OCEAN DIAGNOSTICS

User Manual v1.0 2023.06

SATURNA

Searching for Keywords

Search for keywords such as “Shroud” and “Web Application” to find a topic. If you are using Adobe Acrobat Reader to read this document, press Ctrl+F on Windows or Command+F on Mac to begin a search.

Navigating to a Topic

View a complete list of topics in the table of contents. Click on a topic to navigate to that section.

Printing this Document

This document supports high resolution printing, but please consider the environment first!

Revision Log

Version	Date	Revisions
V1.0	2023.06	Manual Created.

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⇒ Introduction

Thank you for purchasing the Saturna Imaging System, a tool to rapidly automate and standardize particle measuring and imaging. The Saturna Imaging System uses advanced technology to capture particle images and utilizes AI-based learning to analyze particle characteristics such as size, shape, colour and more. This system eliminates the need to manually measure particles individually, which saves hours of laboratory time, reduces human error and standardizes analysis.

The Saturna Imaging System will automatically analyze particle physical characteristics and output a CSV (Comma Separated Values) file with thirteen distinct data points for every particle and corresponding particle image map. These data points describe the particles' characteristics.

⇒ Video Tutorial

Go to the address below or scan the QR code to watch the Saturna 2023 tutorial videos, which demonstrates how to use the Saturna Imaging System:

https://youtu.be/TTdR3tDYRM0

URLs may change over time. Contact info@oceandiagnostics.com if you are not able to view the video tutorial.

⇒ Box Contents

Item	Specifications
	Saturna Imaging System Camera and Tripod Integrated 8MP Sony IMX179 CMOS imaging sensor for high resolution data Integrated ~4000k neutral white LED array for highly standardized particle images with consistent lighting for comparative size and colour analysis across time, location and external lighting conditions Captures visible particles (>400 μm)
	Type A USB cable Requirements: Windows 10 operating system
	Shroud (cover) Light-blocking shroud to provide highly standardized particle images with consistent lighting for comparative size and colour analysis across time, location and external lighting conditions
	Background Sheet Included QR Code background sheet provides accurate particle sizing reference for physical analysis computer vision algorithms Dark and light colours provide appropriate contrast (See Instructions)
	Hard Case Waterproof hard case included for easy transport into the field (26cm x 20cm x 12cm)

⇒ CAUTION

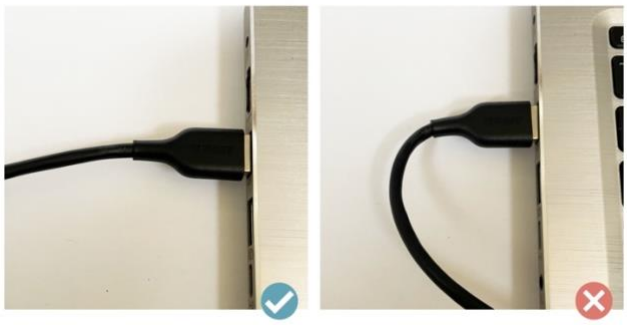
When handling Saturna, it is important to take certain precautions to ensure its proper functioning and longevity.

Here are some cautionary tips to keep in mind:

- Avoid getting Saturna wet: Saturna cannot withstand moister and will not be useable in the event of water damage.
- Be cautious with the USB cable: The USB cable is a critical component of the camera, used for transferring data. It is important to handle the USB cable with care and avoid excessively or forcefully bending it. Bending or twisting the USB cable beyond its recommended range can cause damage to the cable or the camera's USB port, resulting in connectivity issues.
- Handle with care: Avoid dropping or mishandling the camera, as this can result in internal damage or scratches on the lens or body. When carrying or storing the camera, always use the protective case to prevent accidental bumps or impact.
- Keep away from extreme temperatures: Saturna is sensitive to extreme temperatures. Avoid exposing Saturna to extreme heat or cold, as it can affect its performance and potentially damage internal components.
- Clean properly: Only clean with a gentle microfiber cloth and lens cleaning solution. Avoid using harsh chemicals or abrasive materials that can scratch or damage the camera's surfaces.
- Follow the user guide: Carefully read and follow this Saturna Imaging System 2023 manual.

By taking these precautions and handling Saturna with care, you can help ensure its optimal performance, longevity and reliability, allowing you to capture high-quality images and reliable data to make the most out of your imaging system.

⇒ Do’s and Don’ts

DESCRIPTION	
Position the legs of Saturna off the background sheet.	
Do not image particles without shroud in place.	
Use caution to ensure the USB cable is not excessively bent.	

The Shroud, Saturna legs and the background tabletop should not be visible through the *Saturna Web Application*.

Particles should be carefully placed on the background sheet. Place light particles on the black half of the background sheet and dark particles on the light half to increase contrast.

Ensure the QR code is not covered.

All particles must be within view on the viewer panel. Particles outside of view will not be captured correctly.

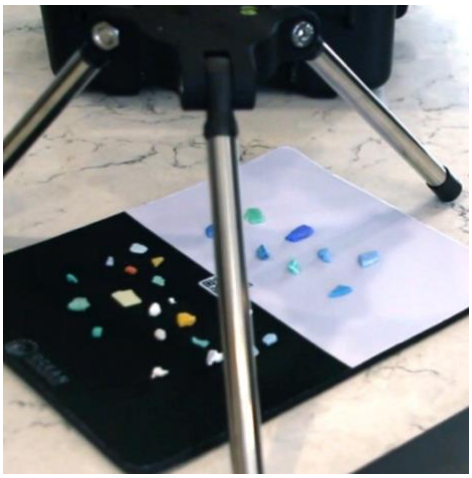
Ensure no particles are overlapping. If particles overlap, they will be detected as a single particle, which will lead to inaccurate results.

⇒ Instructions

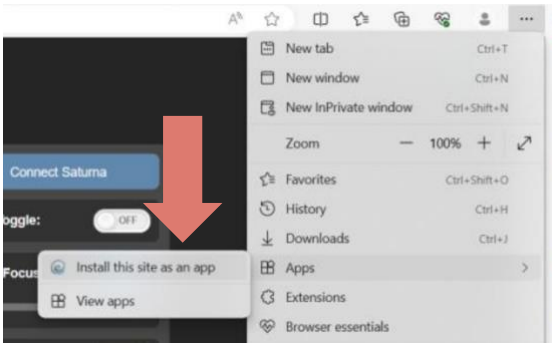
STEP 1: CONNECT SATURNA

1. Place particles on the background sheet.
    a. Place light-coloured particles on the black half of the background sheet and dark-coloured particles on the white half.
    b. Spread the particles out so they are not touching each other or overlapping.
    c. Ensure particles do not cover the QR code in the middle.

2. Take the *Saturna Imaging System* camera + tripod out of the protective box.
3. Remove the lens cap from the camera.
4. Place the *Saturna Imaging System* tripod over the background sheet with particles, aligning the camera directly over the QR code.
5. Place the shroud over the tripod.

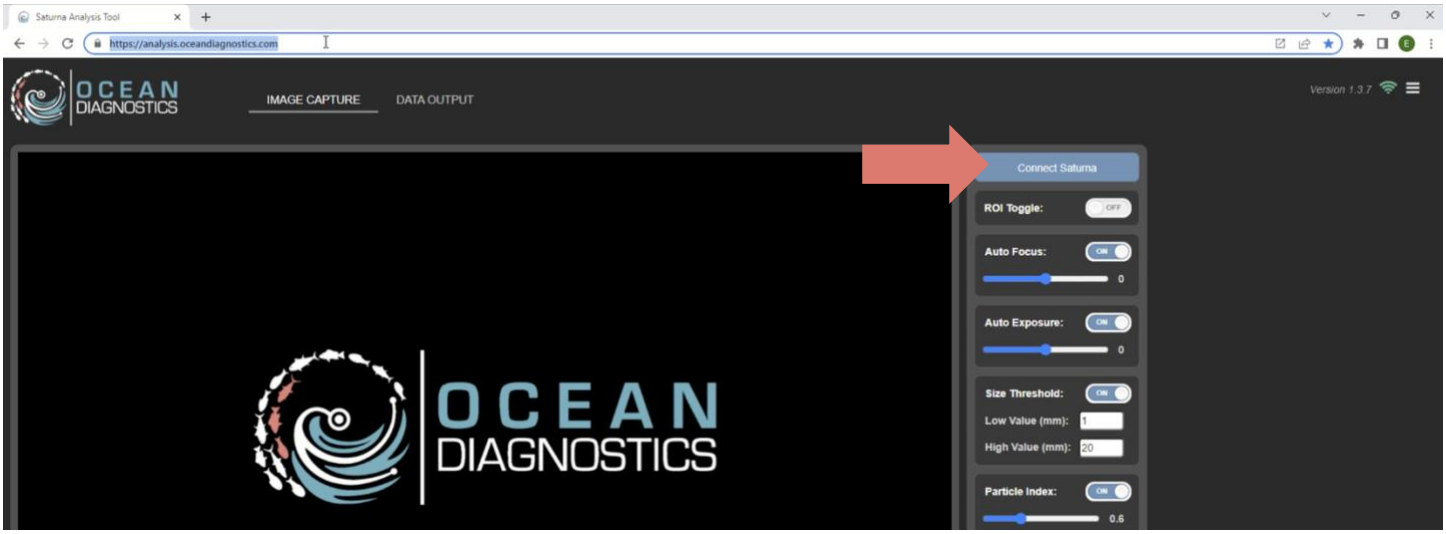




6. Open your **Windows PC** or **Chrome Book** computer.
7. Open your internet browser to the *Saturna Imaging System* web application through the following web address: **analysis.oceandiagnostics.com.**



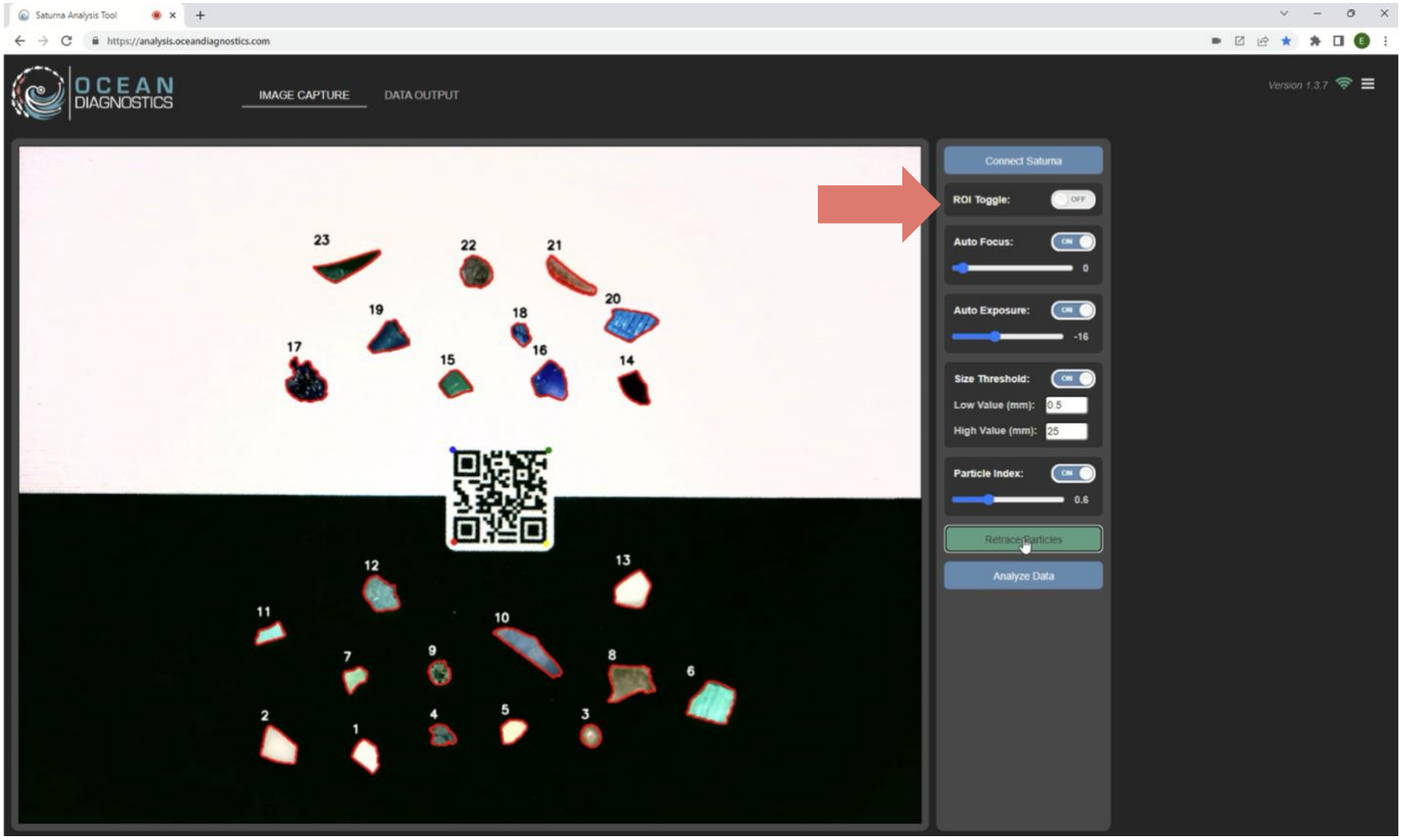
TIP: The *Saturna Imaging System* web application can be downloaded and used offline in Google Chrome if required. To do this, click **Install *Saturna Imaging System* Analysis Tool** in the URL line.

8. Carefully hold the tripod and connect the cable from *Saturna Imaging System* to your computer.
9. Click **Connect Saturna** on the web interface.

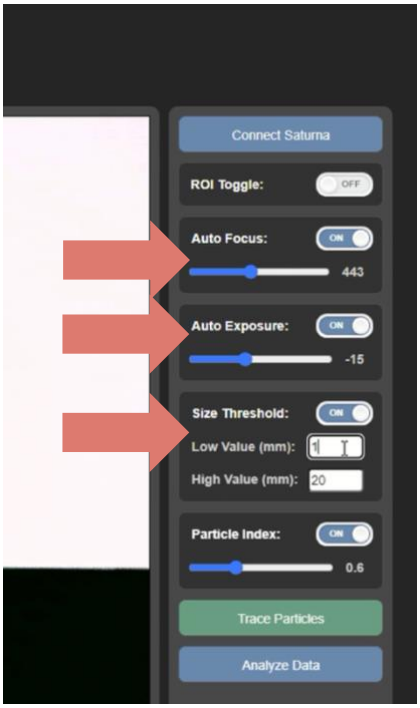


10. The window viewer should show the background sheet and particles.
11. Make sure only the background sheet is in view.
12. Ensure the shroud and tripod legs are not in view.
13. Click **Trace Particles** to automatically trace particles and capture data.
14. Check to ensure all particles are traced with a red line. Nothing else (e.g., shadows or dust) should be traced with a red line. If there are issues, follow the troubleshooting steps below.

IMPORTANT: Data **will not be saved** until it is downloaded. Download the Image and Data files to your local computer by clicking the blue buttons **Image** and **Data** in the **Data Output** tab.



15. If particles are not tracing correctly, refer to these troubleshooting steps:
    a. Make sure only the background sheet is in view. Adjust the placement or height of the tripod sheet if needed.
    b. Ensure the shroud and tripod legs are not in view.
    c. If specific particles are not picked up on the white background sheet, move them to the black background sheet, and vice versa.
    d. Click **Retrace**.



e. If you still pick up unintended particles, adjust threshold levels using the **Size Threshold**. The threshold levels determine the smallest and largest size of particles detected. If you are picking up small pieces like dust, change the low value to a higher number. For example, if you used a 1 mm sieve, adjust the low threshold to 1 mm.

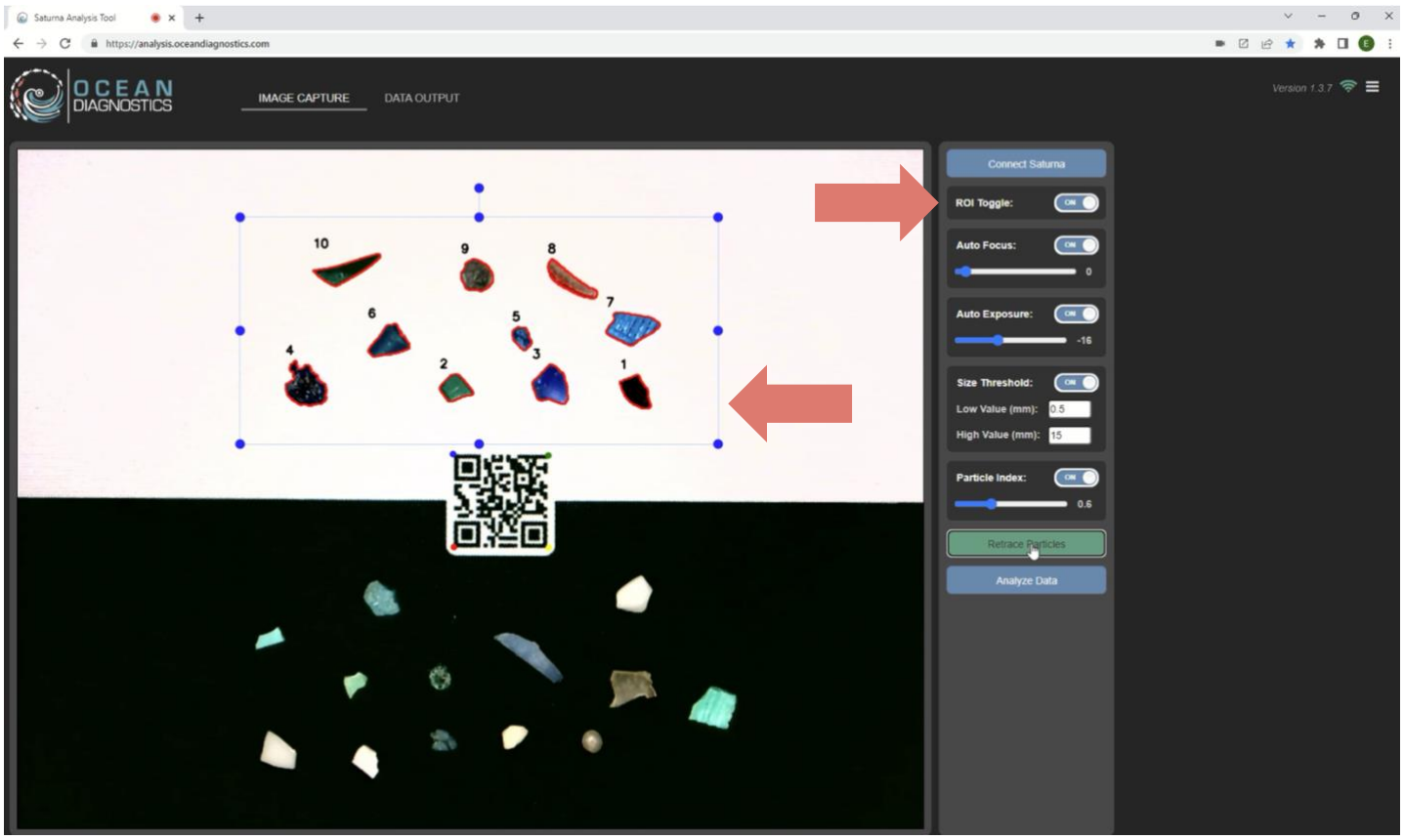
f. Click **Retrace**.

g. If you still pick up unintended particles, adjust the **Exposure** level. Move the exposure toggle until the brightness looks appropriate.

h. Click **Retrace**.

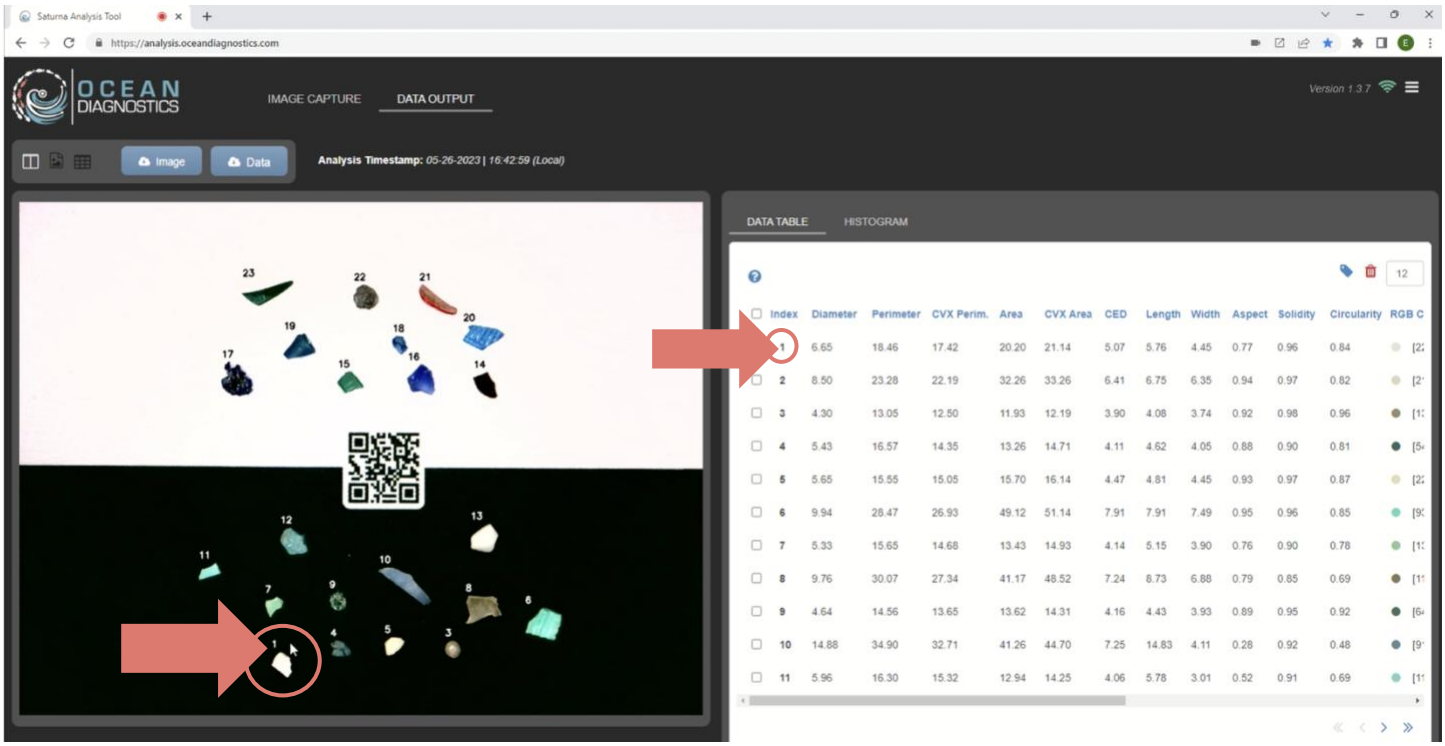
i. If you still pick up unintended particles, use the **ROI (Region of Interest)** tool to isolate just the particles you want to analyze. Click the ROI toggle and adjust the rectangle to the area you wish to image. Nothing outside of the rectangle will be imaged and analyzed.

j. Click **Retrace**.

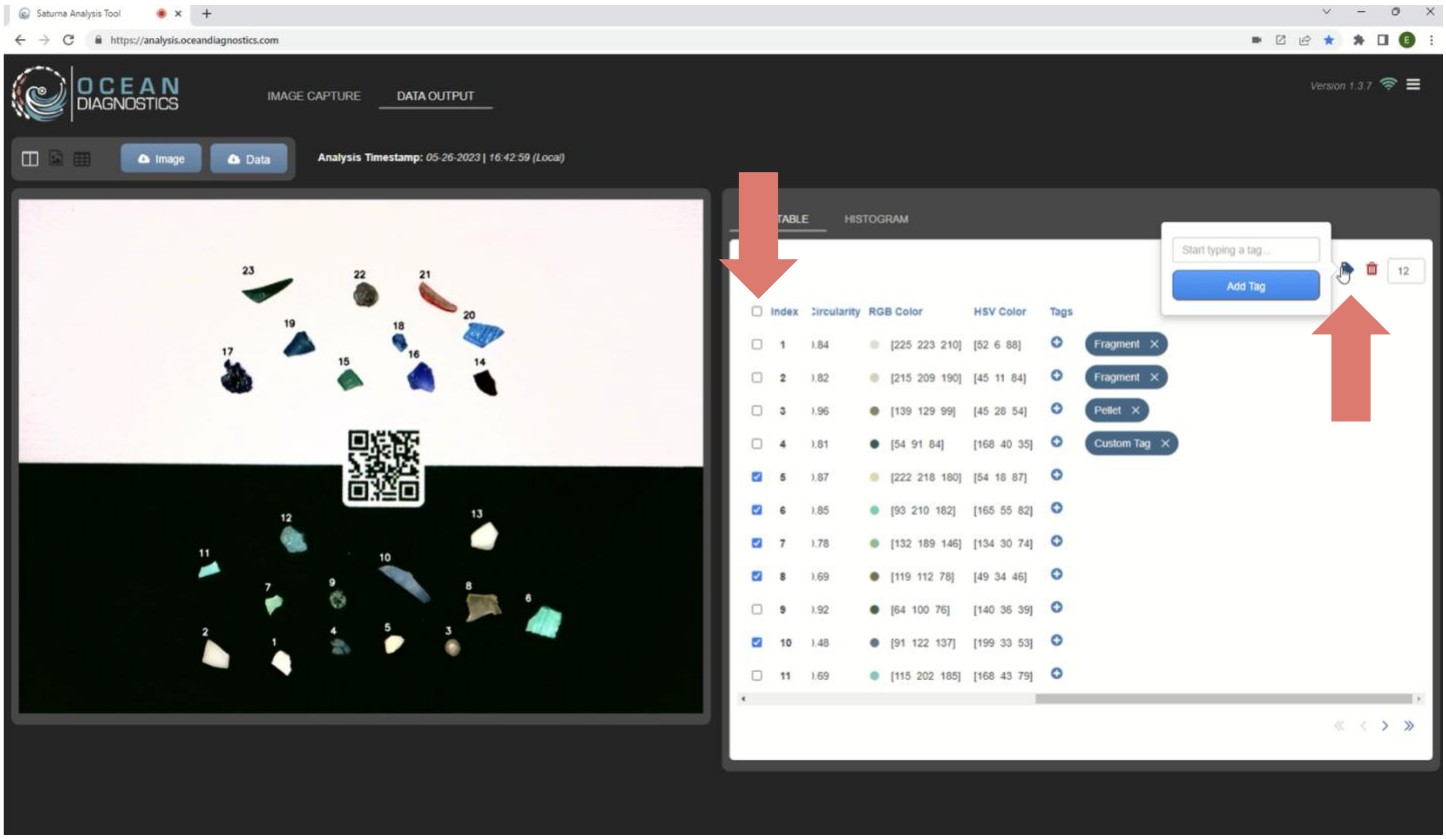


STEP 2: ANALYZE DATA

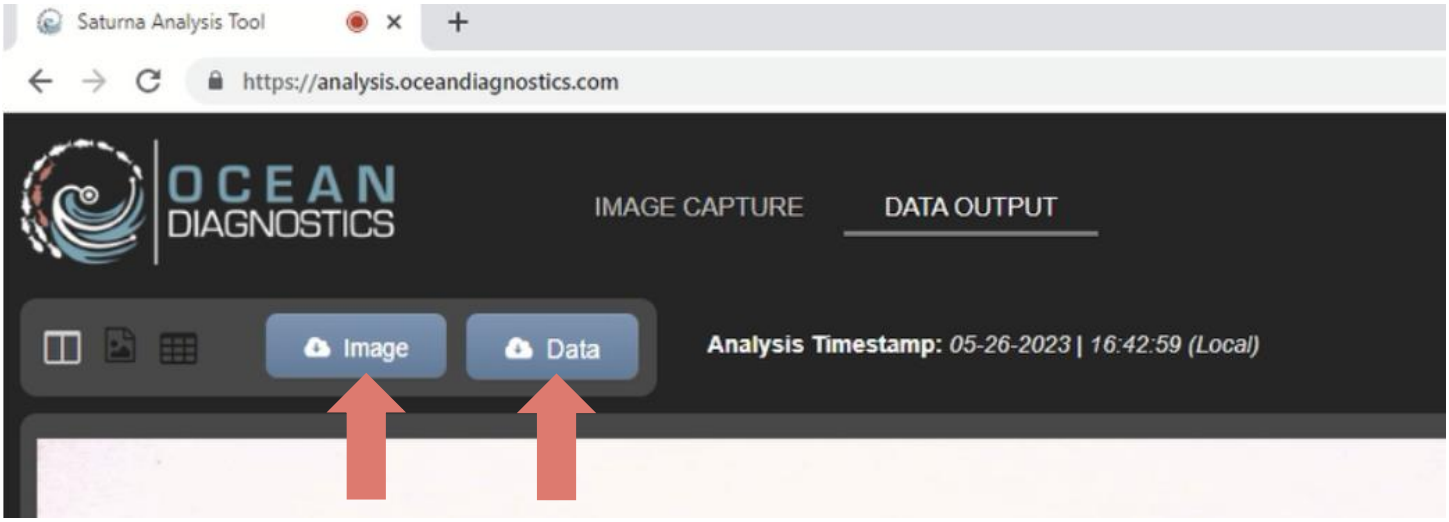
1. When particles are properly traced, press the blue **Analyze Data** button.
2. The results will automatically appear on the right-hand side of the web application.
3. The Index number identifies the particle being analyzed. It is labelled accordingly on the image (left) and dataset (right). The index number aligns with the label on the image, so you know which dataset (row of data) belongs to which particle.



4. Add notes or categories using the tag function.
    a. Select all particles you would like to apply a tag to. Refer to the index number in the image and the corresponding index number in the data rows. Click the checkbox to the left of the index number on the data table.
    b. Click the tag icon.
    c. Type the note or category in the text box.
    d. Click **Add Tag**.
    e. Repeat for all notes or categories.



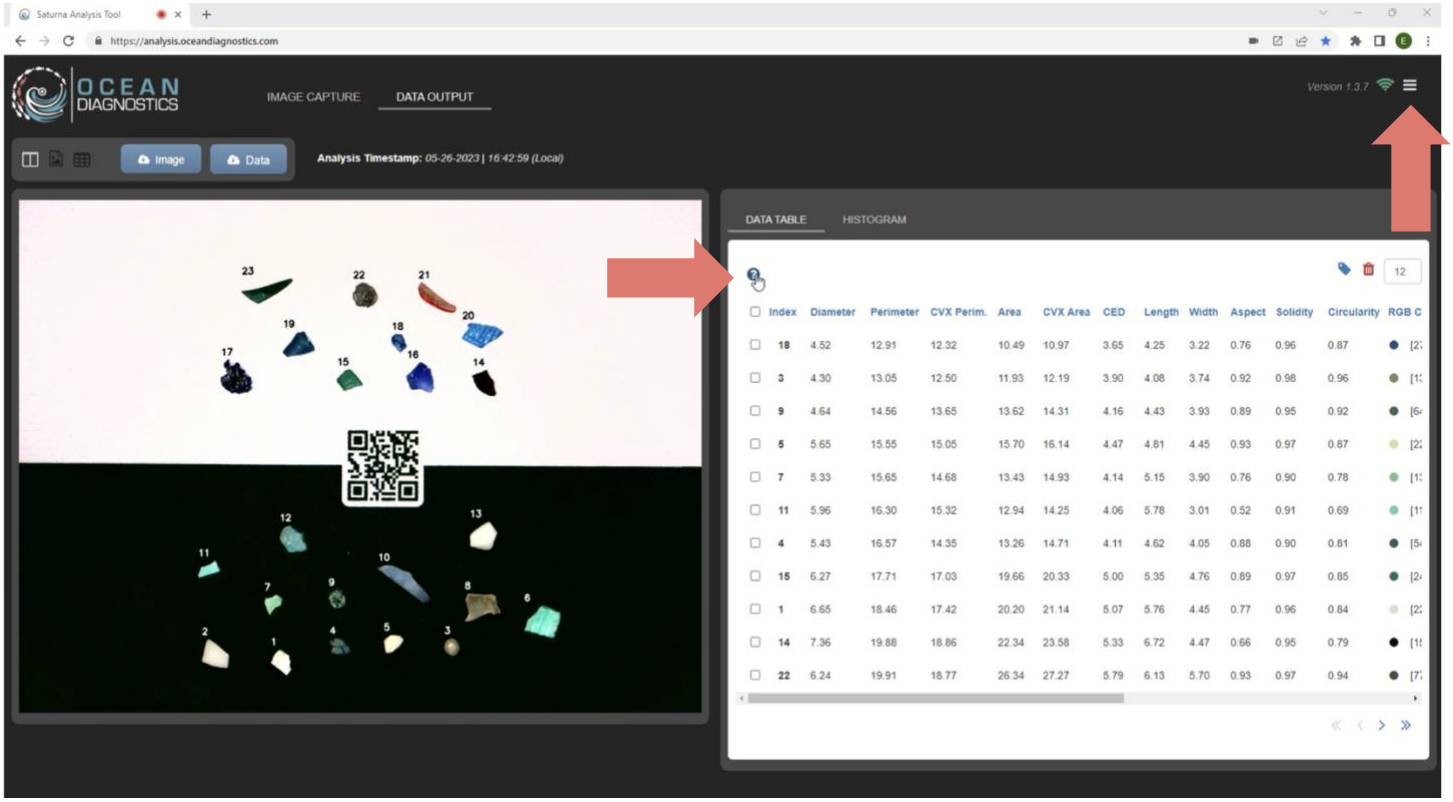
5. Explore the data by clicking the **Histogram** tab.
6. Download the Image and Data files to your local computer by clicking the blue buttons **Image** and **Data**.



⇒ Understand the Data

To explore the different types of data collected with the *Saturna Imaging System*, explore the Data Reference.

1. Click the question mark on the Data Table or click the three-line toggle in the upper right corner of the *Saturn Web Application*.
2. In Data Reference, you can explore the definition and meaning of each data type.



Physical Analysis Metrics

The Saturna Analysis Tool was developed to interface with ODI's Saturna Imaging System to rapidly analyze the physical parameters of visible microplastic particles using standardized computer vision algorithms. The following documentation was developed to provide users with a complete understanding of the output metrics generated by the software system. Please select an output parameter from the dropdown below to learn more:

Diameter

Diameter is a size parameter that defines the maximum dimension of a particle along its entire perimeter. This metric can sometimes be referred to as Feret Diameter, Maximum Width, or Caliper Dimension.

- Diameter values are reported in millimeters (mm)
- The algorithm works by extracting all of the perimeter pixels of the particle and then running an optimized algorithm to find the two pixels in the set that have the greatest distance from one another in 2-dimensional space. The resulting maximum distance is converted to millimeters using a calibration transformation based on the QR code reference in the image

Exit

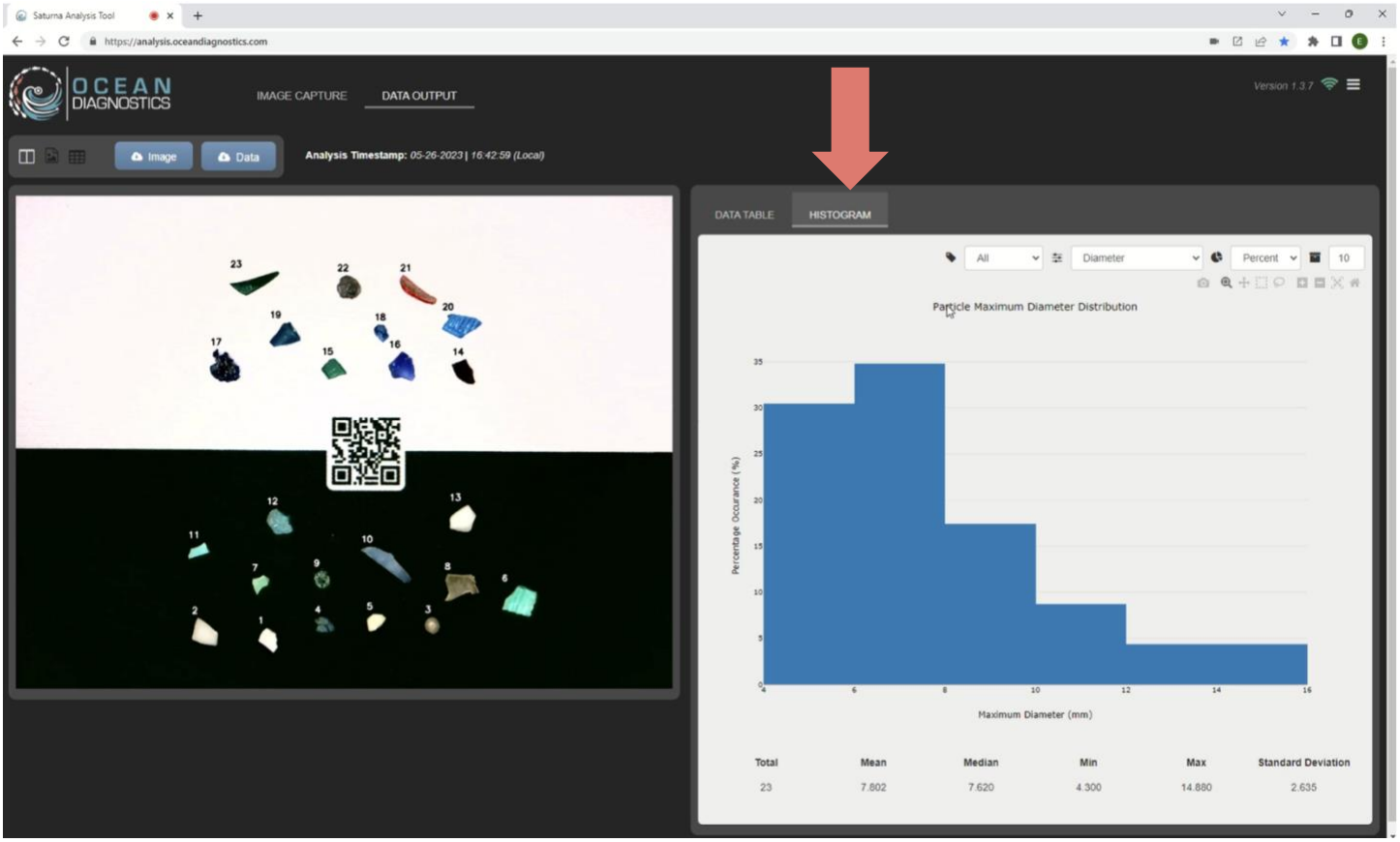
⇒ Data Visualization

Within the Saturna Web Application, basic histograms can be created and some statistical measurements of the analyzed particles can be collected.

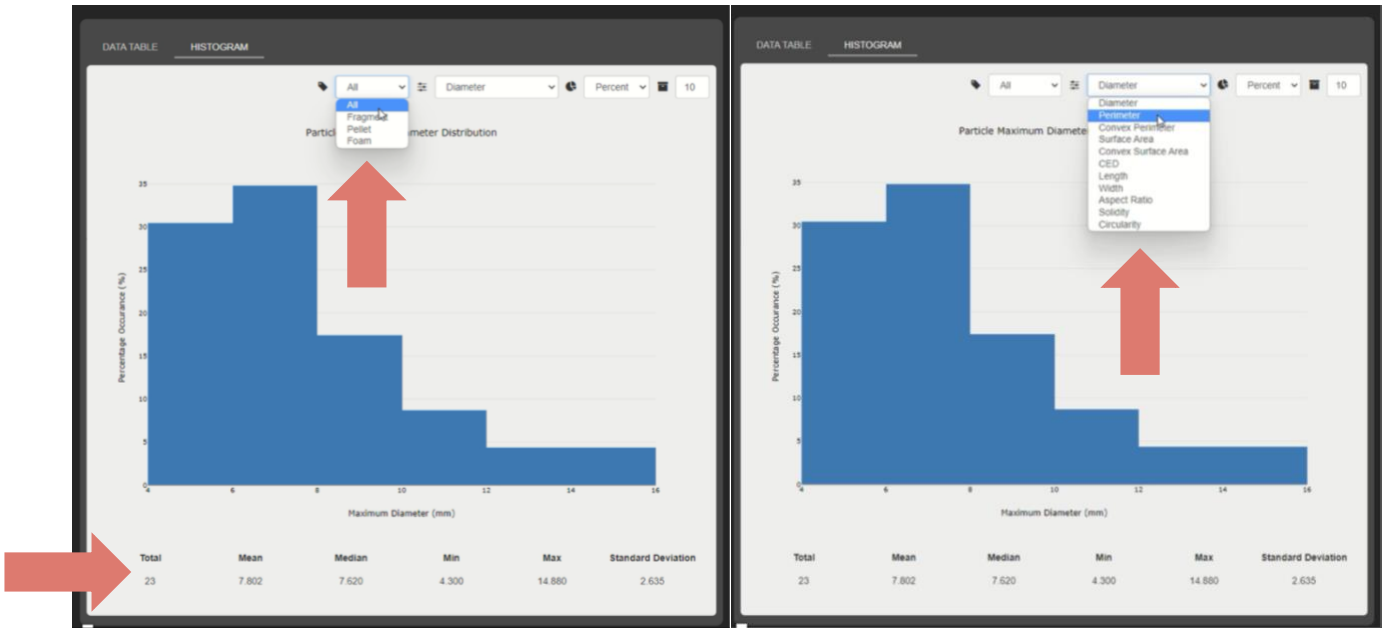
INSTRUCTIONS

1. To access this module, navigate to the **Histogram** tab above the data table after a group of particles has been analyzed.

Note: the plotting feature can only be used when connected to the internet.



2. Sort by tag. Using the dropdown menu at the top of the panel, select the category/tags you would like to plot into a histogram.



3. Sort by parameter. Using the dropdown menu at the top of the panel, select the parameter (e.g., perimeter, surface area, etc.) you would like to plot into a histogram.
4. Sort by tag. Further sort the data by selecting a tag from the dropdown. The histogram will only be populated with data that have the specific tag applied.
5. Customize your histogram. Adjust the bin number to change the width of bars in the histogram.
6. Capture descriptive statistics, including mean, median, min, max and standard deviation. When a new size parameter is selected from the dropdown menu, the statistics for that distribution will automatically update underneath the plot.

⇒Frequently Asked Questions

What if the *Saturna Web Application* does not detect the Saturna Camera?

- Check to make sure that Saturna is plugged into a USB port of the computer and that the USB C cable that is being used is a *data* cable, not just a charging cable. We recommend using the cable provided with the kit. Saturna works best with the Google Chrome Internet Browser on either a Windows PC/Laptop or ChromeBook. Support on other browsers is intermittent or not fully supported at this time.

What if Saturna picks up shadows or dust?

- First, ensure that the background sheet is clean. If needed, use a lint roller to remove any debris from prior sessions. If the *Saturna Imaging System* is still picking up unintended particles, adjust the exposure settings. Increasing the exposure may help the system recognize only the particles you are interested in. You can also change the minimum threshold level to eliminate dust and other unwanted small particles or use the ROI tool as outlined in the Saturna Imaging System 2023 Manual.

What if Saturna does not read the QR code?

- Make sure the QR code is fully visible and is not obscured by any particles. Adjust the exposure settings as necessary to ensure that the code is clearly visible. If needed, unplug and re-plug the *Saturna Imaging System* to reset the device settings. Note that Saturna will not pick up the QR code as a particle. It is trained not to include the QR code as a particle. Four dots will appear when Saturna is connected to the computer, but they will not be traced or included in the data.

Why is Saturna not recognizing particles?

- Ensure that the particles do not overlap one another. Make sure that light-coloured or white particles are on the dark side of the background sheet and darker or black particles are on the white side of the background sheet. Adjust the exposure levels and the threshold as necessary to improve image clarity. If needed, unplug and re-plug the *Saturna Imaging System* to reset the device. Carefully follow the instructions in the Saturna Imaging System 2023 Manual carefully.

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What should I do if I need to retrace the particles?

- Adjust exposure and threshold toggles if needed and be sure to click **Retrace Particles** any time you want to update the trace. Ensure all particles are visible by the camera. Saturna will automatically retrace all particles once the button is pressed.

How can I troubleshoot issues with the *Saturna Imaging System* if it still does not work properly?

- Step 1: Check to make sure everything is plugged in and you are using the correct device (Windows PC /Laptop or ChromeBook).
- Step 2: Unplug and re-plug Saturna in to reset the system.
- Step 3: Refresh the app using CTRL+R or by hitting the refresh button on the top of the browser page.
- Step 4: Adjust exposure levels.
- Step 5: Adjust threshold levels.
- Step 6: Use the ROI tool to isolate just the particles you want to analyze.
- Step 7: If all else fails, email info@oceandiagnostics.com for support.

What can I do if I need help understanding the data points generated by the *Saturna Imaging System*?

- Refer to the Data Reference from the three-line toggle in the top right corner of the *Saturna Web Application*. Explore each parameter through the drop-down menu to get more information about the analyses performed.

Can the system detect particles from diverse types of environmental samples (e.g., water, soil, air, ingested by animals)?

- The system can detect particles from different environments, but samples must be isolated from environmental matrices and cleaned of any biological material that can obscure the image. Saturna will analyze anything that is in the field of view without discriminating material type, so it is imperative that particles are first isolated before analyzing.

How long does it take to process a batch of samples?

- The process of tracing and analyzing particles should take less than a few minutes. When the data is generated by the app, images and data can be downloaded instantly.

Can I use Saturna without internet access?

- The *Saturna Web Application* is a Progressive Web App (PWA) and can be downloaded offline in the Chrome Browser by clicking the “Install App” button in the URL. The *Saturna Web Application* will then become available as a “Chrome App”, which can be accessed offline by clicking the “Apps” button in the top left of the Chrome Browser. In addition, a desktop shortcut can be created to launch the *Saturna Web Application* directly from the Windows OS.

What are the system requirements for the *Saturna Imaging System*?

- Saturna must be used with a Windows operating system (Windows PC / Laptop) or in ChromeOS on a ChromeBook with a device that has a USB port to connect the Saturna Imaging System. We recommend using the Google Chrome browser for best performance and reliability.

Are there any maintenance requirements for the *Saturna Imaging System*?

- Software updates to the *Saturna Web Application* are synced automatically and can be accessed by simply refreshing the page at any time. If using the app offline, you may wish to re-connect to the app online every couple of months to ensure you have the latest version or open a new https://analysis.oceandiagnostics.com/ window every time you use Saturna to have the most up to date *Saturna Web Application* version. Software update logs can be viewed in the App by accessing the toggle menu in the top right and selecting Update Log.
- We highly recommend cleaning particles before placing them on the background sheet. The sheet can become dirty if particles are not cleaned and dry, which may affect analysis results and require the need to purchase a replacement background sheet over time. Cleaning and drying the particles ahead of analysis will help to prolong the life of the sheet.

How do I provide feedback on the product, such as reporting bugs or requesting new features?

- Product and software feedback have been integrated directly into the app. To report a bug, request a new feature, or to see what we are working on in our software pipeline, access the toggle menu in the top right of the app and select the Feedback button to launch the support form.