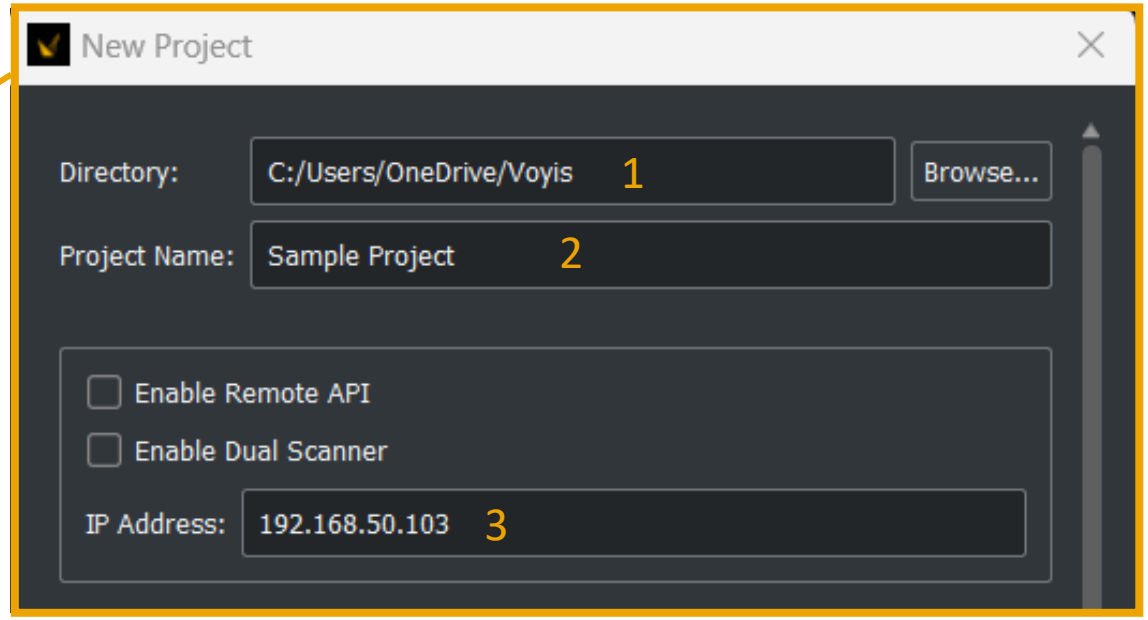




VIEWLS

Creating a Project

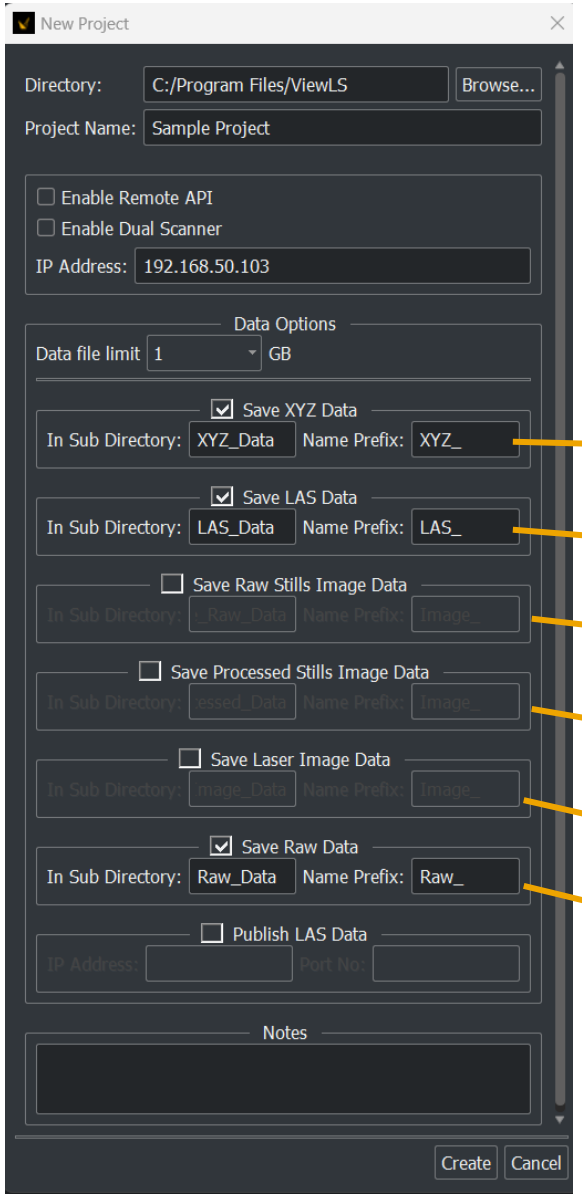




1. Directory where all project files and settings are saved.
2. Name of Project
3. This is the IP address of the Insight Nano (located on Control Housing)
   - Ensure computer is on same subnet xxx.xxx.50.xxx (next slide for instructions)

VIEWLS

Data Output Selections



XYZ data is the most common (open format) data output - Check

User preference. LAS data is typically used for streaming data to NAV software - Check

Do not use for the Nano - Uncheck

Do not use for the Nano - Uncheck

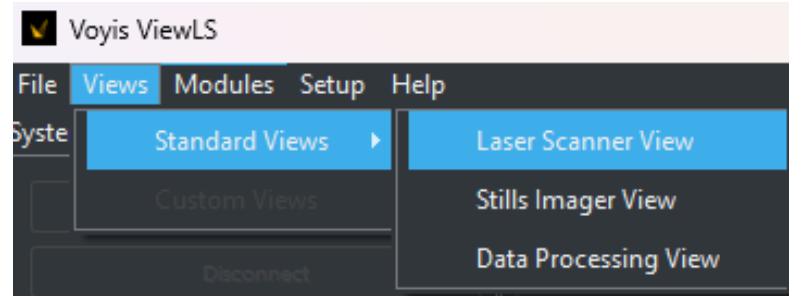
Do not use for the Nano - Uncheck

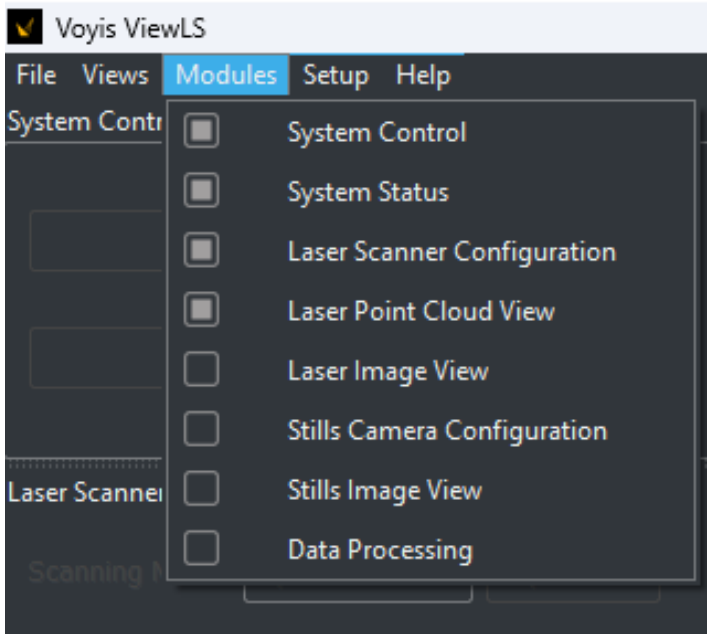
Voyis raw data. Used for Voyis support and debugging purposes only – Check

VIEWLS

Control Modules

- Recommended ViewLS View – **Laser Scanner View**
- Users can also customize the modules they want to see in the ViewLS if they want a different layout
- Module windows are resizable and configurable to suit the user's preference (multiple monitors)
- The user's module set-up is saved with the project automatically
- Recommended Modules are shown below:

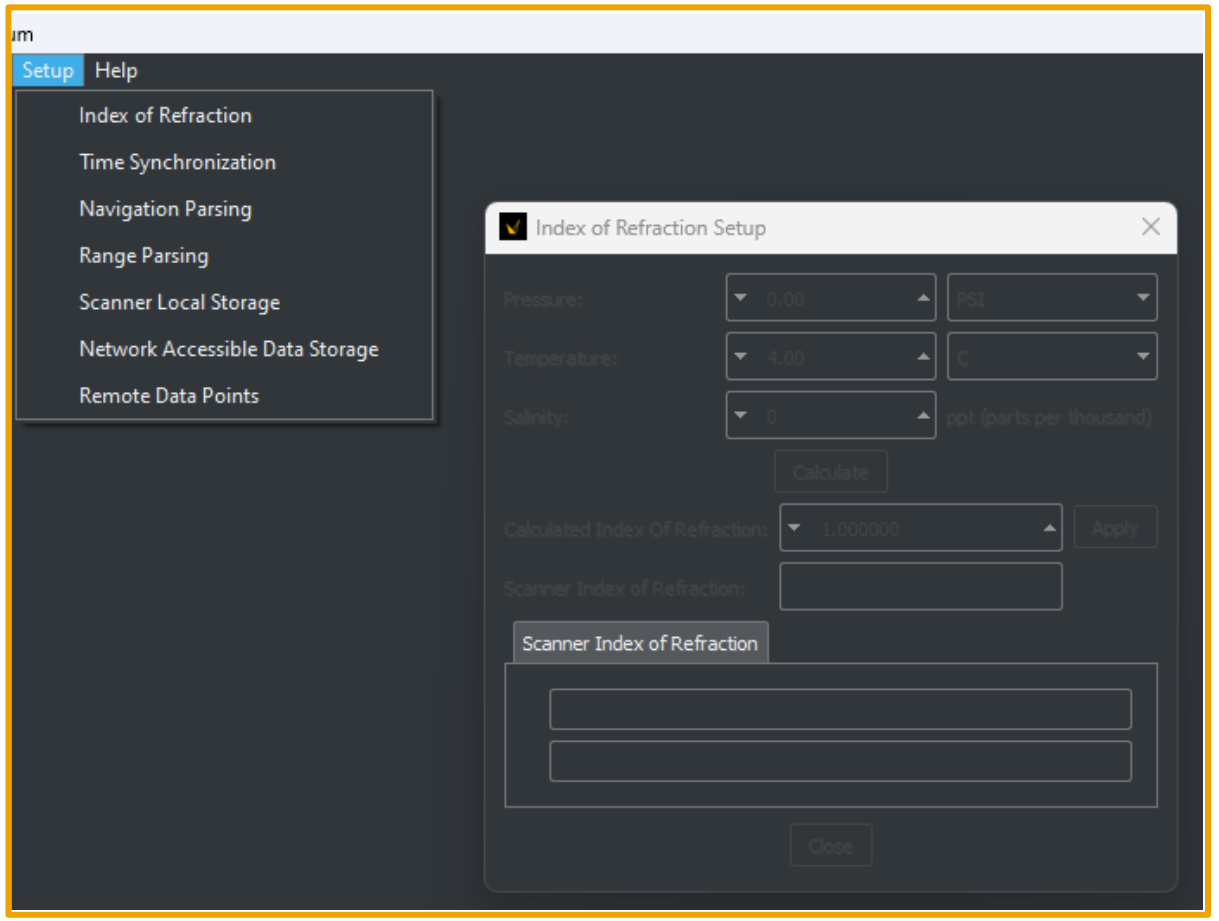




VIEWLS

Index of Refraction

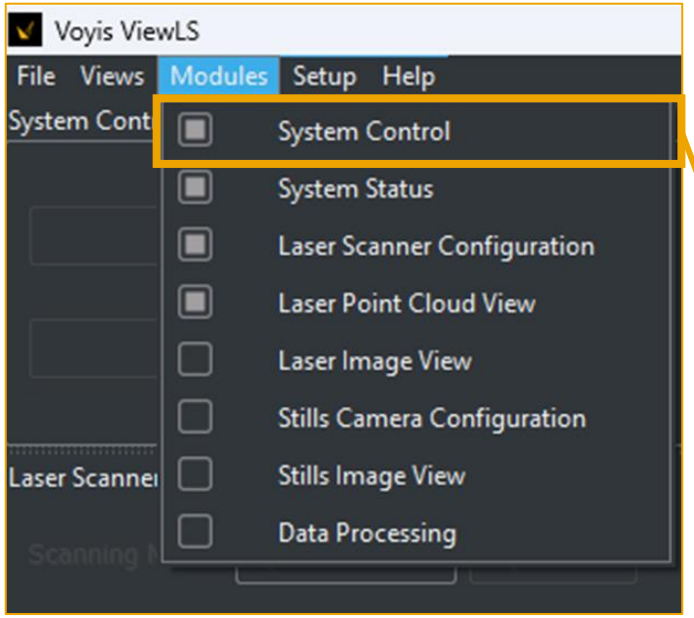
- Before laser scanning, it is critical the user sets the appropriate Index of Refraction (Setup → IoF)
- Recommend **Manual Input** for most applications
  - Scanning in Air: IoF = 1.00
  - Scanning in Fresh Water: IoF = 1.333
  - Scanning In Salt Water: IoF = 1.34 (approx.)
  - *If using a Lookup Table, use 440nm light*
- Can calculate with Pressure, Temperature, Salinity
  - Often from an underwater CTD Sensor
  - Shifts in depth of <50m typically do not affect the value

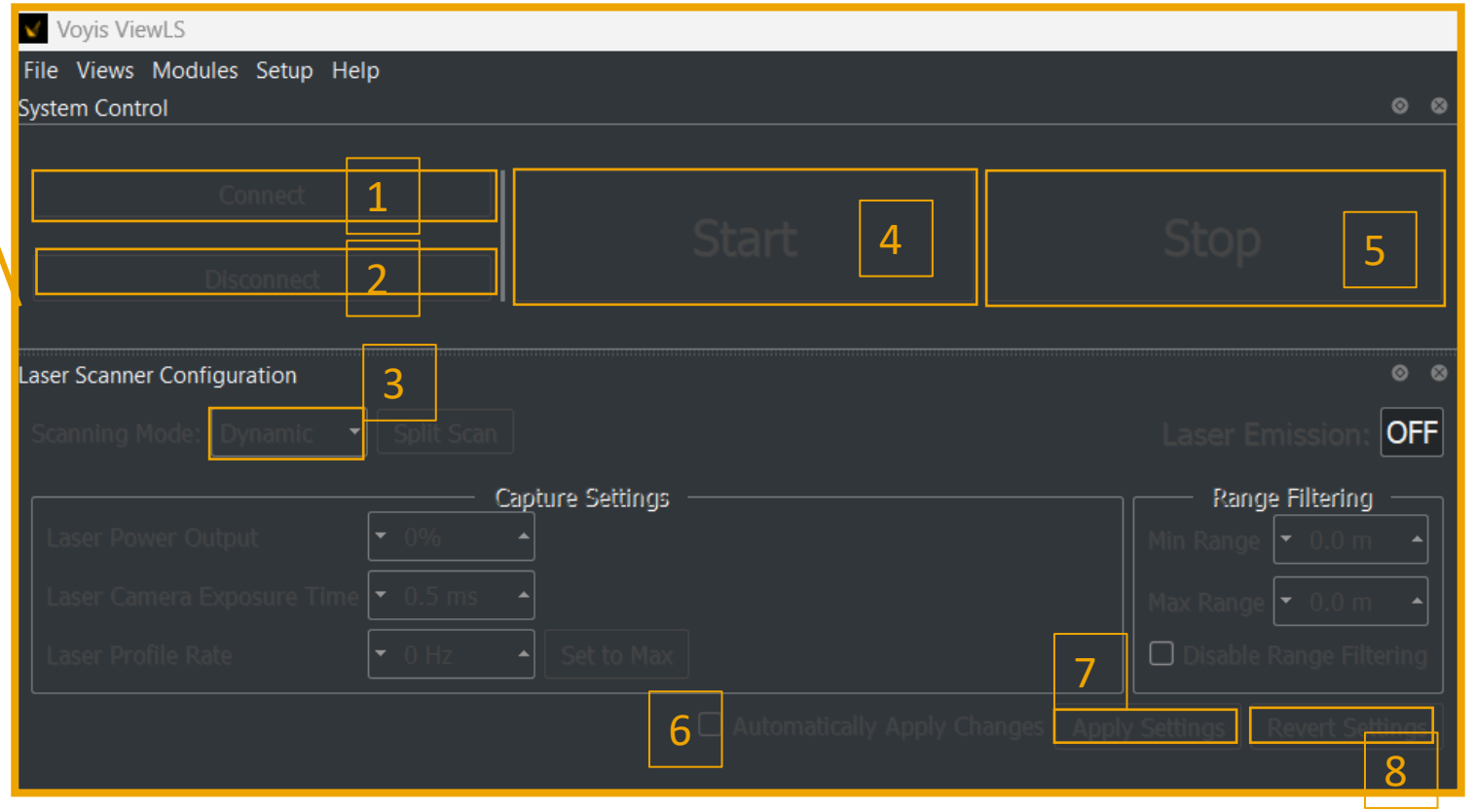


Note: Always set the Index of Refraction prior to commencing a scanning operation

VIEWLS

System Control Module

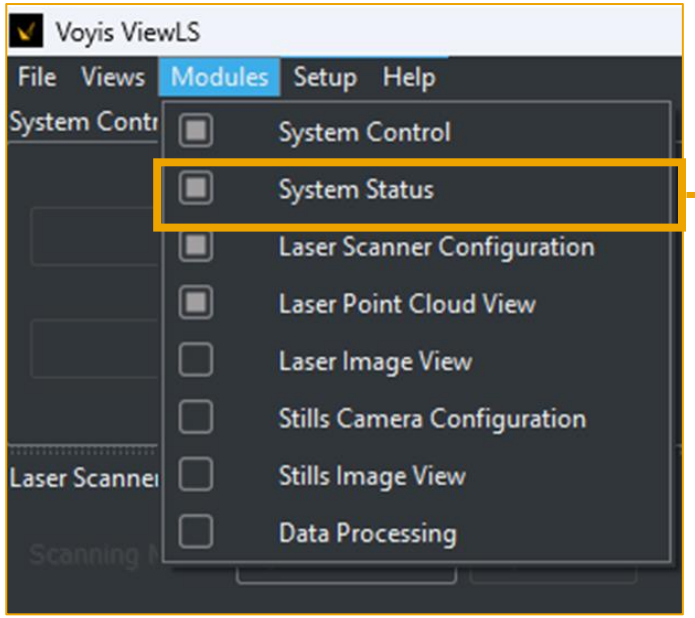


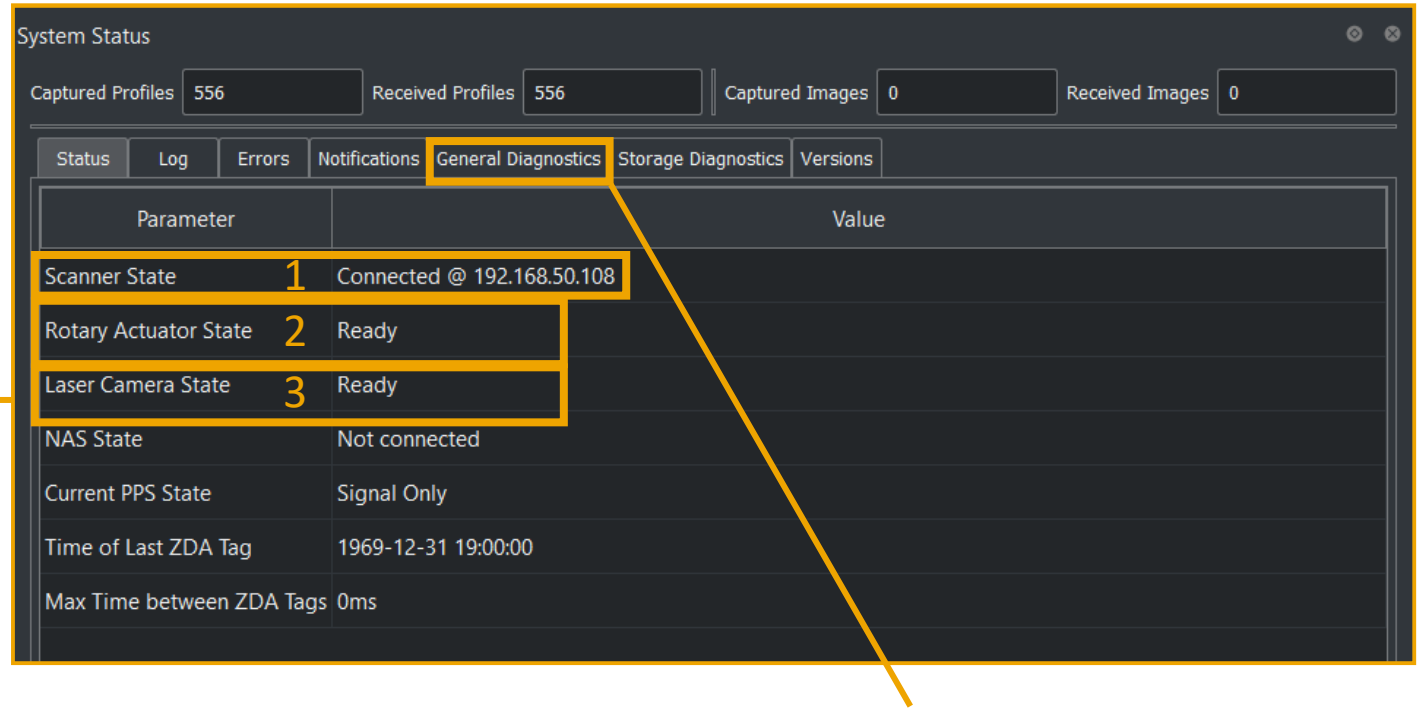


1. Connect to Scanner IP
2. Disconnect from Scanner IP
3. Stationary Mode (using actuator)
   Dynamic Mode (not using actuator)
4. Starts Scanning
5. Stops Scanning
6. Automatically Applies Settings when Adjusted
7. Yellow settings are not applied until “Apply Settings” is clicked
8. Revert to previous settings before applying

VIEWLS

System Status





Status Parameters to Monitor

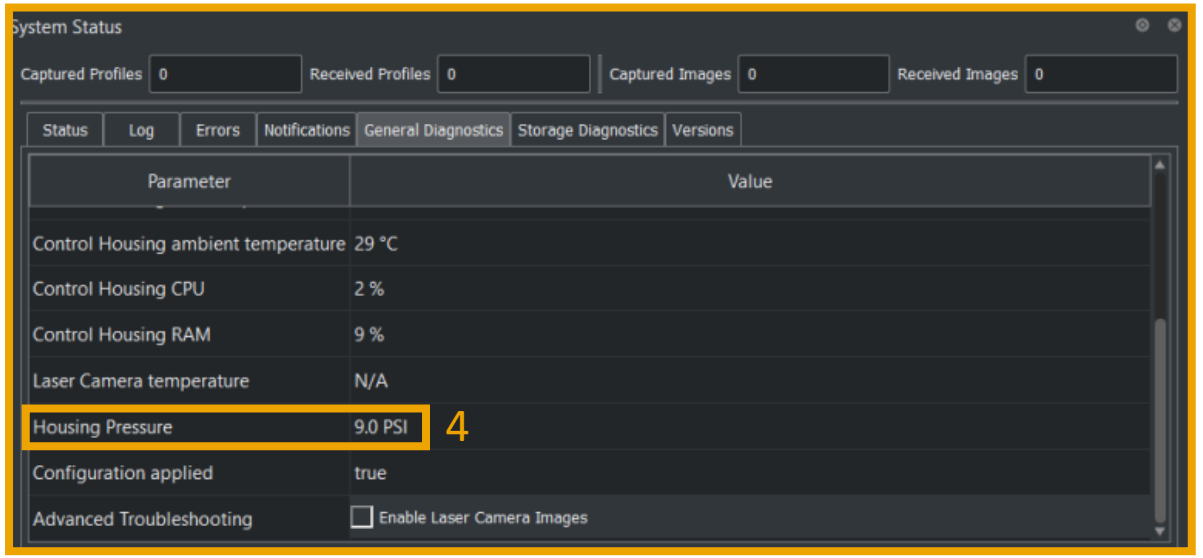
1) Scanner Connection State – Is the computer connected to the product?

2) Rotary Actuator State – Is the Nano's actuator connected?

3) Laser Camera State – Is the Nano's camera connected?

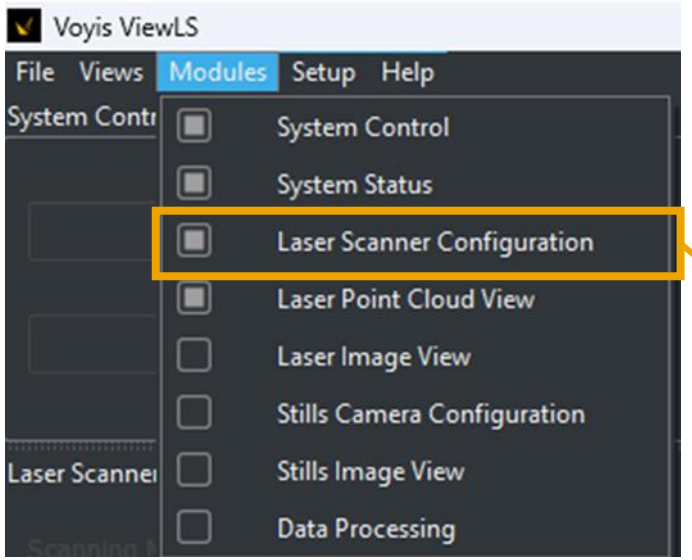
4) Housing Pressure - Should be around 8–12 PSI

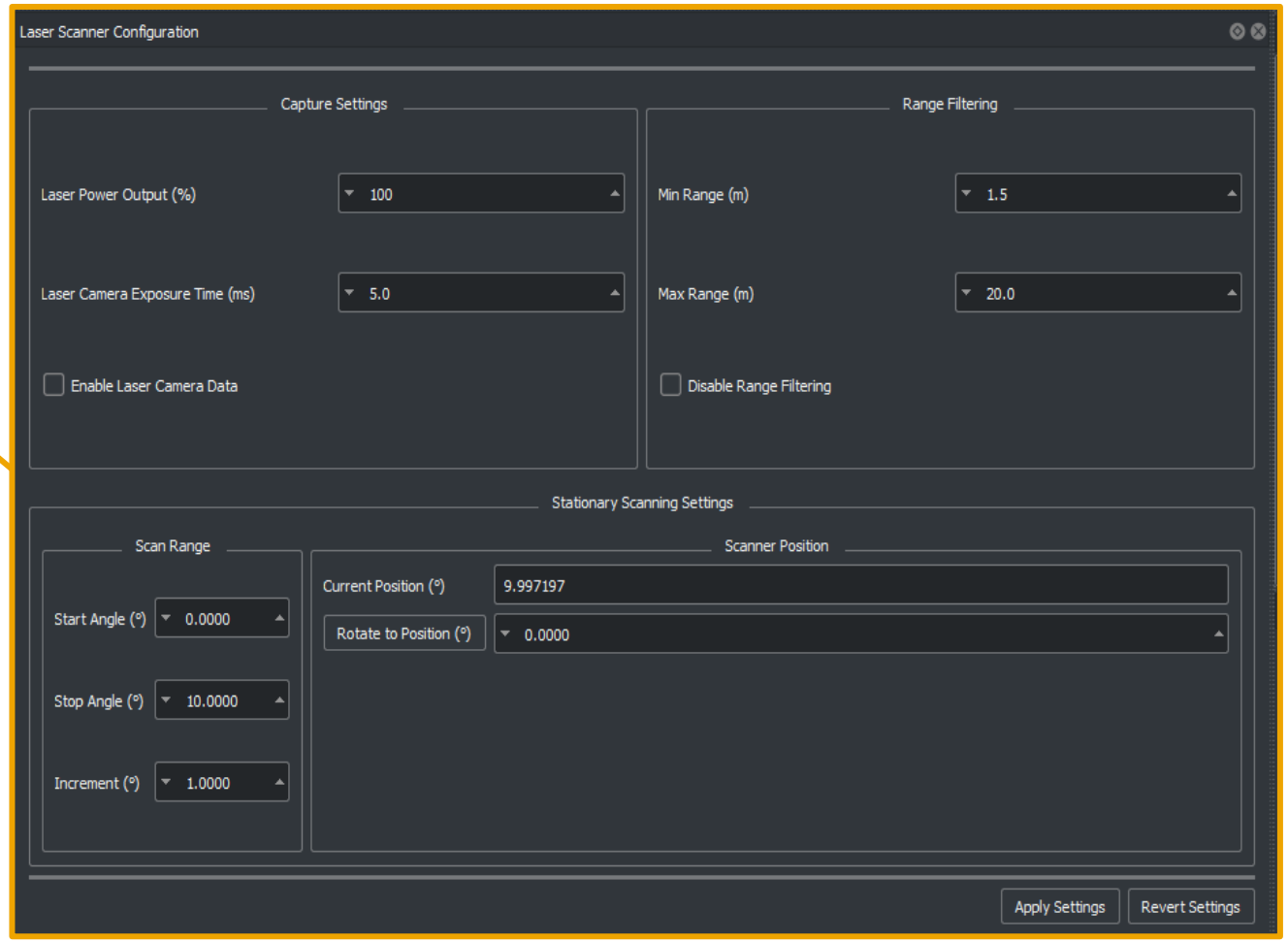
- **If the pressure increases to 13 PSI, it may indicate a housing leak!**



VIEWLS

Laser Scanner Configurations



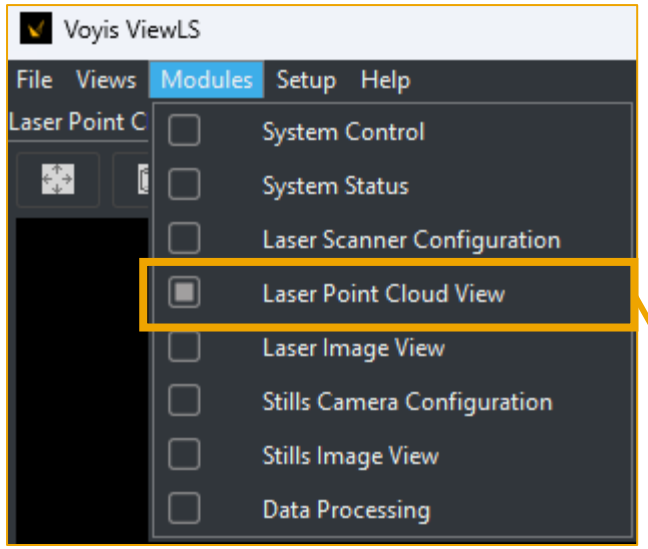


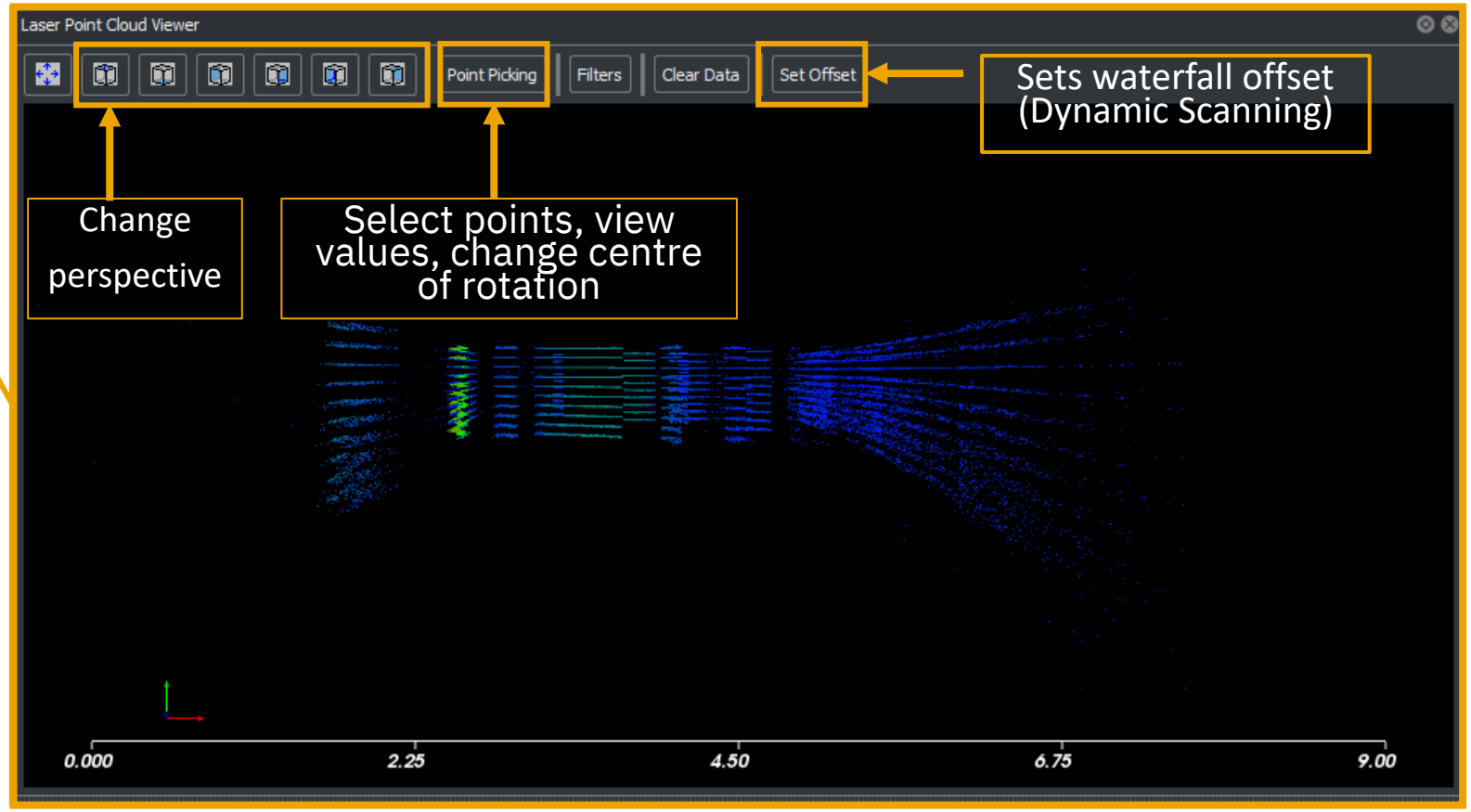
Recommended Settings

- **Laser Power Output:** 100% (ON)
- **Camera Exposure:** Adjust as required (**Slide 21)**
- **Enable Laser Camera Data:** OFF (Test Scans Only)
- **Min & Max Range:** Set based on target distance
- **Start/Stop Angle:** Chosen scan angles
- **Increment:** Chosen angular resolution of the scan – Higher resolution = Longer scan time
- **Current Position:** Current rotational position of scanner

VIEWLS

Laser Point Cloud View



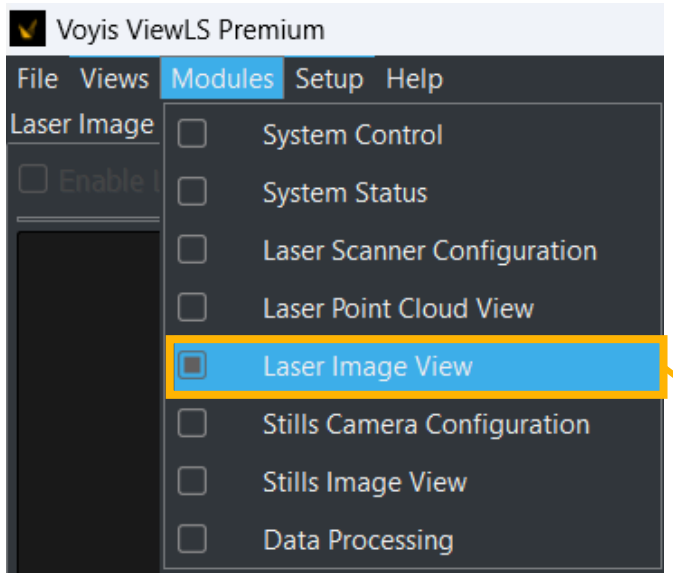


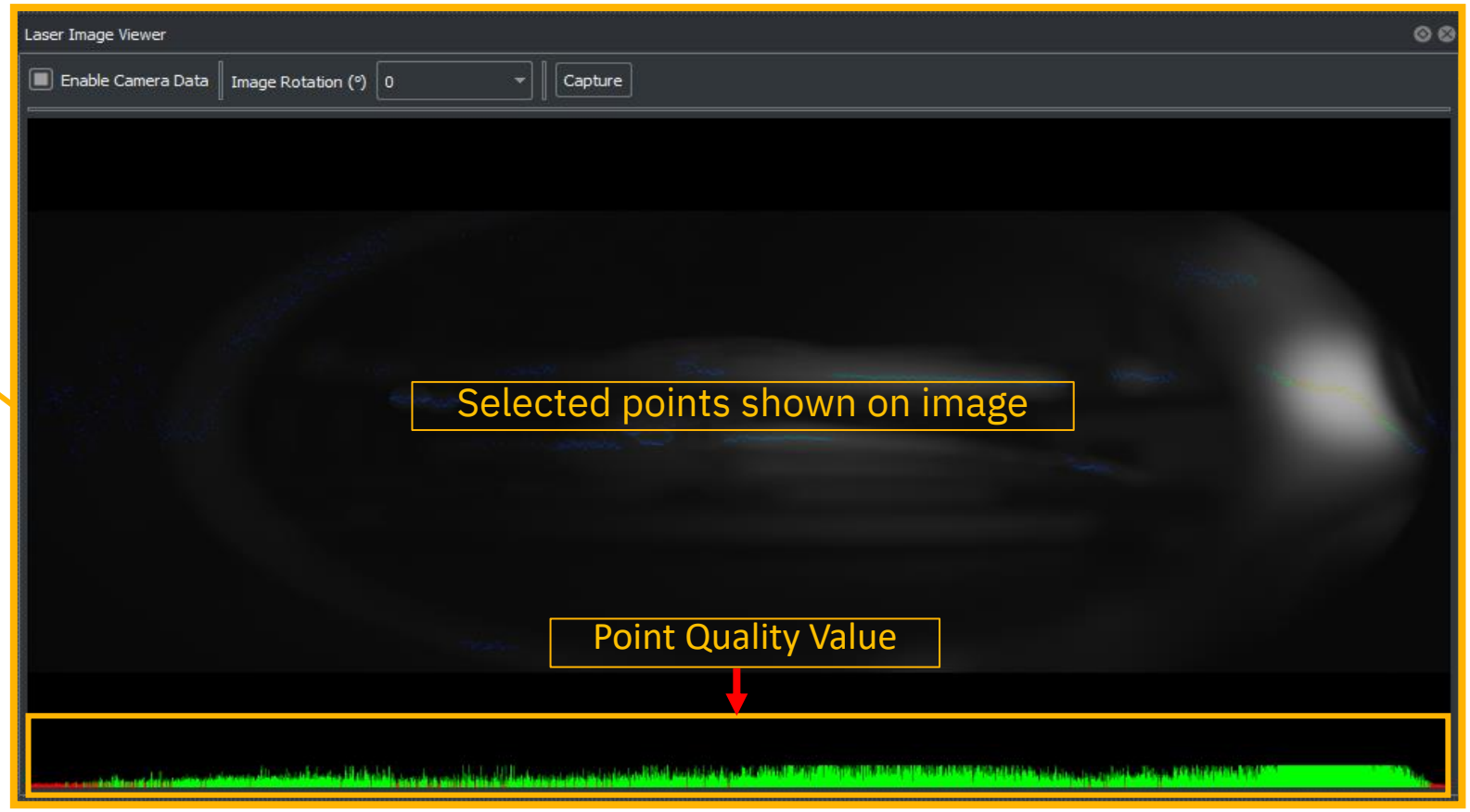
For viewing purposes only

No options affect data collected or saved

VIEWLS

Laser Image View

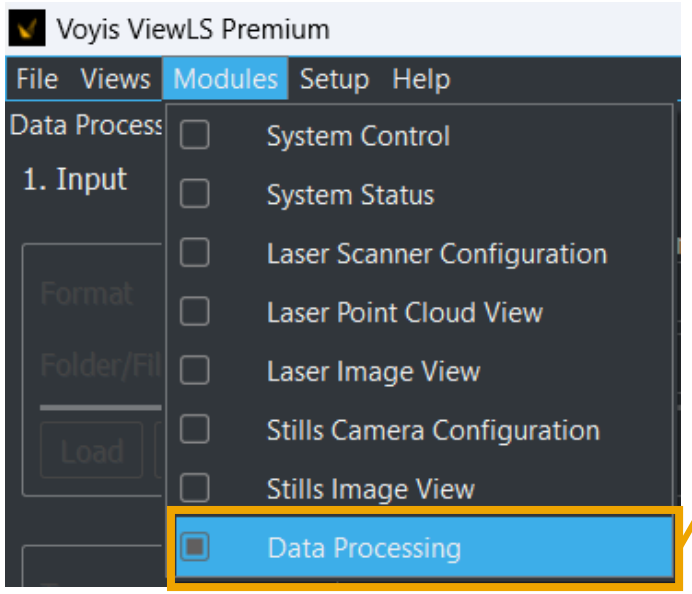


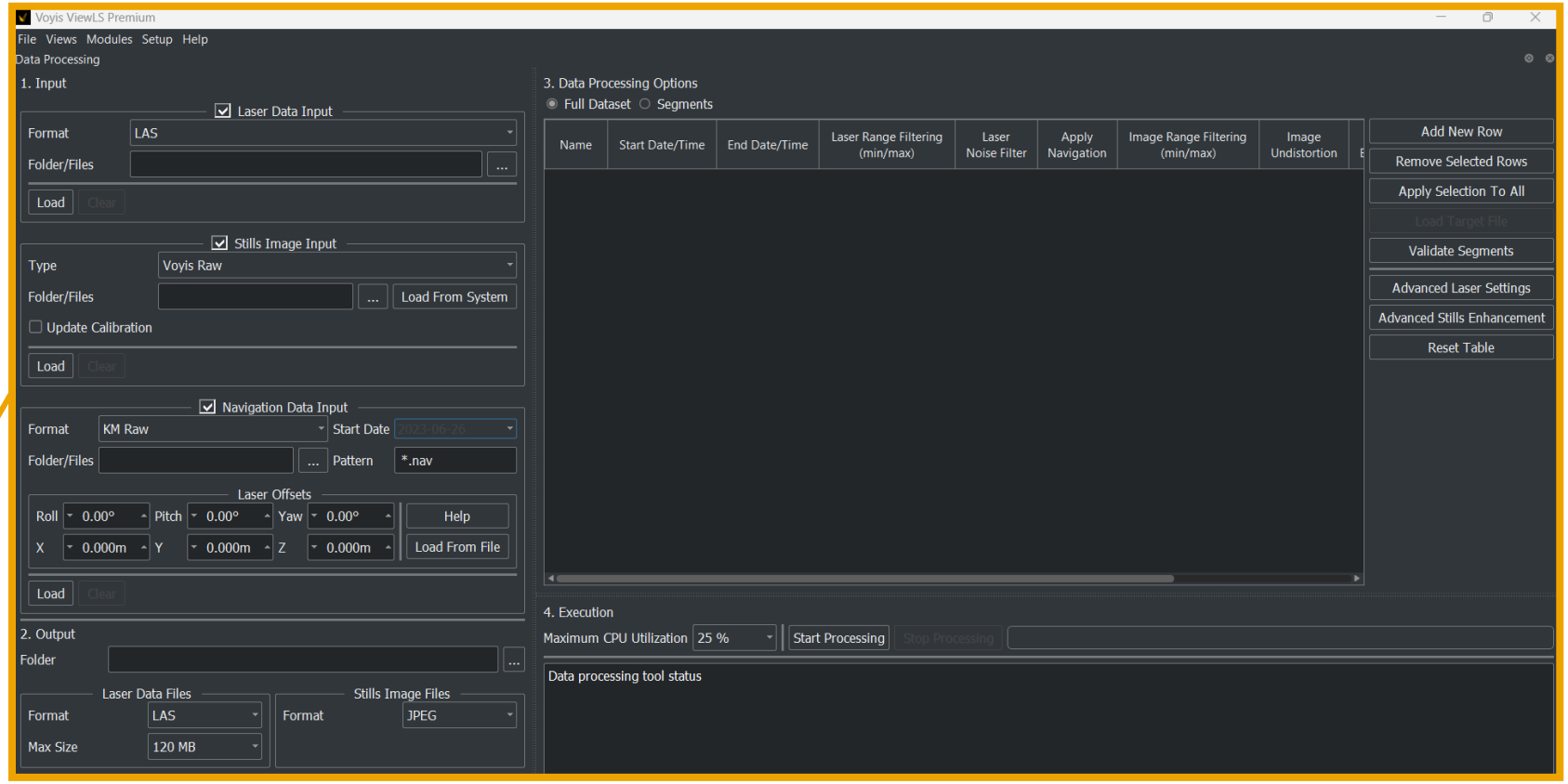


VIEWLS

Data Processing

- Data Processing Module is used after laser scanning to segment & filter the laser data





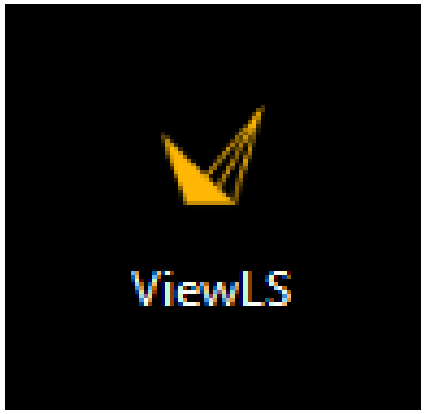
See detailed **ViewLS User Manual** for more information

Data Viewing & Processing

DATA VIEWING/PROCESSING

Introduction

Real-Time Viewing



Voyis **ViewLS** software enables users to **view** the laser data in real-time as its collected.

Open “Laser Image View” under View-Modules

Note: *Editing laser data is not possible in ViewLS*

Post Scan Analysis

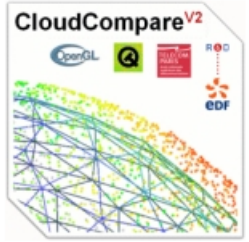
Cloud Compare software enables editing of *your* XYZ/LAS files after scanning

Cloud Compare is an opensource software downloadable here: cloudcompare.org/

There are many other 3D data viewing softwares including EIVA Navisuite.

DATA VIEWING/PROCESSING

Cloud Compare



CloudCompare

3D point cloud and mesh processing software
Open Source Project

- Use Cloud Compare to view and edit your laser data.
- Once installed on your PC you can quickly import and edit your point clouds.
- Drag your files into the Cloud Compare window or simply open your files under “Open Files”
- When prompted after loading your files, click on "Apply All".

Below is a link to some helpful YouTube videos for learning how to use Cloud Compare.

There are also videos added to the Product UBD drive that will be helpful.

Cloud Compare Tutorial Set:
https://youtu.be/IitUKpvBVBg

DATA VIEWING/PROCESSING

Cloud Compare

1) Add your XYZ or LAS files

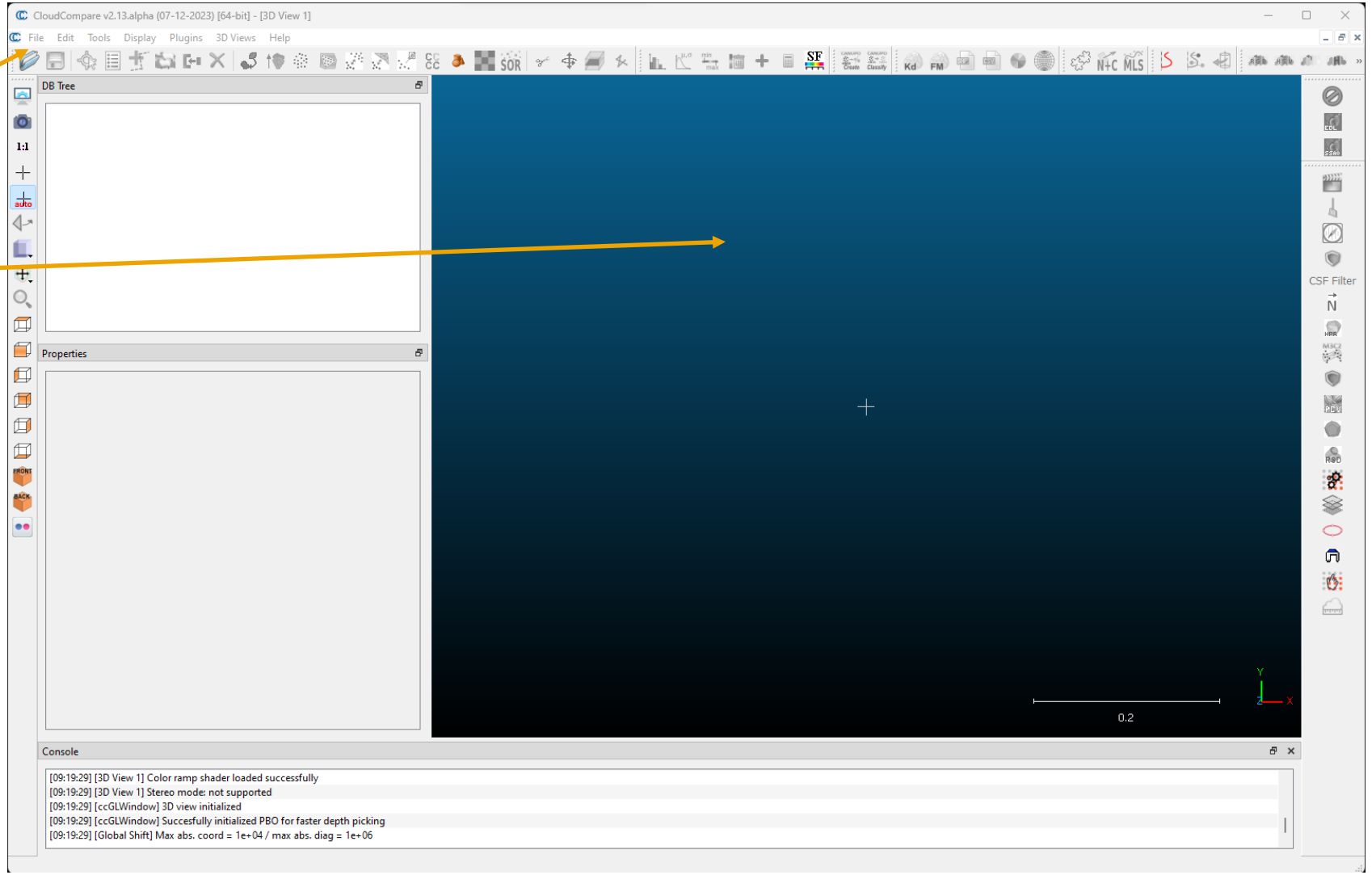
Two options:

a) File → Open

b) Drag your files here

2) Window Pops Up → **Apply All**

3) View your data!



DATA VIEWING/PROCESSING

Cloud Compare

Below is a link to some helpful YouTube videos for learning how to use Cloud Compare. There are also videos added to the customer project folder that will be helpful.

https://youtu.be/IitUKpvBVBg

Pre-Dive Test

PRE-DIVE TEST

System Checks

The Pre-Dive Tests should be performed prior to every deployment to ensure proper system functionality

1. **Power on the System** (24V), and verify that the power draw is acceptable (less than 60W)
   - If over 60W, check for shorts in the electrical wiring

2. Wait **30** seconds, then verify that the IP address of the system responds. Open ViewLS and connect to the system.
   - If there is no connection, debug network connections and ensure the product is receiving power
   - Use Windows Command Prompt to ping the Insight Nano IP Address.

3. **After ViewLS connects,** verify System Status and verify there are no warnings reported in the log window
   - If warnings exist, first disconnect and reconnect the system. If the warning persists, troubleshoot based on the warning.

PRE-DIVE TEST

System Checks

The Pre-Dive Tests should be performed prior to every deployment to ensure proper system functionality

4. **Optional:** If a Time Synchronization System will be used, setup this in ViewLS
    - Setup Toolbar → Time Synchronization
    - After a minute of operation, verify the system is reporting that PPS is stable and working.
    - If PPS is not working, check the wiring connections

5. **Test Scan 1:** Scan at 1-degree Increment, and click “Enable Laser Camera Data”.
    - You should see the camera image, with overlayed point data. The head should rotate and capture a laser line every degree.
    - If there is no image, debug the connection to camera

VIEWLS

System Checks

The Pre-Dive Tests should be performed prior to every ROV dive to ensure proper system functionality

6. **Test Scan 2:** Turn OFF “Enable Sensor Data”, then verify product is working correctly by starting a quick scan at the chosen Increment
    - You can pass an object in front of the sensor housing and verify that an immediate change in the data is shown in the GUI
    - While scanning, ensure the “Captured Data Profiles” and “Received Profiles” numbers are increasing at the same rate

7. **Power off** the system

Best Practices

Camera Exposure In Air or Water?

- **Air** - set your scans to 1.0 ms - 3.0 ms
- **Water** - set your scan to 5.0 ms – 15ms
  - These are suggested guidelines as each laser scan environment is unique.

Scan Time vs. Higher Resolution?

- **Looking to save time on your scans?** Increase your scanning increment to a lower resolution – Example 0.8

- **Looking for Higher Resolution data**? Lower your scanning increment to a higher resolution - Example: 0.05

Index of Refraction Values

- **Verify the Index of Refraction** for your survey environment. This directly affects accuracy!
  - An incorrect IOR value may be observed as “bowing” in the laser data, along the laser line

Keep the target in the Center of the Laser Line when possible

- The laser scanner is most accurate in the center of the camera's field of view
- When possible, utilize the middle portion of the laser line to scan critical target dimensions
- This is because water refraction is highest at the edges of the field of view (high angles), and most impacted by the accuracy of the user's input Index of Refraction

BEST PRACTICES

Recommendations

- **CENTER THE LASER LINE ON IMPORTANT TARGETS**
  - The overall field of view (FOV) of the laser scanner is 50 degrees, but important targets should be kept within a 40-degree swath if possible. This is particularly important when scanning at long ranges.

- **+33% OVERLAP BETWEEN ADJACENT SCAN**
  - If using multiple scan positions to cover a large target, neighbouring scan passes should have at least 33% overlap to ensure they can be registered (stitched together)

- **MINIMIZE SCAN RANGE FOR IMPROVED ACCURACY/RESOLUTION**
  - The closer you are to the target, the higher the data resolution (2064 data points are spread along laser line)
  - Coverage is sacrificed when closer to the target.

- **BEGIN WITH TEST SCANS AT 1 DEGREE OR LARGER TO OPTIMIZE SETTINGS**
  - Conduct an initial scan with a large increment (1 degree) to quickly fine-tune Scan Settings
  - Optimize Camera Exposure, Range Filtering, and Start/Stop Positions
  - Change to a higher resolution and conduct a final scan (longer scan time

BEST PRACTICES

Recommendations

- **CONSIDER SCANNER ORIENTATION RELATIVE TO TARGET**
  - The Insight can be oriented relative to the target to move the laser line across the target from different directions
  - This will impact data quality in certain cases, so try multiple orientations

BEST PRACTICES

FAQ

- **How important is setting the Laser Scanner's Index of Refraction (IoF)?**
  - The index of refraction input parameter will directly affect the accuracy of the data
  - IoF is constant for air (1.0) and fresh water (1.333)
  - IoF changes in salt water based on temperate, salinity, and depth. For accurate scanning it is best to measure this directly with a CTD Sensor

- **Is the Index of Refraction (IoF) impacted by water turbidity?**
  - No, the Index of Refraction is not affected by turbidity, only by temperature, salinity, and depth

BEST PRACTICES

Troubleshooting

Symptom	Possible Cause	Debugging
Captured profiles lags received profiles	a) Slow Ethernet Connection	a) Check your network speed, then debug subsea cable ethernet connections if required
Cannot connect to scanner	a) Wrong IP address b) Incorrect wiring (custom cable) c) Scanner recently disconnected	a) Check IP address on product decal Ping IP address (cmd) for response b) Check network connection, wiring, and connectors c) Wait 90 seconds for scanner to reboot after disconnecting
Laser Not Turning On	a) Laser output power set to 0% (off)	a) Increase laser output power setting to 100% (on)
Laser data return intensity too high (red) or low (blue)	a) Incorrect scan settings b) Complex target surface	a) Adjust “camera exposure” and repeat the scan
Scanner stops scanning part way through scan	a) Known bug, fix will be released soon	a) Increase increment (smaller step sizes are more susceptible) b) Workaround, if scan stops, start second scan at location where first scan stops and combine point clouds afterwards.