



# Mech-Eye Industrial 3D Camera User Manual

v2.1.0

# Table of Contents

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1. Welcome	1
2. Getting Started	3
3. Mech-Eye SDK Release Notes	12
4. Mech-Eye SDK Installation Guide	20
5. Mech-Eye Viewer	24
5.1. User Interface	24
5.2. Instruction Guide	28
5.2.1. Set Camera IP Address and Connect to Camera	28
5.2.2. Acquire Data and Switch Data Type	31
5.2.3. Adjust Parameters	39
5.2.4. Save Data	42
5.2.5. Manage Log	43
5.3. Parameter Reference Guide	43
5.3.1. Parameters of PRO S / PRO M / NANO Series	44
5.3.2. Parameters of DEEP / LSR Series	61
5.3.3. Parameters of UHP-140	79
5.3.4. Parameters of V3 Cameras	95
5.4. Tools	113
5.4.1. Camera Firmware Upgrade	114
5.4.2. Camera Controller	115
5.4.3. Intrinsic Parameter Tool	116
5.4.4. Depth Analyzer	120
5.4.5. Exposure Assistant	121
5.4.6. FOV Calculator	121
5.4.7. Full Pallet Simulator	122
5.4.8. Custom Reference Frame	124
5.4.9. Check and Configure 2D Cameras	127
6. Mech-Eye API	130
6.1. Mech-Eye SDK Installation Guide (Ubuntu)	131
6.2. Capture Tutorial	132
6.3. Sample Usage Guide	137
6.3.1. C++ (Windows)	137
6.3.2. C++ (Ubuntu)	145
6.3.3. C#	150
6.3.4. Python (Windows)	155
6.3.5. Python (Ubuntu)	159
6.3.6. ROS	162
6.4. Tools	165
6.4.1. Firmware Upgrade Tool	166
6.5. Mech-Eye API Reference	166
7. GenICam Interface	167
7.1. GenICam Basics	167



7.2. HALCON .....	168
7.2.1. HALCON: Connect to Camera, Perform Image Capturing, and Adjust Parameters ...	168
7.2.2. HALCON: Hand-Eye Calibration .....	176
7.2.3. HALCON: Obtain Textured Point Cloud .....	185
7.2.4. HALCON: Obtain Depth Values Only .....	186
7.2.5. HALCON: Set IP Address .....	187
7.3. GenICam Reference .....	189
7.3.1. Camera Parameters Supported for GenICam .....	189
7.3.2. Use Mech-Eye Viewer to Adjust Camera Parameters for GenICam Client .....	193
7.3.3. Obtain HALCON-Readable Point Cloud through Mech-Eye API .....	195
8. Camera Hardware User Manual .....	197
8.1. Camera Models .....	197
8.1.1. Technical Specifications (V4) .....	199
8.1.2. Technical Specifications (V3) .....	201
8.2. NANO .....	202
8.3. PRO Series .....	214
8.4. UHP-140 .....	227
8.5. DEEP .....	238
8.6. LSR L .....	249
9. Extended Reading .....	262
9.1. Structured-Light 3D Scanning Mechanism .....	262
9.2. Set IP Address on Computer .....	263
10. Troubleshooting .....	266
10.1. Camera Not Found in Mech-Eye SDK .....	266
10.2. Camera Cannot Be Connected in Mech-Eye SDK (Unreachable) .....	269
10.3. Camera Cannot Be Connected in Mech-Eye SDK (Windows Server) .....	272
10.4. Enable Jumbo Frames .....	272

# 1. Welcome

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## Product Introduction

Mech-Eye Industrial 3D Camera (“camera”) is the industrial 3D camera developed by Mech-Mind.

Mech-Eye Industrial 3D Camera is controlled by Mech-Eye SDK. Through Mech-Eye SDK, you can obtain 2D images, depth maps and point clouds, as well as adjusting the camera parameters.

Mech-Eye SDK consists of Mech-Eye API and Mech-Eye Viewer. Mech-Eye Viewer is a graphical user interface software product developed with Mech-Eye API. Mech-Eye API is the application programming interface for Mech-Eye Industrial 3D Camera. You can call Mech-Eye API through C++, C# and Python methods to connect to the camera, adjust camera parameters, obtain data and save data.

Meanwhile, Mech-Eye Industrial 3D Camera is also compliant with the GenICam standard and can be controlled by third-party machine vision software also compliant with the GenICam standard (“GenICam clients”).

## Content

### Getting Started

Getting started with the camera

[See more](#)

### Release Notes

Mech-Eye SDK Release Notes

[See more](#)

### Installation Guide

Mech-Eye SDK Installation Guide

[See more](#)

### Mech-Eye Viewer

Mech-Eye Viewer Software User Manual

[See more](#)

### Mech-Eye API

Mech-Eye API User Guide

[See more](#)

## GenICam

GenICam Interface User Guide

[See more](#)

## Camera Hardware

Camera Hardware User Manual

[See more](#)

## Extended Reading

Learn more about the camera

[See more](#)

## Support

Troubleshooting

[See more](#)

## 2. Getting Started

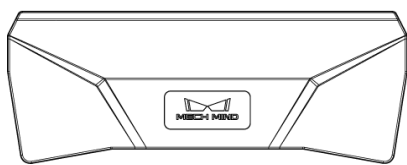
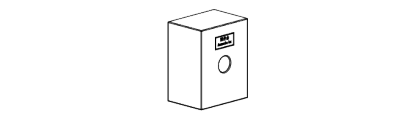

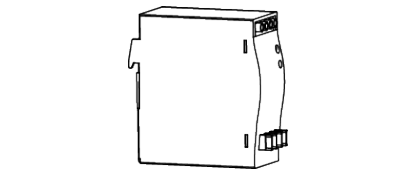
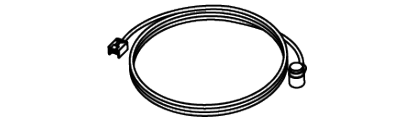
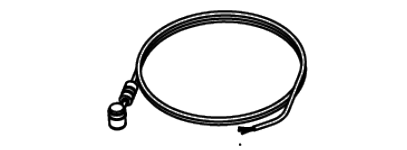
This topic will guide you through the entire process from checking package contents to using Mech-Eye Viewer to capture images.

### Check Package Contents

1. Make sure that the package is intact when you receive it.
2. Check contents according to the “packing list” in the package to ensure that no devices or accessories are missing or damaged.

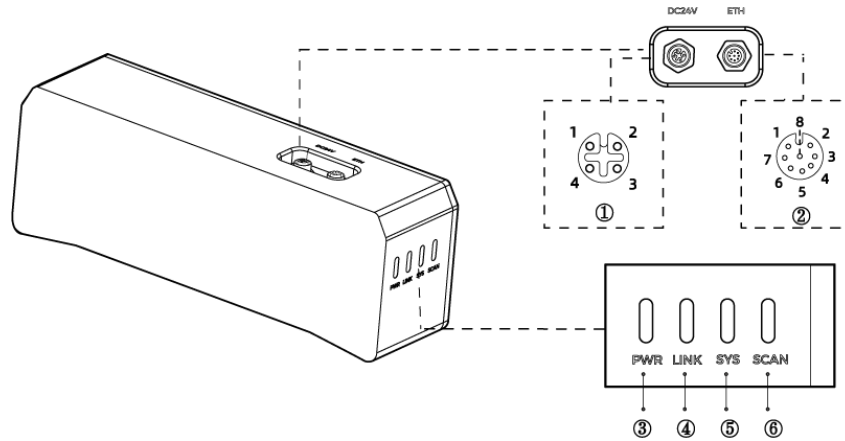


The table below is for reference only. Please take the “packing list” in the package as the final.

Camera	
Accessory box	
User manual	
DIN rail power supply	
Ethernet cable	
DC power cable	

### Check Ports and Indicator Lights

Please refer to the following figures and tables and check the functions of the ports and indicator lights on the camera.



The figure above is for reference only. The actual product may differ.

No.	Name	Function
①	DC 24V port	1: GND
		2: GND
②	ETH port	3: 24 VDC
		4: 24 VDC
		1: MD3_P
		2: MD2_N
③	PWR indicator light	3: MD2_P
		4: MD0_P
		5: MD1_P
		6: MD0_N
④	LINK indicator light	7: MD3_N
		8: MD1_N
		Off: not connected to power
		Green: normal voltage
⑤	SYS indicator light	Yellow: abnormal voltage, but system is still functioning
		Red: voltage too high or too low, system power is disconnected
		Off: not connected to network
		Blinking green: data being transmitted
⑥	SCAN indicator light	Solid green: no ongoing data transmission
		Off: system not started
		Solid green: system starting up
		Blinking green: system operating properly
		Blinking yellow: system operating with error but still functioning
		Blinking red: system not operating
		Solid: capturing and processing in progress
		Off: not capturing or processing

## Mount the Camera

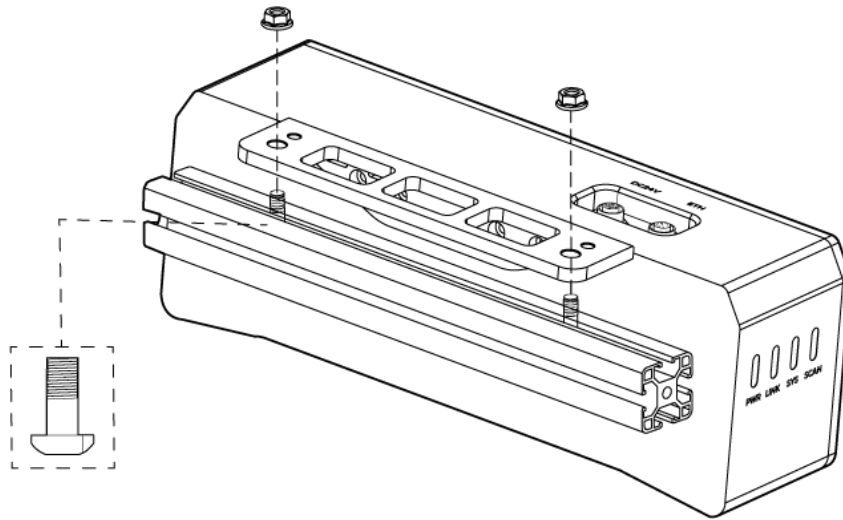


When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the **Dimensions** section of the technical specifications for each model.

Mech-Eye Industrial 3D Camera can be mounted in two ways. Please select the mounting method appropriate for your actual situation.

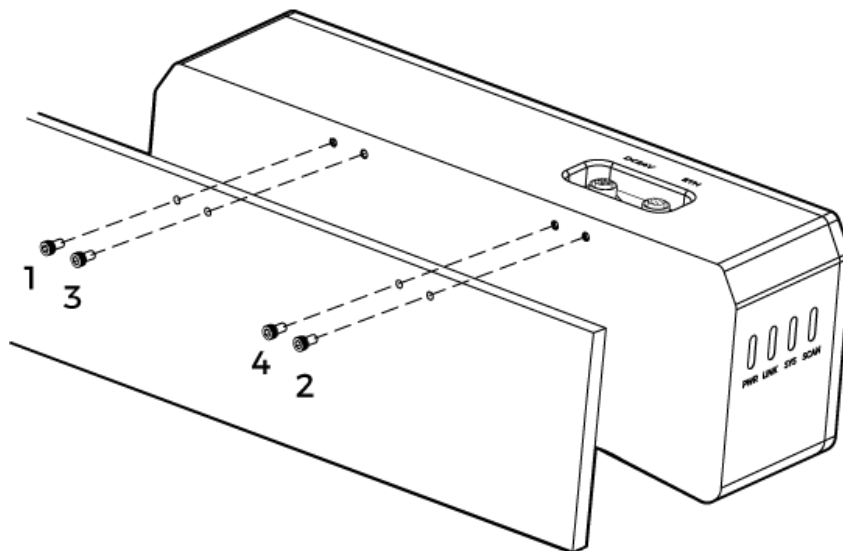
### Mount through Camera Bracket

As shown below, use the wrench to tighten the two bolts.



### Mount through Threaded Holes

1. Use the wrench to detach the camera bracket from the camera.
2. As shown below, place 4 bolts in the holes, use the wrench to loosely screw on the bolts in the specified order, and then fully tighten all the bolts in the specified order.



## Connect Cables

Please follow these steps to connect the Ethernet and power cables of the camera.



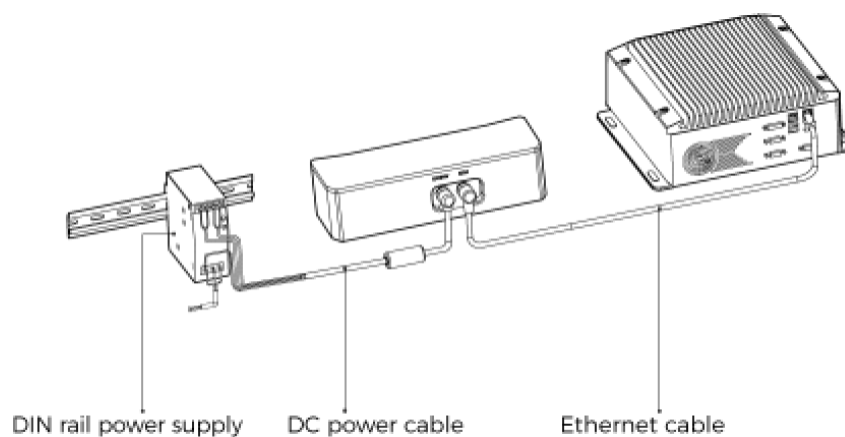
- Please connect the power cable last. The PWR indicator light should turn on after power is supplied to the camera. If the light does not turn on, please contact Technical Support.
- The recommended tightening torque for the bolts is 16 N·m.
- When mounting the camera onto a robot arm or other mobile device, please fasten the DC power and Ethernet cables properly to avoid damaging the cables or connectors due to strain.

### Ethernet Cable

As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

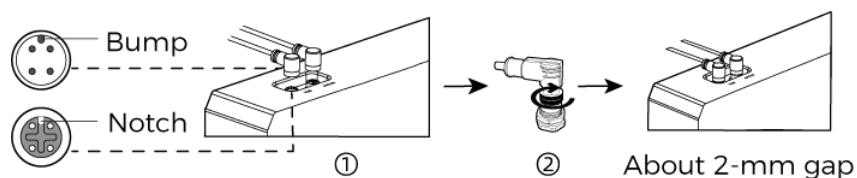
### DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

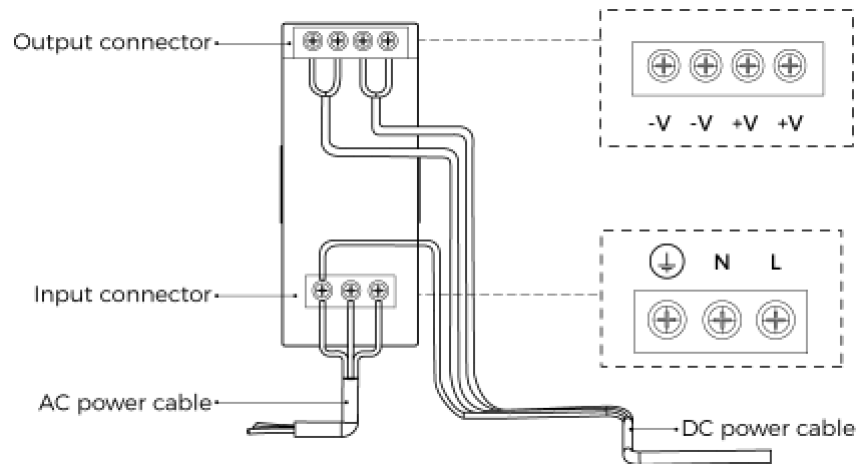


Connect the M12-A connectors of the cables to the corresponding ports:

1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.



### DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊕).
- The DC power cable (24V) has three wires: V+, V- and PE (⊕).

#### ⚠ Warning

- Please install the DIN rail power supply inside a control cabinet.
- The DIN rail power supply or the DIN rail should be reliably grounded. If mounting multiple DIN rail power supplies on the same DIN rail, ensure enough distance in between.
- The stripped part of the PE wire should be as short as possible.

The mounting and connection of the camera hardware is completed. The following sections will introduce how to use Mech-Eye Viewer to connect to the camera and control the camera to capture images.

## Set IP Addresses


You can download the Mech-Eye SDK installation package from [Mech-Mind Download Center](#).

Decompress the installation package, and then double-click the installer to install Mech-Eye SDK. For more information, please refer to [Mech-Eye SDK Installation Guide](#).

Before connecting to the camera, please make sure that the following IP address are in the same subnet and are unique.

- Camera IP address
- The IP address of the IPC Ethernet port connected to the camera

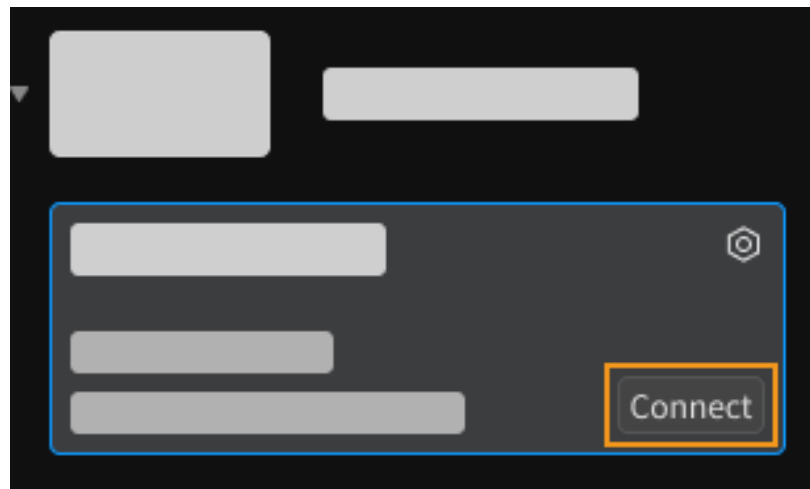
Follow these steps to set the camera IP address:


1. Double-click to open Mech-Eye Viewer.
2. Select the camera to be connected, click , and [set the camera IP address](#).



## Connect to Camera and Upgrade Firmware

1. Find the camera to be connected in Mech-Eye Viewer, and click [ **Connect** ].




2. If the version of the camera firmware is lower than the version of Mech-Eye Viewer, a firmware upgrade message will pop up. Follow these steps to upgrade the camera firmware.
  - a. Click [ **Yes** ] in the pop-up window, and click [ **Upgrade Firmware** ] in the new pop-up window.
  - b. Wait for the firmware upgrade to complete and restart the camera according to the instructions.
  - c. In the upper left of Mech-Eye Viewer, click  next to **Camera List** to refresh the list. Repeat until the camera to be connected is displayed again.
  - d. Find the camera to be connected and click [ **Connect** ].

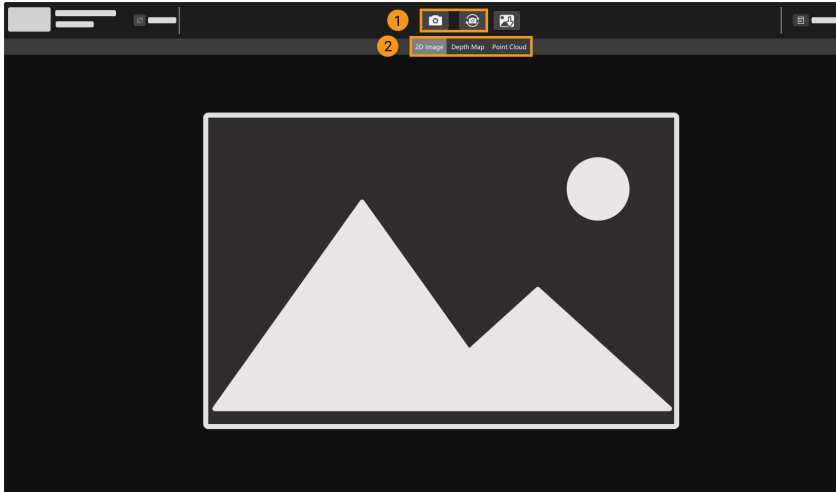
## Capture images

Click  to perform image capturing once.



Clicking  will trigger the camera to repeatedly capture images at predetermined intervals. Click again to stop the image capturing.

Click the data types below the image capturing buttons to check the 2D image, depth map and point cloud obtained from the camera.



For more information on image capturing and data types, please refer to [Acquire Data and Switch Data Type](#).

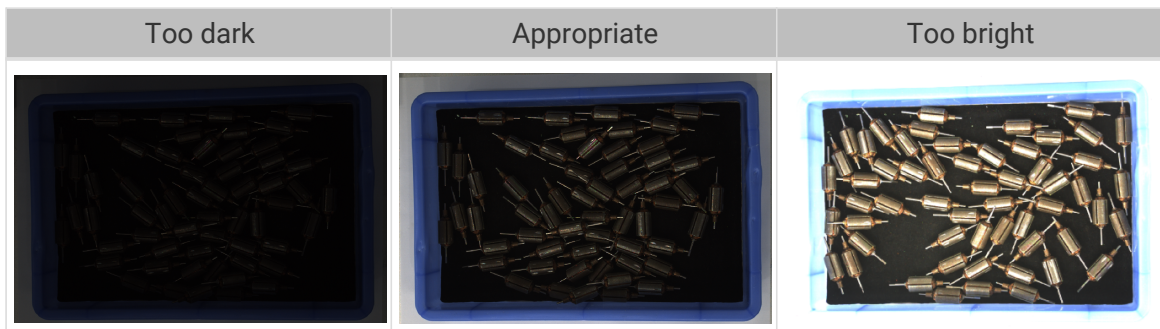
## Adjust Parameters

If the quality of the obtained 2D image, depth map and point cloud is not satisfactory, you can adjust the relevant parameters in the parameter panel on the right of the software to improve data quality.

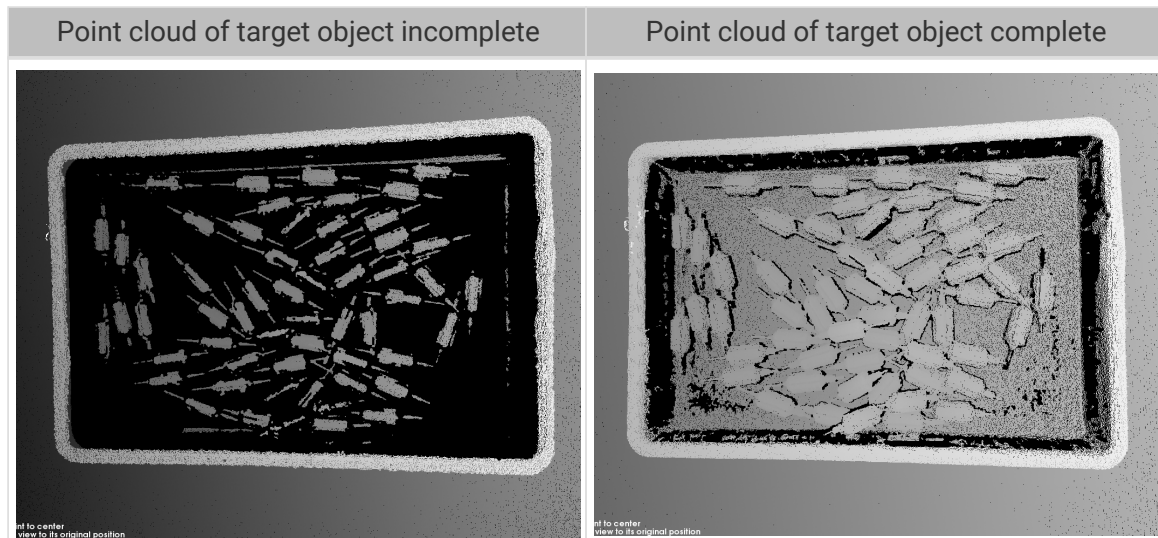
### Determine Data Quality

Based on the following criteria, roughly determine the quality of the obtained data.

- 2D image: the 2D image is not too bright or too dark; the surface features of the target object are clearly visible.



- Depth map and point cloud: in the depth map and point cloud, the data corresponding to the target object should be complete. In the following example, the target object is the rotors.



## Improve 2D Image Quality

1. Set the **Exposure Mode** parameter in the **2D Parameters** category to **Timed**, and then adjust the **Exposure Time** parameter.
  - If the 2D image is too dark, increase **Exposure Time**.
  - If the 2D image is too bright, decrease **Exposure Time**.



DEEP and LSR series provide two types of 2D images corresponding to different parameters. For detailed information, please refer to [Parameters of DEEP and LSR Series](#).

2. Capture images again and check the quality of the 2D image.

## Improve Quality of Depth Map and Point Cloud


1. Adjust the **Exposure Time** parameter in the **3D Parameters** category.
  - If the object is dark-colored or not reflective, increase **Exposure Time**.
  - If the object is light-colored or reflective, decrease **Exposure Time**.
2. Capture images again and check the quality of the depth map and point cloud.



For more explanations of the parameters, please refer to [Parameter Reference Guide](#).

## Use Data

The 2D image, depth map and point cloud obtained through Mech-Eye Viewer can be saved locally or can be output to Mech-Vision or third-party machine vision software for subsequent processing and calculation.

- Save the data: Click  in the data acquisition area, set the destination path, check the data types to be saved, and then click [ **Save** ].
- Use the data in Mech-Vision: Please refer to [Vision System Tutorial](#) and learn how to build the entire vision system that includes Mech-Vision.

- Use the data in third-party machine vision software: The data obtained by the camera can be transmitted to third-party software through [Mech-Eye API](#) or the [GenICam interface](#).

## 3. Mech-Eye SDK Release Notes

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This document introduces the new features, improvements, and resolved issues of Mech-Eye SDK 2.1.0.

### Highlights

- Improved point cloud quality: The **Point Cloud Processing** parameters have been redesigned and can effectively remove outliers and noises while preserving the object edge information in the point cloud, improving point cloud quality.
- Enhanced the functionality of interfaces:
  - Parameters used for hand-eye calibration are added to the GenICam interface and Mech-Eye API, and corresponding sample programs are provided. You can now perform hand-eye calibration directly with the interfaces.
  - Parameters for obtaining multi-part payload type data are added to the GenICam interface, and corresponding HALCON sample programs are provided. You can now easily obtain textured point clouds and depth maps that contain only the Z values.
  - A firmware upgrade tool is added. You can now upgrade the camera firmware without Mech-Eye Viewer.
- Improved capture speed: the camera capture speed has been elevated by measures such as improving memory usage and providing options of lower image resolutions. Applications with higher requirements on cycle time can be bettered handled.

### New Features

#### GenICam

- Added Parameters and Sample Programs for Hand-Eye Calibration

Parameters used for hand-eye calibration are added to the GenICam interface, and [corresponding HALCON sample programs](#) are provided. Through these sample programs, you can perform hand-eye calibration, obtain extrinsic parameters, and switch the reference frame in which the point cloud is output from the camera.

- Added Parameters and Sample Programs for Multi-Part Payload Type
  - GenICam parameters for obtaining multi-part payload type data in the **AreaScan3D** mode are added. Two channels are now supported, Range and Intensity.
  - Two HALCON sample programs demonstrating the applications of the above parameters are added:
    - `obtain_textured_point_cloud`: uses data from the Range and Intensity channels to [generate the textured point cloud](#).
    - `obtain_depth_map`: [obtains the depth map that contains only the Z values of points](#) through the Range channel, speeding up the data transmission and improving efficiency.
- Added Parameters and Sample Program for Camera IP Settings

Parameters for obtaining the current IP settings of the camera are added to the GenICam

interface, and a HALCON sample program for [obtaining and modifying the camera IP settings](#) is provided. You can now obtain and modify the camera IP settings with a GenICam client. Through the HALCON sample program, you can obtain the current IP address, subnet mask and gateway of the camera, as well as modifying these settings.

- Added Read-Only Parameters for Camera Intrinsic Parameters and Temperatures
  - Parameters for obtaining the camera intrinsic parameters are added. You can now obtain the camera intrinsic parameters with a GenICam client.
    - **Scan3dFocalLengthX**
    - **Scan3dFocalLengthY**
    - **Scan3dPrincipalPointU**
    - **Scan3dPrincipalPointV**
  - Parameters for obtaining the temperatures are added. You can now obtain the temperatures of the camera CPU and projector with a GenICam client.
    - **DeviceTemperatureSelector**: for selecting the camera component whose temperature you want to obtain. Options include **MainBoard** (CPU) and **Sensor** (projector).
    - **DeviceTemperature**: displays the temperature of the selected camera component.

## Mech-Eye API

- Added Methods and Sample Programs for Hand-Eye Calibration (C++ Only)

C++ Methods used for hand-eye calibration are added, and a corresponding sample program is added. Through this sample program, you can perform hand-eye calibration, and obtain extrinsic parameters.

- Added Firmware Upgrade Tool

A [firmware upgrade tool](#) is added. With this tool, Ubuntu users can now upgrade the camera firmware as well.

- Added Methods for Obtaining Device Temperature

- C++:

```
ErrorStatus MechEyeDevice::getDeviceTemperature(DeviceTemperature &)
```

- C#:

```
ErrorStatus MechEyeDevice.GetDeviceTemperature(ref  
mmind.apiSharp.DeviceTemperature temperature)
```

- Python:

```
Device.get_device_temperature(self)
```

## Mech-Eye Viewer

- Two 2D Image Types Displayed for DEEP (V4) and LSR (V4) Series

For the DEEP (V4) or LSR (V4) series, you can now select whether to display **2D Image (Texture)** or **2D Image (Depth Source)** in Mech-Eye Viewer. The **2D image (texture)** is used for texturing the point cloud, and the **2D images (depth source)** are used in hand-eye calibration, checking intrinsic parameters and setting ROI. Switching the 2D image display helps you adjust the exposure of different 2D images.

Meanwhile, the names of the relevant **2D Parameters** have been updated accordingly:

Old name	New name
Color Camera Exposure Mode	2D Image (Texture) Exposure Mode
Monochrome Camera Exposure Mode	2D Image (Depth Source) Exposure Mode
Monochrome Camera Exposure Time	2D Image (Depth Source) Exposure Time

- Added MTU Value Setting

The setting for adjusting the MTU value is added to the IP address configuration window. This setting is available in the **Administrator** account. Meanwhile, after the camera firmware is upgraded to 2.1.0, the default MTU value of the camera will change to 1500.



The MTU value of the camera should be consistent with the [jumbo frame value](#) set on the computer.

- Adjustable Depth Map Resolution for DEEP (V4) series

The resolution of the depth map obtained by the DEEP (V4) series can now be adjusted. Options include 2048 × 1536 and 1024 × 768. Using the lower resolution can speed up image capturing effectively (about 35%) and thus better cope with applications with short cycle time.

In the **Administrator** account, select Tools > Camera Controller, and adjust the resolution in the **Depth Map** menu.

- Added Reset to Factory Intrinsic Parameters Function

The reset to factory intrinsic parameters function is added to [Intrinsic Parameter Tool](#). This function is available in the **Administrator** account.

## Improvements

### Improved Point Cloud Processing Parameters

The **Point Cloud Processing** parameters have been redesigned, upgrading from 2 parameters to 4, and the performance of smoothing and unwanted-point removal has been greatly enhanced.

- The old **Point Cloud Smoothing** parameter is upgraded to [Surface Smoothing](#). The smoothing algorithm is enhanced, and the same intensity now provides better smoothing result.
- The old **Noise Removal** parameter is upgraded to [Outlier Removal](#) and [Noise Removal](#). Unwanted points are divided into outliers and noise, with separate, more targeted removal parameters. The removal algorithm is also enhanced, and the same intensity now provides better removal result.

- A new [Edge Preservation](#) parameter is added. You can now select the type of edge preservation to perform based on the object type, better preserving the object edge features.

If you want to achieve the processing result similar to the old parameters, please adjust the new parameters in the following way:

- If the old **Point Cloud Smoothing** parameter was set to **Normal**, set the new **Surface Smoothing** parameter to **Weak**.
- If the old **Noise Removal** parameter was set to **Normal**, set the new **Outlier Removal** parameter to **Weak**.

## Improved Capture Speed of Camera

After the camera firmware is upgraded to 2.1.0, the capture speed of the camera is improved.

- Depth map:
  - When obtaining the depth map through Mech-Eye API C++, the capture speed is improved by at least 2% and at most 35% or more.
  - When obtaining the depth map through Mech-Vision, the capture speed is improved by at least 5% and at most 20% or more.
- 2D image:
  - For V4 non-laser cameras, when obtaining the 2D image through Mech-Eye API C++, the capture speed is improved by at least 59% and at most 70% or more.
  - For V4 non-laser cameras, when obtaining the 2D image through Mech-Vision, the capture speed is improved by at least 66% and at most 70% or more.



The 2D image distortion correction function has been added to V4 laser cameras, which resulted in a reduction of the capture speed of the 2D image.

## Mech-Eye Viewer

- Changed the Default Format of Depth Map when Saving

The default format of depth map when saving is changed from **TIFF** to **PNG**, improving usability.

- Improved Intrinsic Parameter Tool
  - The user interface of [Intrinsic Parameter Tool](#) has been improved, with more tips and hints added, improving the usability of the tool.
  - A high-accuracy mode is added, in which stricter standards are used to check the intrinsic parameters. This mode is suitable for projects with high accuracy requirements. This mode is available in the **Administrator** account.
- Improved Display of Parameter Description Section

After the close button of the Parameter Description section is clicked, this section is no longer displayed, so that the parameters are not overlapped, improving the usability of the parameter panel.

To display the Parameter Description section again, check the **Parameter Description** option in the **View** menu.



- Improved FOV Calculator Tool
  - The user interface of the [FOV Calculator](#) tool has been improved, improving the usability of the tool.
  - The drop-down list of camera models has been improved and is more convenient for finding the more frequently used models.
  - The LSR S (V4) model is added to the list.
- The texture camera binning function of LSR L (V4) has been moved to [Camera Controller](#) and redesigned as the 2D image resolution setting function.
- The default value of **Camera Gain** for the DEEP (V4) series is updated from 0 to 5.
- The value range of **Laser Power** for laser cameras is updated from 20–100% to 50–100%.

## Mech-Eye API

The **Point Cloud Processing** parameters have been redesigned, upgrading from 2 parameters to 4. The corresponding Mech-Eye API methods are upgraded as follows:

- C++:
  - **Surface Smoothing**

```

ErrorStatus
MechEyeDevice::setCloudSurfaceSmoothingMode(PointCloudProcessingSettings
::PointCloudSurfaceSmoothing)
ErrorStatus
MechEyeDevice::getCloudSurfaceSmoothingMode(PointCloudProcessingSettings
::PointCloudSurfaceSmoothing &)
  
```

- **Noise Removal**

```

ErrorStatus
MechEyeDevice::setCloudNoiseRemovalMode(PointCloudProcessingSettings::Po
intCloudNoiseRemoval)
ErrorStatus
MechEyeDevice::getCloudNoiseRemovalMode(PointCloudProcessingSettings::Po
intCloudNoiseRemoval &)
  
```

- **Outlier Removal**

```

ErrorStatus
MechEyeDevice::setCloudOutlierRemovalMode(PointCloudProcessingSettings:::
PointCloudOutlierRemoval)
ErrorStatus
MechEyeDevice::getCloudOutlierRemovalMode(PointCloudProcessingSettings:::
PointCloudOutlierRemoval &)
  
```

- Edge Preservation

```
ErrorStatus  
MechEyeDevice::setCloudEdgePreservationMode(PointCloudProcessingSettings  
::PointCloudEdgePreservation)  
ErrorStatus  
MechEyeDevice::getCloudEdgePreservationMode(PointCloudProcessingSettings  
::PointCloudEdgePreservation &)
```

- C#:

- Surface Smoothing

```
ErrorStatus  
MechEyeDevice.SetCloudSurfaceSmoothingMode(mmind.apiSharp.PointCloudSurf  
aceSmoothing mode)  
ErrorStatus MechEyeDevice.GetCloudSurfaceSmoothingMode(ref  
mmind.apiSharp.PointCloudSurfaceSmoothing mode)
```

- Noise Removal

```
ErrorStatus  
MechEyeDevice.SetCloudNoiseRemovalMode(mmind.apiSharp.PointCloudNoiseRem  
oval mode)  
ErrorStatus MechEyeDevice.GetCloudNoiseRemovalMode(ref  
mmind.apiSharp.PointCloudNoiseRemoval mode)
```

- Outlier Removal

```
ErrorStatus  
MechEyeDevice.SetCloudOutlierRemovalMode(mmind.apiSharp.PointCloudOutlie  
rRemoval mode)  
ErrorStatus MechEyeDevice.GetCloudOutlierRemovalMode(ref  
mmind.apiSharp.PointCloudOutlierRemoval mode)
```

- Edge Preservation

```
ErrorStatus  
MechEyeDevice.SetCloudEdgePreservationMode(mmind.apiSharp.PointCloudEdge  
Preservation mode)  
ErrorStatus MechEyeDevice.GetCloudEdgePreservationMode(ref  
mmind.apiSharp.PointCloudEdgePreservation mode)
```

- Python:

- **Surface Smoothing**

```
Device.set_cloud_surface_smoothing_mode(self, info)
Device.set_cloud_surface_smoothing_mode(self, info)
```

- **Noise Removal**

```
Device.set_cloud_noise_removal_mode(self, info)
Device.get_cloud_noise_removal_mode(self)
```

- **Outlier Removal**

```
Device.set_cloud_outlier_removal_mode(self, info)
Device.get_cloud_outlier_removal_mode(self)
```

- **Edge Preservation**

```
Device.set_cloud_edge_preservation_mode(self, info)
Device.get_cloud_edge_preservation_mode(self)
```

## Resolved Issues

The following issues are resolved in Mech-Eye SDK 2.1.0:

- When a laser camera used 3 exposure times, and **Laser Frame Partition Count** was set to 3 or 4, the camera would disconnect occasionally due to insufficient memory.
- For Laser L (V3) and Laser L Enhanced (V3) cameras, if **Laser Frame Partition Count** was set to 2 or higher, and exposure time(s) was set to 20 ms or less, the depth data would be abnormal.
- **ROI** setting occasionally became ineffective when the parameter group had been switched.
- For the DEEP (V4) and LSR (V4) series, if **Exposure Mode** was set to **Auto** or **HDR**, the **Flash** option of **Monochrome Camera Exposure Mode** would not take effect.
- When the camera was connected to a router, a large MTU value of the camera would result in occasional malfunction of the camera.
- Data frames were occasionally lost due to insufficient camera memory.
- For the PRO (V4), DEEP (V4) and LSR (V4) series, the default low power consumption mode would result in occasional data frame loss.
- When multiple cameras had the same IP address, changing the IP address of one camera would change the IP addresses of the other cameras at the same time.
- The 2D image distortion correction function of monocular cameras resulted in slower capture speed.

## Release Notes of Previous Versions

[Mech-Eye SDK 2.0.2 Release Notes](#)

[Mech-Eye SDK 2.0.1 Release Notes](#)

[Mech-Eye SDK 2.0.0 Release Notes](#)

## 4. Mech-Eye SDK Installation Guide

---

This topic guides you through the downloading, installation, upgrade, uninstallation, repair, and installation modification of Mech-Eye SDK (including Mech-Eye Viewer and Mech-Eye API) on Windows.

### Download Mech-Eye SDK Installation Package

You can download the Mech-Eye SDK installation package from [Mech-Mind Download Center](#).

### Verify the Integrity of Mech-Eye SDK Installation Package

Since the Mech-Eye SDK installation package may be corrupted during transmission or downloading, you need to verify the integrity of the installation package. The integrity of the installation package can be verified with the CRC32 value, which is provided on the download page.

To verify the integrity of the software installation package, follow these steps:

1. Copy the installation package to a specified directory on the IPC or PC, such as *D:/*.
2. Right-click the installation package and select CRC SHA > CRC32 to calculate the CRC32 value for the installation package.



If the software installation package is a compressed file, you should calculate the CRC32 values against the compressed file and the decompressed installer.

3. Check the calculated CRC32 value against the one on the download page. The two values should be identical.

---

If you are using Mech-Eye SDK for the first time, refer to [Install Mech-Eye SDK](#) to complete the software installation.

If you have already installed Mech-Eye SDK, refer to [Upgrade Mech-Eye SDK](#) to upgrade the software to the latest version.

### Install Mech-Eye SDK

To install Mech-Eye SDK, follow these steps:

1. Double-click the downloaded installer to open the Mech-Eye SDK setup wizard.
2. In the **Welcome** window, browse the software information and click **[ Next ]**.
3. In the **License Agreement** window, read the license agreement carefully, check the **I accept the terms and conditions in the license agreement** check box, and then click **[ Next ]**.
4. In the **Select Product** window, select the components to install. If needed, check the **Create desktop shortcut(s)** option, and then click **[ Next ]**.



- Make sure that the **Add to PATH** option is checked.
- It is recommended to check the **Mech-Eye SDK Docs** option, which allows you to open the user manual without Internet connection.

5. In the **Set Path** window, change the installation path as required, and then click **[ Next ]**.



Default installation path: *C:/Mech-Mind/Mech-Eye SDK-x.x.x.*

6. In the **Confirm** window, confirm that the installation path is correct and then click **[ Install ]**.

7. In the **Install** window, wait for the installation to complete.

8. After the software is installed, in the **Finish** window, click **[ Finish ]** to exit the setup wizard.



It is recommended to restart your computer after the installation. If not restarted, the environmental variable added to PATH may not be effective.

## Upgrade Mech-Eye SDK



Only Mech-Eye SDK setup wizard 2.0.0 and above supports this function, and only upgrade of Mech-Eye SDK 1.6.1 and above is supported.

For users who have Mech-Eye SDK 1.6.1 and lower installed, if you need to upgrade it to version 2.0.0 or above, please uninstall the lower version and then [install the new version](#).

To upgrade Mech-Eye SDK, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Upgrade** window, click either **[ Upgrade and keep history versions ]** or **[ Upgrade and delete history versions ]**.
3. Upgrade the software according to the prompts in the setup wizard.
4. After the software is upgraded, in the **Finish** window, click **[ Finish ]** to exit the setup wizard.

## Uninstall Mech-Eye SDK

You can uninstall Mech-Eye SDK either with the Mech-Eye SDK setup wizard or the Windows Control Panel.

### Uninstall Using the Setup Wizard

To uninstall Mech-Eye SDK using the setup wizard, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click **[ Uninstall ]**.
3. In the **Uninstall** window, click either **[ Keep user configuration files ]** or **[ Do not keep user configuration files ]**.
4. Wait for the uninstallation to complete. After the software is uninstalled, in the **Finish** window, click **[ Finish ]** to exit the setup wizard.

### Uninstall Using the Control Panel

To uninstall Mech-Eye SDK using the Control Panel, follow these steps:

1. Open the **Control Panel** on the computer.
2. Choose **Program > Uninstall** or change a program.
3. Right-click **Mech-Eye SDK**, and then select **Uninstall**. The Mech-Eye SDK setup wizard will be opened.
4. In the **Maintain** window, click [**Uninstall**].
5. In the **Uninstall** window, click either [**Keep user configuration files**] or [**Do not keep user configuration files**].
6. Wait for the uninstallation to complete. After the software is uninstalled, in the **Finish** window, click [**Finish**] to exit the setup wizard.

## Repair Mech-Eye SDK



Only Mech-Eye SDK setup wizard 2.0.0 and above supports this function.

If Mech-Eye SDK failed to work normally, you can repair it using the Mech-Eye SDK setup wizard.

To repair Mech-Eye SDK, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click [**Repair**].
3. Wait for the repair to complete. After the software is repaired, in the **Finish** window, click [**Finish**] to exit the setup wizard.

## Modify Installed Components



Only Mech-Eye SDK setup wizard 2.0.0 and above supports this function.

After installation, you can use the setup wizard to change the installed components of the software. To modify installed components, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click [**Modify**].
3. In the **Select Product** window, select the products or components to install, or deselect the products or components to uninstall.
4. Install the software according to the prompts in the setup wizard.
5. After the software is installed, in the **Finish** window, click [**Finish**] to exit the setup wizard.

## Software License Agreement

For the license agreement of Mech-Eye SDK, refer to [End-User License Agreement](#).

## Troubleshoot Common Installation Problems

### Failed to Start the Setup Wizard

Symptom:

After double-clicking the installer, the setup wizard could not be started properly or crashed.

#### Possible Causes:

There is not enough space on the system drive.

#### Troubleshooting Procedure:

Check whether the available space on the system drive is larger than the size of the installer.

- If the available space on the system drive is smaller than the size of the installer, delete unnecessary files to free up the space, and then reinstall. If the problem still exists, contact Mech-Mind Technical Support.
- If there is enough space on the system drive, contact Mech-Mind Technical Support.

### Installation Failed

#### Symptom:

An error message saying "Installation failed." appeared in the **Finish** window during the installation.

#### Possible Causes:

- Corrupted installer or missing files.
- The current user does not have administrator access.
- Another Wizard is performing the installation or the Windows system is being upgraded.
- Other reasons.

#### Troubleshooting Procedure:

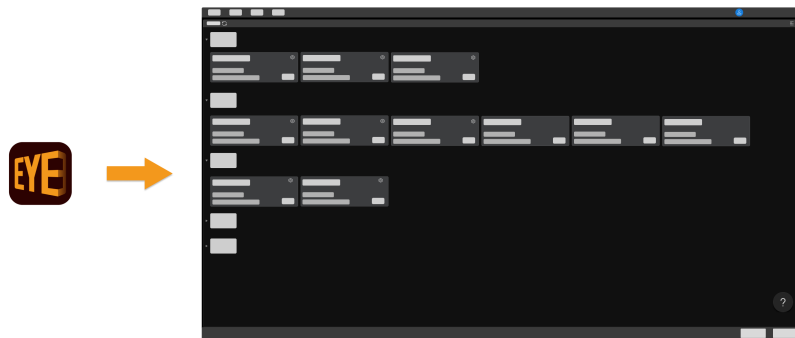
1. Obtain a new installer and [check its integrity](#), and then try the installation again.
  - If the problem is resolved, the troubleshooting is completed.
  - Otherwise, proceed to step 2.
2. Right-click the installer and select **Run as administrator** to reinstall.
  - If the problem is resolved, the troubleshooting is completed.
  - Otherwise, proceed to step 3.
3. Try the installation again after the installation of other software completes or after the Windows system upgrade completes.
  - If the problem is resolved, the troubleshooting is completed.
  - Otherwise, proceed to step 4.
4. Restart your computer and try the installation again.
  - If the problem is resolved, the troubleshooting is completed.
  - If the problem still exists, click the **installation log** link in the **Finish** window to collect installation logs and send them to Technical Support.



## 5. Mech-Eye Viewer

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Mech-Eye Viewer is the camera configuration and data visualization software independently developed by Mech-Mind for Mech-Eye Industrial 3D Camera. Based on the characteristics of the target objects, you can adjust the parameters of Mech-Eye Industrial 3D Camera to conveniently obtain high-quality 2D images, depth maps, and point clouds.



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Instructions on installing Mech-Eye Viewer:

[Mech-Eye SDK Installation Guide](#)

---

Introduction of the user interface:

[User Interface](#)

---

Instructions on connecting to camera, obtain and view data, and adjust parameters:

[Instruction Guide](#)

---

Detailed information on parameters:

[Parameter Reference Guide](#)

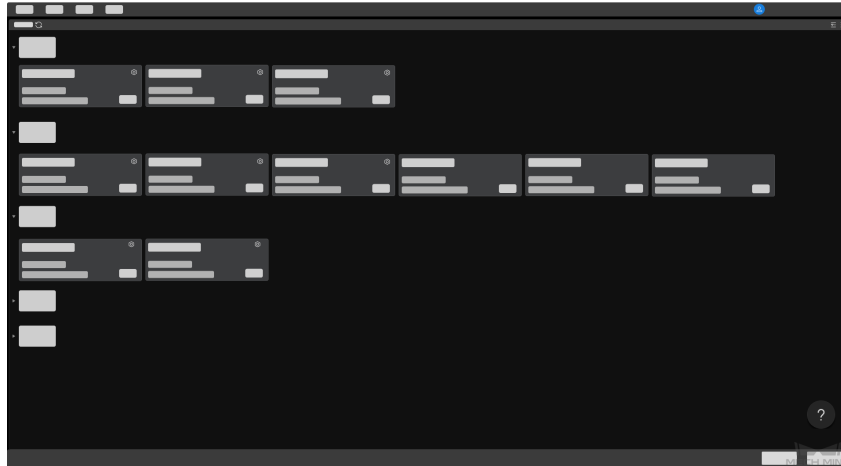
---

Instructions on using the tools in Mech-Eye Viewer:

[Tools](#)

### 5.1. User Interface

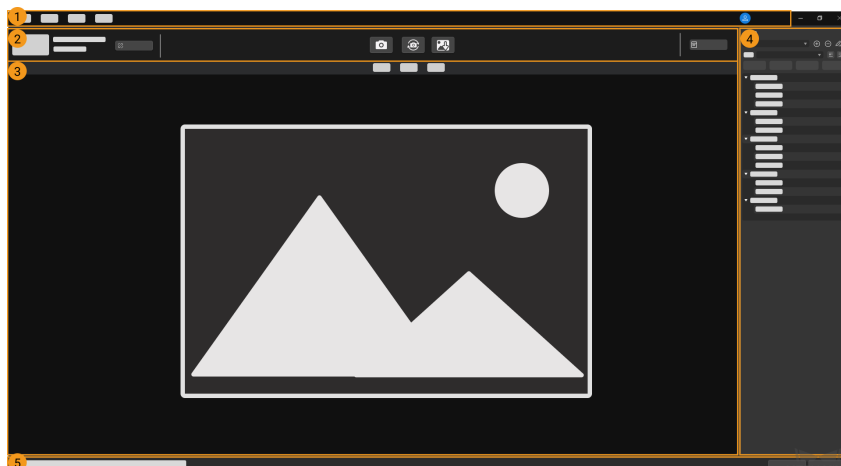
When you open Mech-Eye Viewer, the following interface is displayed.



In this interface, you can view all the available cameras and their information, [set camera IP address and connect to a camera](#).

Click  to view troubleshooting guidance on [camera connection issues](#).

After the camera is successfully connected, the following interface is displayed.




This interface consists of the following parts:

1. **Menu bar**: save raw data, start virtual camera, open built-in tools, check software information, etc.
2. **Data acquisition area**: disconnect from the camera, obtain and save data, and view the camera log.
3. **Data display area**: display the 2D image, depth map, and point cloud obtained from the camera.
4. **Parameter panel**: view and adjust parameters, and save parameter groups for different purposes.
5. **Status bar**: display software status information. Click [ **Previous** ] or [ **Next** ] to switch between messages.

## Menu Bar

The menu bar provides the **File**, **Tools**, **View**, **Help** and user switch menus.

Menu	Option	Description
File	Save Raw Data of Camera	Save the raw data in MRAW format for troubleshooting and analysis.
	Start Virtual Camera	Load saved raw data and view the parameter values set when the data was saved.
Tools	Provide supplementary tools. For detailed information, please refer to <a href="#">Tools</a> .	
View	Toolbar	Check to display the toolbar. Unchecked by default.
	Image Information Box	Check to display the image information box on the 2D image and depth map. Checked by default.
	Point Cloud Exhibit Button	Check to display the [ <b>Play</b> ] button on the point cloud. Unchecked by default.
	Parameter Description	Check to display the <b>Parameter Description</b> section in the parameter panel. Checked by default.
Help	About	Display software version.
	What's New	Open the Mech-Eye SDK release notes.
	User Manual	Open the user manual in your browser.
	Options	Switch the software display language. Change is applied after the software is restarted.
	Click to switch user account. The default account is <b>Standard</b> . The other accounts require passwords. If needed, please contact Technical Support.	

## Data Acquisition Area

In the data acquisition area, you can:

- [Set a custom camera name](#)
- [Perform image capturing](#)
- [Save obtained data to local](#)
- [View the log](#)
- Disconnect from the camera

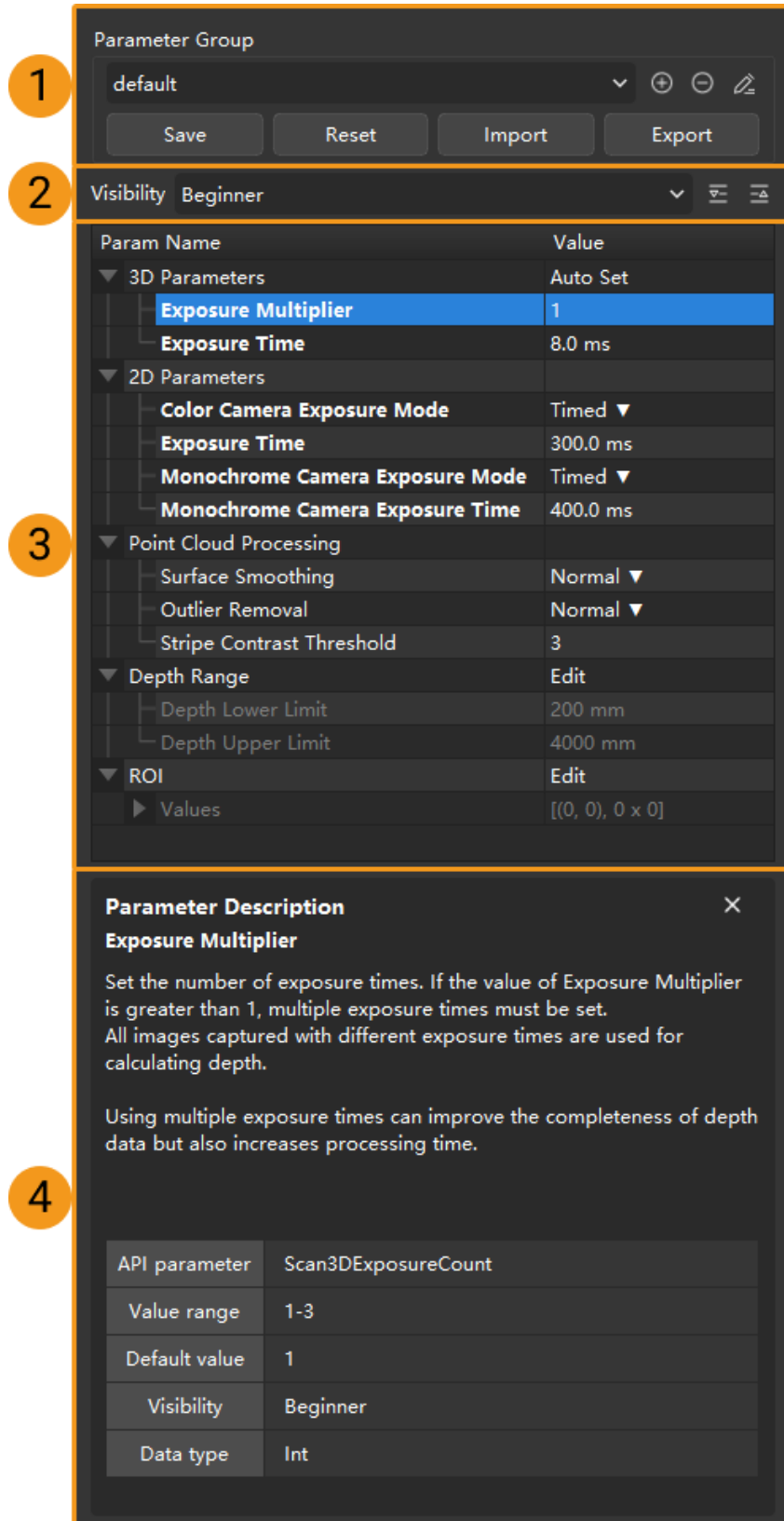
## Data Display Area

This area displays the data output from the camera. You can [switch among 2D image, depth map and point cloud](#).

For detailed information on the function of this area, please refer to [Adjust Data Display](#).

## Parameter Panel

The parameter panel consists of the following sections:



**1** Parameter Group: default

**2** Visibility: Beginner

Param Name	Value
3D Parameters	Auto Set
Exposure Multiplier	1
Exposure Time	8.0 ms
2D Parameters	
Color Camera Exposure Mode	Timed ▼
Exposure Time	300.0 ms
Monochrome Camera Exposure Mode	Timed ▼
Monochrome Camera Exposure Time	400.0 ms
Point Cloud Processing	
Surface Smoothing	Normal ▼
Outlier Removal	Normal ▼
Stripe Contrast Threshold	3
Depth Range	Edit
Depth Lower Limit	200 mm
Depth Upper Limit	4000 mm
ROI	Edit
Values	[(0, 0), 0 x 0]

**3**

**4** Parameter Description: Exposure Multiplier

Set the number of exposure times. If the value of Exposure Multiplier is greater than 1, multiple exposure times must be set. All images captured with different exposure times are used for calculating depth.

Using multiple exposure times can improve the completeness of depth data but also increases processing time.

API parameter	Scan3DExposureCount
Value range	1-3
Default value	1
Visibility	Beginner
Data type	Int

1. Parameter group: create a new parameter group, save parameter values to a parameter group, delete a parameter group, rename a parameter group, and import and export parameter groups.
2. Visibility: change the visibility of parameters.

3. Parameter list: [adjust parameters](#).
4. Parameter description: [view more information of the selected parameter](#).

---

This topic introduced the user interface of Mech-Eye Viewer. Continue reading for instructions on using Mech-Eye Viewer.

## 5.2. Instruction Guide

This topic provides instructions on using Mech-Eye Viewer to connect to the camera, acquire data, view the data, adjust parameters and save the data.

Before adjusting the parameters, please [check the intrinsic parameters of the camera](#). The coordinates of points are accurate only if the camera intrinsic parameters are accurate.

---

Instructions on **setting the camera IP address, connecting to the camera, and setting a custom camera name**:

[Set Camera IP Address and Connect to Camera](#)

---

Instructions on **obtaining data and viewing the data**:

[Acquire Data and Switch Data Type](#)

---

Instructions on **actions relevant to the parameters**:

[Adjust Parameters](#)

---

Instructions on **saving the obtained data**:

[Save Data](#)

---

Information on **actions relevant to the log** in the case that you encounter a problem with the software:

[Manage Log](#)

### 5.2.1. Set Camera IP Address and Connect to Camera

To ensure that Mech-Eye Viewer can connect to the camera successfully, it is recommended to set the IP addresses first. Please make sure that the following IP addresses are in the same subnet and are unique.

- The [IP address of the camera](#)

- The [IP address of the computer Ethernet port connected to the camera](#)

After setting the IP addresses, you can [connect to the camera](#). Once the camera is connected, you can [set a name for the camera](#) for easy recognition of different cameras.



If the camera to be connected is not displayed in Mech-Eye Viewer, please refer to [Camera Not Found in Mech-Eye SDK](#).

## Set Camera IP Address


You can set a static IP address for the camera, or set it to dynamic IP address, which is automatically assigned.

### Set Static IP address



Record the set camera IP address for future reference.

Follow these steps to set a static camera IP address with Mech-Eye Viewer:


1. Open Mech-Eye Viewer, select the info card of the camera to be connected, and click  in the upper right of the card to open the **Config Camera Network** window.
2. Select **Set as Static IP**.
3. Based on the IP address and subnet mask displayed in **Computer IP Configuration**, select **IP Address Class**, and enter the camera IP address and subnet mask. Then, click **[ Apply ]** to apply the changes.



- The IP address must be unique.
- The **Computer IP Configuration** section displays the IP address and subnet mask of the computer Ethernet port connected to the camera.

### Set Dynamic IP address

Follow these steps to set a dynamic camera IP address with Mech-Eye Viewer:

1. Open Mech-Eye Viewer, select the info card of the camera to be connected, and click  in the upper right of the card to open the **Config Camera Network** window.
2. Select **Set via DHCP** and click **[ Apply ]**.

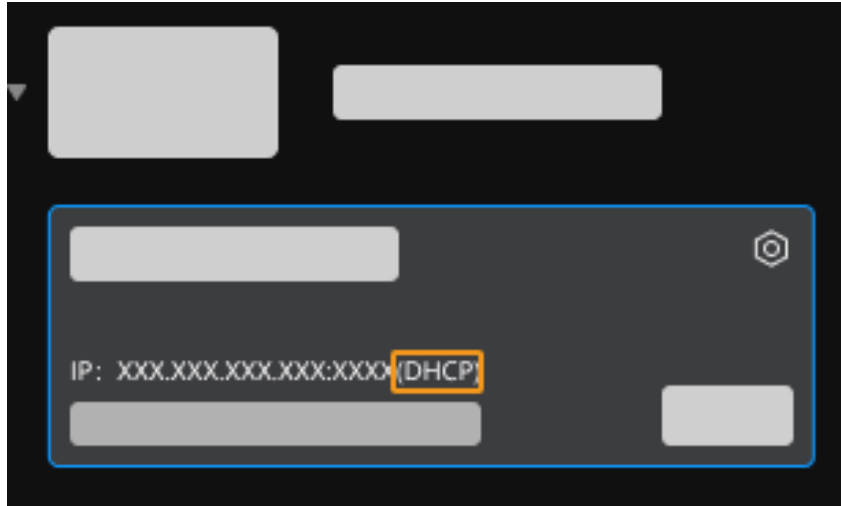


If you want to set the IP address of the computer Ethernet port connected to the camera, please refer to [Set IP Address on Computer](#).

## Check Camera Status

Before connecting to the camera, please check if the camera is in a connectable status.

The camera status can be check in the camera info card, to the right of the IP address, as shown below.

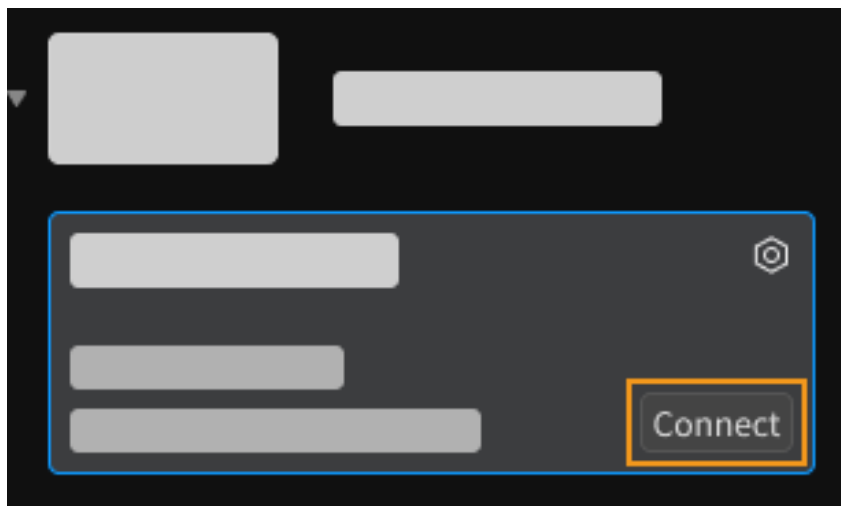


The camera can be in any of the following four statuses:

Status	Connectable?	Description
Static	Yes	camera is using a static IP address
DHCP	Yes	camera is using a dynamic IP address
Unreachable	No	Please refer to <a href="#">Camera Cannot Be Connected in Mech-Eye SDK (Unreachable)</a> and troubleshoot.
Connected	No	Connected by a GenICam client. Please disconnect the camera from the GenICam client first.

### Connect to Camera


After confirming that the camera can be connected, select this camera and click [ **Connect** ].



- For the very first time that the camera is connected to the computer, it may take up to a few minutes for the camera to show up in Mech-Eye Viewer.
- If a prompt of camera firmware upgrade pops up, please click [ **Yes** ] and [upgrade camera firmware](#).

## Customize Camera Name

The camera name can be used to distinguish different cameras, clarifying the usages and locations of the cameras, and more. Please set the name according to your actual needs. The camera name will be displayed in the camera list.

After connecting to the camera, on the left of the data acquisition area, click  or **Set camera name** to set a camera name.

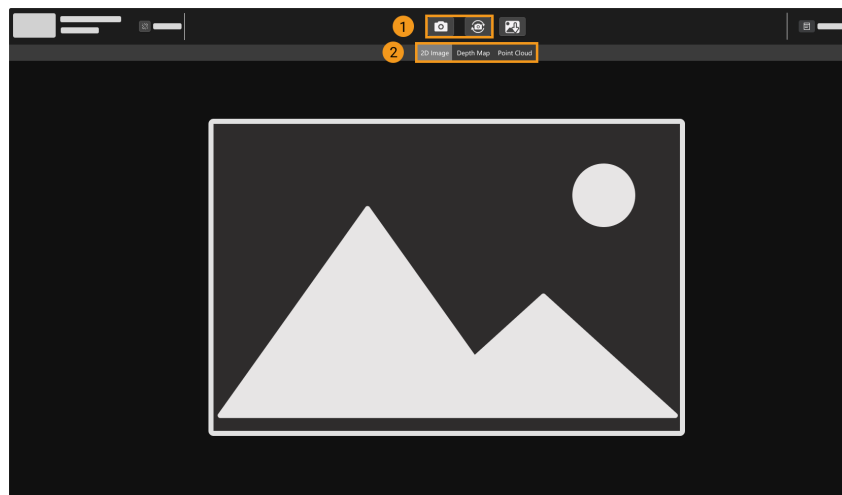


- The following characters cannot be used: \, /, :, \*, ?, ", <, >, |.
- The name of a virtual camera cannot be customized.
- If you need to change the name later on, click the name to do so.

Once the camera is connected, you can start acquiring data. The next topic introduces the actions for acquiring data and viewing the obtained data.

### 5.2.2. Acquire Data and Switch Data Type



Once the camera is successfully connected, the following interface is displayed. In this interface, you can acquire and view the data.



1. Acquire data
2. Switch the displayed data type

### Acquire Data

There are two ways to acquire data:

-  : Acquire data once.
-  : Acquire data continuously at predetermined intervals. Click again to stop data acquisition.



For an explanation of the data acquisition and output process of structured-light cameras, please refer to [Structured-Light 3D Scanning Mechanism](#).

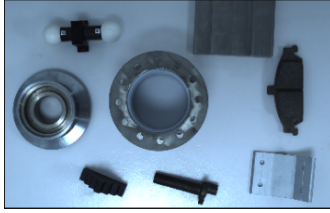
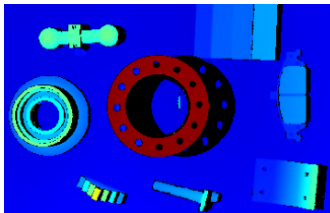
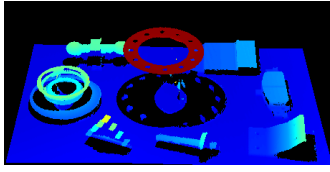


## Switch Data Type

The camera outputs multiple types of data to Mech-Eye Viewer. Click the corresponding button to switch the displayed data type.

The types of data output by different camera models differ.


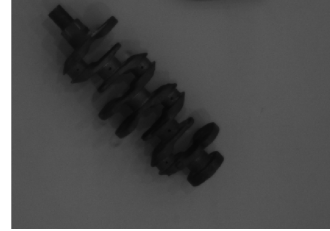
- The data output by models other than the DEEP (V4) and LSR (V4) series include the following types:


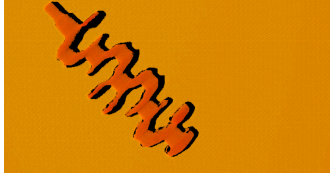
Type	Description	Example
2D image	The 2D image used for texturing the point cloud	
Depth map	A 2D image containing depth information	
Point cloud	A collection of data points that represent the 3D shape of the object surface	



For binocular cameras, two 2D images are output with each round of data acquisition. For specific models of binocular cameras, please refer to [Camera Models](#).

- The data output by the DEEP (V4) and LSR (V4) series include the following types:

Type	Description	Example
2D image (texture)	The 2D image used for texturing the point cloud	
2D images (depth source)	The 2D images captured by the 2D cameras that acquire the depth data	

Type	Description	Example
Depth map	A 2D image containing depth information	
Point cloud	A collection of data points that represent the 3D shape of the object surface	



The 2D images (depth source) are used in hand-eye calibration, checking intrinsic parameters and setting ROI.

### Adjust Data Display

In the data display area, you can adjust the display of the data through mouse actions, keyboard, and buttons and menus in the software interface.

The instructions below are divided by data types.

#### Adjust 2D Image Display

In the 2D image display, you can perform the following actions:

- **Zoom:** While the cursor is on the 2D image, scroll the mouse wheel to zoom the 2D image.
- **Move:** While the 2D image is zoomed in, hold and drag to move the 2D image.
- **Reset size:** Right-click the 2D image and select **Reset View** to fit it to the window.
- **Check pixel position and RGB/grayscale values:** In the image information box at the lower right of the 2D image, you can check the pixel position and RGB/grayscale values of the pixel where the cursor is located.



- The pixel position of the upper-left corner of the image is (0, 0).
- To hide the image information box, uncheck **Image Information Box** in the **View** menu.

#### Adjust Depth Map Display

In the depth map display, you can perform the following actions:

- **Zoom:** While the cursor is on the depth map, scroll the mouse wheel to zoom the depth map.
- **Move:** While the depth map is zoomed in, hold and drag to move the depth map.
- **Reset size:** Right-click the depth map and select **Reset View** to fit it to the window.
- **Check pixel position and coordinates:** In the image information box at the lower right of the depth map, you can check the pixel position and coordinates in the camera reference frame of the pixel where the cursor is located.



- The pixel position of the upper-left corner of the image is (0, 0).
- To hide the image information box, uncheck **Image Information Box** in the **View** menu.

menu.

- **Adjust depth data display:** The display of the depth data can be adjusted in the left panel. For detailed instructions, please refer to [Adjust Depth Data Display](#).

### Adjust Point Cloud Display

In the point cloud display, you can perform the following actions:

- **Zoom:** While the cursor is on the point cloud, scroll the mouse wheel to zoom the point cloud.
- **Rotate:** Hold the left mouse button and drag to rotate the point cloud.
- **Pan:** Hold the mouse wheel and drag to pan the point cloud.
- **Reset the view:**
  - Press the **R** key to reset the panning of the view, and adjust the zoom of the point cloud to a default level.
  - Press the **Backspace** key to reset the panning and rotation of the view, and adjust the zoom of the point cloud to a default level.
- **Display view cone:** Right-click and select **Show Frustrum** to display the FOV of the 2D cameras and projector in the form of view cones.
- **Display camera reference frame:** Right-click and select **Show Axes** to display the axes of the camera reference frame.
- **Adjust depth data display:** The display of the depth data can be adjusted in the left panel. For detailed instructions, please refer to [Adjust Depth Data Display](#).
- **Point Cloud Exhibit:** This function moves the point cloud along a predetermined trajectory to display it from various angles. For detailed instructions, please refer to [Point Cloud Exhibit](#).

### Adjust Depth Data Display

In the left panel of the depth map or point cloud display, you can adjust the display reference frame, color rendering, and range of the depth data.

#### Change Reference Frame

In the **Reference Frame** menu at the top of the left panel, you can select the reference frame used for displaying the depth data.

- **Camera** (default): displays the depth data in the camera reference frame.
- **Custom:** displays the depth data in the [custom reference frame defined by the user](#).



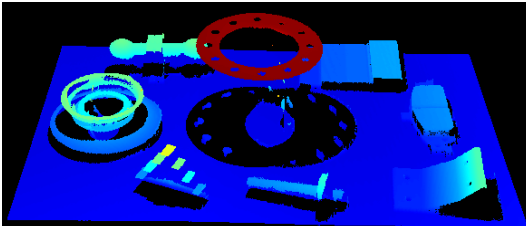
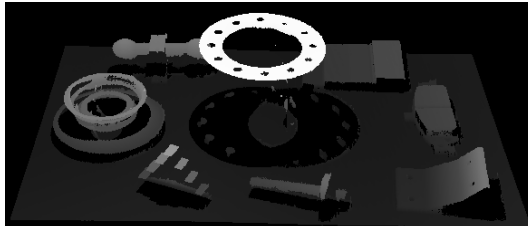
The reference frame setting is simultaneously applied to both depth map and point cloud.

#### Change Color Rendering

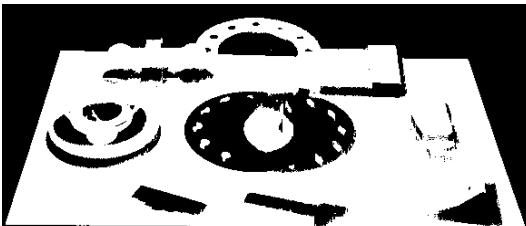
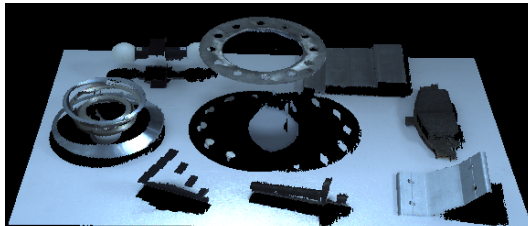
In the **Color** menu in the left panel, you can choose the color rendering scheme of the depth data.

The **Jet** and **Gray Scale** options are available for both depth map and point cloud. When **Jet** or **Gray Scale** is selected, the [depth range of the color rendering can be adjusted](#).

Option	Jet	Gray Scale
--------	-----	------------

Description	Render the depth data with the jet color scheme	Render the depth data with grayscale
Example		

The **White** and **Texture** options are only available for the point cloud.

Option	White	Texture
Description	Display the untextured point cloud	Display the point cloud textured with the 2D image
Example		



When **White** or **Texture** is selected, if you switch to the depth map display and then switch back to the point cloud display, the **Color** setting will be automatically changed to the option selected in the depth map display.

### Adjust Depth Range of Color Rendering

When the depth map and point cloud are displayed with **Jet** or **Gray Scale**, every time data acquisition is performed, Mech-Eye Viewer automatically adjusts the color rendering according to the range of the obtained depth data.

- **Jet**: Dark red corresponds to the minimum depth value obtained, dark blue to the maximum depth value obtained, and the rest of the colors are distributed evenly in between.
- **Gray Scale**: White corresponds to the minimum depth value obtained, black to the maximum depth value obtained, and the rest of the colors are distributed evenly in between.

With the functions in the **Range** section of the left panel, you can adjust the depth range in which the color is rendered, in order to conveniently observe the depth variation in a specific range.



The depth range of color rendering is simultaneously applied to both depth map and point cloud.

#### Examples of suitable scenarios:

- Observe the depth variation of an area on the workpiece surface to check if this area is flat enough.
- Accentuate the display of a certain workpiece.

Follow these steps to adjust the color rendering range of the depth data:

1. Adjust the **Depth Range** parameter in the parameter panel: **Min** and **Max** of the slider in the left panel corresponds to the **Depth Range** parameter. You can first [adjust this parameter to an appropriate range](#) to eliminate the unneeded depth data.
2. Check the rough depth: On the depth map, move the cursor to the area to be observed, and check the third value of **Coordinates** in the image information box in the lower right. This is the depth value.
3. Adjust depth range of color rendering: Move the slider handles or enter the depth values on the right of the slider to adjust the depth range of color rendering according to your needs.



- When using the UHP series, you can change the unit to  $\mu\text{m}$  on the right of the slider.
- After adjusting the range, the depth values outside the range are displayed in the colors corresponding to the minimum/maximum depth values.

4. Lock the range: If you need to compare the depth variations in the same range across multiple acquisitions, you can check the **Lock** option above the slider. When you acquire data again, the depth range of color rendering manually adjusted will be used.

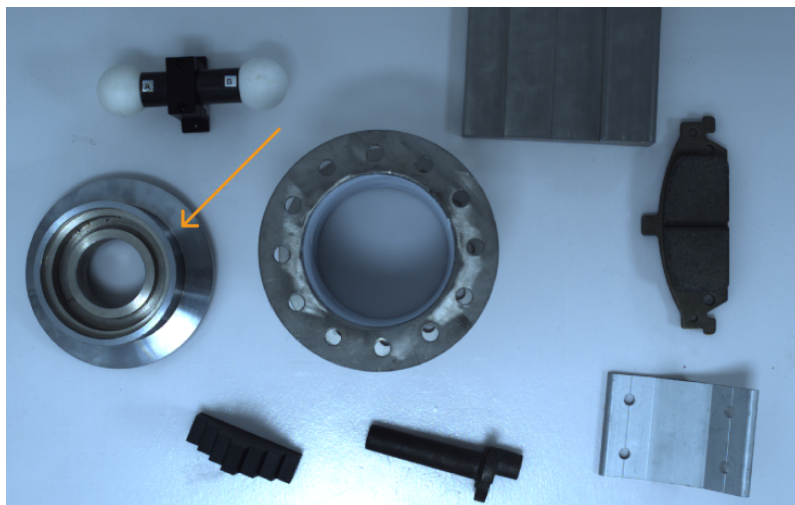


To change back to the automatically adjusted range, uncheck **Lock** and click [**Reset**] to the upper right.

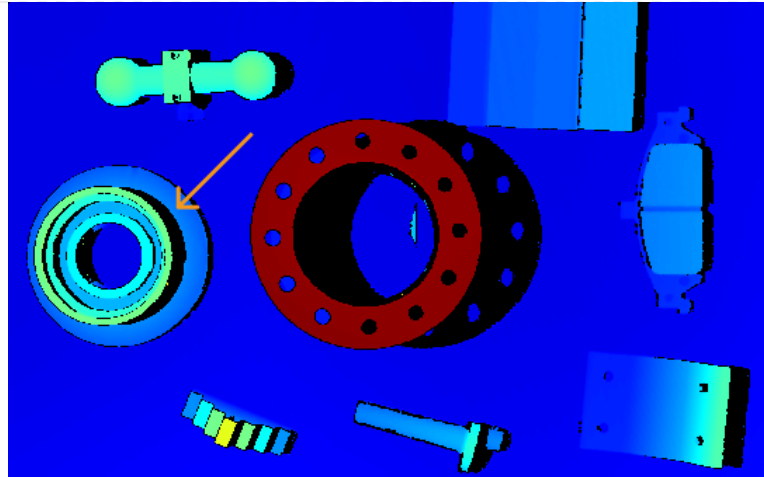
Below are two adjustment examples.

### Example 1

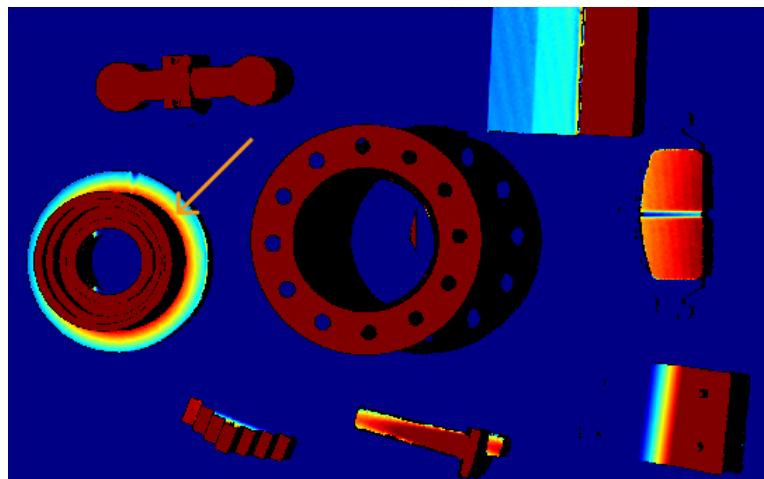
Goal: Check whether the surface pointed by the orange arrow is flat enough.



1. In the depth map, this surface appears to be roughly the same color. It is hard to tell if the surface is perfectly flat or not.

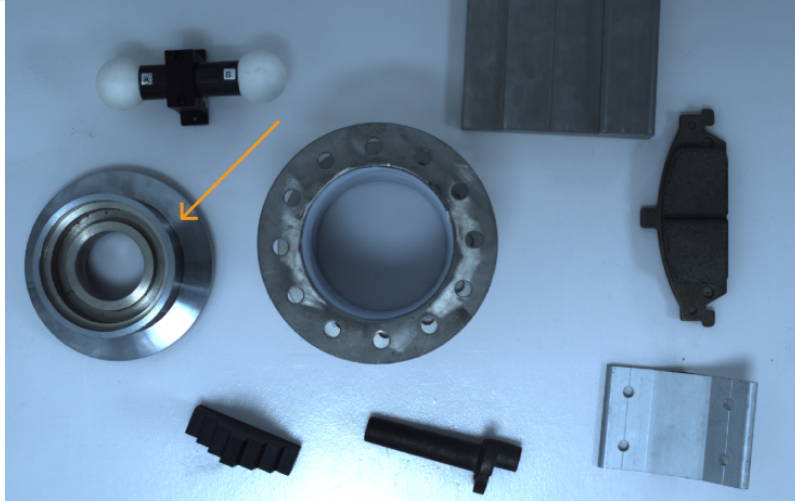


2. Move the cursor onto the surface and check the depth value in the image information box in the lower right (about 0.829 m).
3. Move the slider handles or enter the depth values to adjust the depth range of color rendering to 825–835 mm.
4. Check the depth map again. Now the depth variation of this surface can be easily observed with the color variation.

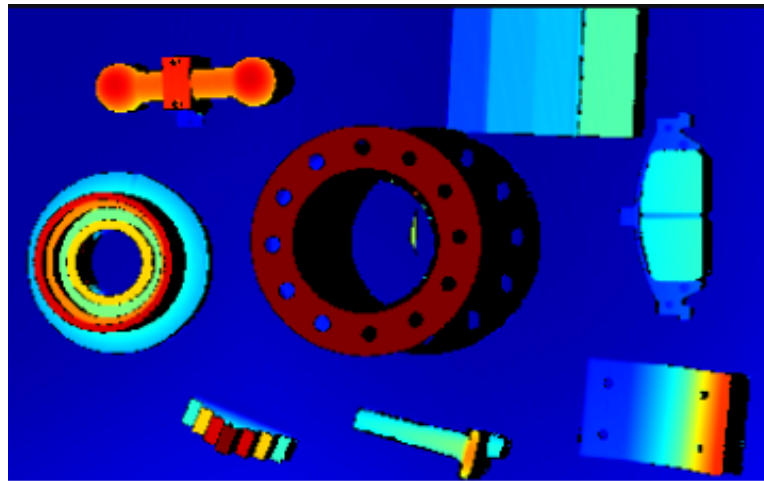


### Example 2

Goal: Accentuate the display of the workpiece pointed by the orange arrow.



1. On the depth map, move the cursor to the highest and lowest part of the workpiece, and check the depth values in the image information box in the lower right (about 0.795 m and 0.829 m).
2. Move the slider handles or enter the depth values to adjust the depth range of color rendering to 790–850 mm.
3. Check the depth map again. Now the workpiece is displayed in more colors, which makes it stand out.



### Point Cloud Exhibit

This function moves the point cloud along a predetermined trajectory to display it from various angles, suitable for scenarios such as exhibits.

Follow these steps to use the **Point Cloud Exhibit** function:

1. Check **Point Cloud Exhibit** in the **View** menu, and a **[ Play ]** button will appear in the upper right of the point cloud display.
2. Click **[ Play ]**, and the point cloud will start moving along the predetermined trajectory.
3. While the point cloud is moving, the **[ Play ]** button is changed to **[ Stop ]**. Click **[ Stop ]**, and the point cloud will stop moving.




This topic introduced data acquisition and data types. The next topic will introduce actions related to parameters.

### 5.2.3. Adjust Parameters

This topic introduces the actions related to parameters, including the general workflow of adjusting parameters, managing parameter groups, changing parameter visibility, and checking parameter descriptions.

#### General Workflow of Adjusting Parameters

When adjusting the parameters, you usually need to acquire the data again to check the result of parameter adjustment. The general workflow of adjusting parameters is as follows:

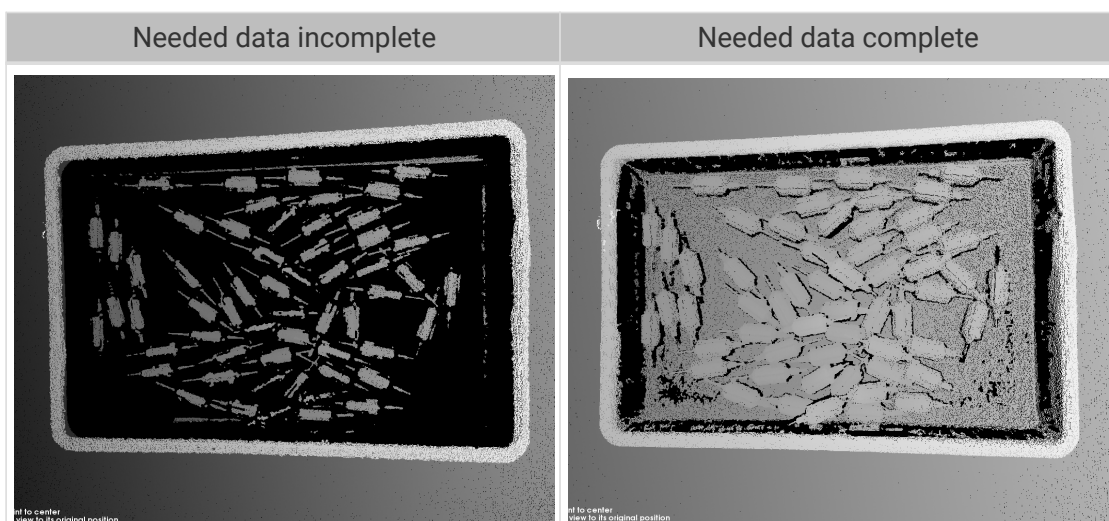
1. At the top of the parameter panel, [create a parameter group](#), or select a parameter group for saving the parameter values.
2. Click  to acquire data and check the data quality.
  - 2D image: not too bright or too dark; the surface features of the target object are clearly visible.



- Depth map and point cloud: the needed data is complete. In the following example, the needed data is the rim of the bin and the rotors inside the bin.



Determine which part of the data is needed according to your actual needs. For example, if you need to pick metal bowls with opening facing up by the rim, usually you only need to make sure that the data of the bowl rims is complete.





3. If the data quality is not good, adjust the corresponding parameters in the parameter panel on the right.
  - If the quality of the 2D image is not good, adjust the parameters in the **2D Parameters** category.
  - If the quality of the depth map is not good, adjust the parameters in the **3D Parameters**, **Depth Range**, and **ROI** categories.
  - If the quality of the point cloud is not good, adjust the parameters in the **3D Parameters**, **Point Cloud Processing**, **Depth Range**, and **ROI** categories.



- When adjusting the parameters, you can refer to the [parameter description](#) at the bottom of the parameter panel.
- For the detailed descriptions of each parameter, please refer to [Parameter Reference Guide](#).

4. Repeat steps 2 and 3 until the data quality meets your requirements.



- Adjustment of the parameters in the **Point Cloud Processing**, **Depth Range**, and **ROI** categories takes effect immediately. You do not need to acquire the data again.
- If the data quality is still not good, you can [change the visibility](#) and adjust the newly displayed parameters.


## Manage Parameter Groups

Parameter groups are used to save parameter values for different applications, projects, workpieces, and so on. When the application, project, workpiece, etc., changes, switching the parameter group in use can quickly apply the corresponding parameter values.

In Mech-Eye Viewer, you can create a new parameter group, save parameter values to a parameter group, delete a parameter group, rename a parameter group, and import and export parameter groups.

### Create Parameter Group

Follow these steps to create a new parameter group:

1. On the right of the Parameter Group section, click .
2. In the pop-up window, enter the name for the parameter group, and click **[OK]**.
3. After the parameter group is created, it will be displayed in the drop-down menu in the Parameter Group section.

### Save Parameters to Parameter Group

Follow these steps to save parameters to a parameter group:


1. Click the drop-down menu in the Parameter Group section, and select the parameter group used for saving parameter values.
2. [Adjust parameters](#).
3. In the Parameter Group section, click **[Save]** or use the shortcut **Ctrl + S** to save the adjusted parameter values to the currently selected parameter group.



An asterisk (\*) next to a parameter name indicates that the value of this parameter has not been saved to the parameter group.

## Delete Parameter Group


To delete a no longer needed parameter group, follow these steps:


1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be deleted.
2. Click , and then click [ **Yes** ] in the pop-up window to delete the parameter group.

 | The **default** and **calib** parameter groups cannot be deleted.

## Rename Parameter Group

Follow these steps to rename a parameter group:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be renamed.
2. Click , enter the new name in the pop-up window, and then click [ **OK** ].
3. After the change, the new name will be displayed in the drop-down menu of the Parameter Group section.

 | The **default** and **calib** parameter groups cannot be renamed.

## Export Parameter Groups

You can export all the parameter groups saved in the current camera to a **JSON** file. Follow these steps to export parameter groups:

1. In the Parameter Group section, click [ **Export** ], select the file path, and then click [ **Save** ].
2. The **Successfully Saved** window will pop-up. Click [ **OK** ] in the window to close this window.

## Import Parameter Groups

You can import parameter groups from a **JSON** file to replace all the parameter groups saved in the current camera. Follow these steps to import parameter groups:

1. In the Parameter Group section, click [ **Import** ], find the **JSON** file that stores all the parameter group information, and click [ **Open** ].
2. The **Successfully Imported** window will pop-up. Click [ **OK** ] in the window to close this window.

## Reset Parameter Group

To reset the parameter values saved in a parameter group to default values, follow these steps:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be reset.
2. Click [ **Reset** ], and then click [ **Yes** ] in the pop-up window to reset the parameter values to those stored in the **default** parameter group.

## Change Visibility

The visibility of parameters in Mech-Eye Viewer includes three levels: **Beginner**, **Expert**, and **Guru**. Select from the drop-down menu of **Visibility** to change the visibility.

- The **Beginner** level includes the most frequently used basic parameters.
- The **Expert** level includes all parameters in the **Beginner** level and provides more parameters.
- The **Guru** level includes all parameters in the **Expert** level and provides more parameters.

Usually, adjusting parameters in the **Beginner** level is enough to meet your needs. If the data quality is still not satisfactory, you can adjust the parameters in the **Expert** level. In rare cases, the parameters in the **Guru** level need to be adjusted to meet special needs.



The **Guru** level is available in the **Administrator** account. If needed, please contact Technical Support.

### Check Parameter Description

After you select a parameter in the parameter list, the bottom of the parameter panel displays more information about this parameter, include parameter explanation, API parameter name, value range, default value, visibility and data type. When you adjust parameters, you can use the information here as a reference.

- If the Parameter Description section blocks the parameter list, click [ × ] at the upper right of this section to close it.
- To display the Parameter Description section again, check the **Parameter Description** option in the **View** menu.

### 5.2.4. Save Data

You can save the obtained 2D image, depth map and point cloud or the raw data from the camera.

#### Save Images

Save the obtained 2D image, depth map and point cloud.



For the DEEP (V4) and LSR (V4) series, only the 2D image (texture) can be saved, the 2D images (depth source) cannot be saved.

Click  in the [data acquisition area](#) to open the **Save Images** interface.

Option	Description
Save to	Select the location for saving the data according to your needs.
Current Index	Set the index number at the end of the filename.
Data type	Select the data types to be saved according to your actual needs.
Overwrite Existing Files	When checked, if a file with the same name exists in the selected path, it will be replaced.
Use Last Obtained Data	When checked, the data last acquired will be saved. If unchecked, new data will be acquired and saved. Checked by default.
Save	Click this button to save the selected data.
Open With Explorer	Open the path for saving the files.



[ **Save** ] can only be clicked after data types have been selected.

## Save Raw Data of Camera

You can save the raw data acquired by the camera in **MRAW** format by clicking File > Save Raw Data of Camera.

The raw data can help Technical Support locate the causes of issues. Therefore, please save the raw data of the problematic capture before contacting Technical Support.

In addition, if you wish to adjust the **Point Cloud Processing**, **Depth Range** and **ROI** parameters later on, you can load the raw data through File > Start Virtual Camera and adjust these parameters. You can save the 2D image, depth map and point cloud from a virtual camera as well.

### 5.2.5. Manage Log

If you encounter a problem when using the camera, you can export the log and send it to Technical Support to facilitate the troubleshooting process.

#### Export Log

If you encounter a problem when using the camera, follow these steps to export the log.

1. Click [ **Show Log** ] in the data acquisition area to open the camera log.
2. Click [ **Show Log Entries** ] in the lower right to display the full log list.
3. Select the log entry to be exported, click [ **Export** ], select the folder for saving the log in the pop-up window, and then click [ **Select Folder** ].
4. If you need to export multiple log entries, repeat step 3.

#### Log Levels

Logs are categorized into four levels:

- i: INFO, descriptive information of execution processes.
- W: WARNING, warning messages of potential issues.
- C: CRITICAL, errors that may not stop the camera from operating.
- F: FATAL, errors that severely affects the camera's operation.

#### Other Actions

You can also perform the following actions in the log window:

- Auto Refresh: automatically refresh the log when enabled.
- Clear: clear the log content displayed in the software.
- Clear Server Logs: delete the log saved in the camera. This action clears the log content displayed in the software at the same time.

## 5.3. Parameter Reference Guide

This topic provides detailed descriptions of each parameter.

Detailed descriptions of the parameters by camera models:

- [Parameters of PRO S / PRO M / NANO Series](#)
- [Parameters of DEEP / LSR Series](#)
- [Parameters of UHP-140](#)
- [Parameters of V3 Cameras](#)

### 5.3.1. Parameters of PRO S / PRO M / NANO Series

This topic introduces the parameters of the PRO S / PRO M / NANO series. The parameters are divided into parameters for the 2D image and parameters for the depth map / point cloud, based on the data types that they affect.

#### Parameters for the 2D Image

The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.

The quality of the 2D image is affected by parameters in the **2D Parameters** category and the **Gain** parameter in the **3D Parameters** category.



If you are using a color camera, and the color of the image differ significantly from that of the objects, you can adjust the **white balance** setting. For detailed instructions, please refer to [Adjust White Balance](#).

#### 2D Parameters

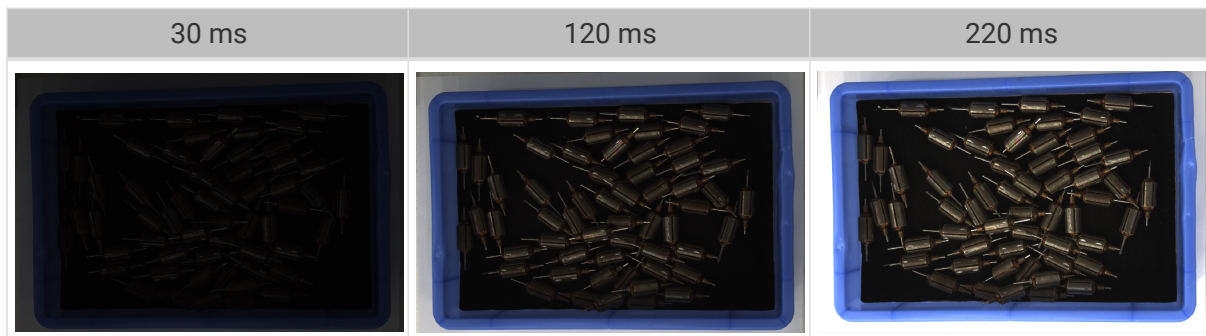
##### Exposure Mode

<b>Parameter Description</b>	Set the exposure mode for capturing the 2D image.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Timed: Set a single exposure time. Usually used in stable lighting conditions.</li> <li>• Auto: The exposure time is automatically adjusted. Usually used in varying lighting conditions.</li> <li>• HDR: Set multiple exposure times and merge the images. Usually used for objects with various colors or textures.</li> <li>• Flash: Use the projector for supplemental light. Usually used in dark environments.</li> </ul>
<b>Instructions</b>	<p>After selecting different options, different parameters are displayed in the <b>2D Parameters</b> category for adjustment:</p> <ul style="list-style-type: none"> <li>• Timed: displays <b>Exposure Time</b>.</li> <li>• Auto: displays <b>Gray Value</b> and <b>Auto-Exposure ROI</b>.</li> <li>• HDR: displays <b>Tone Mapping</b> and <b>Exposure Sequence</b>.</li> <li>• Flash: no other parameters need to be adjusted. The projector projects supplemental light automatically during image capturing.</li> </ul>

## Timed: Exposure Time

Parameter Description	This parameter affects the brightness of the image. <ul style="list-style-type: none"> <li>• Long exposure time increases the image brightness.</li> <li>• Short exposure time decreases the image brightness.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 999 ms</li> <li>• Default value: 30 ms</li> </ul>
Instructions	Adjust this parameter based on the quality of the 2D image. The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image. <ul style="list-style-type: none"> <li>• Long exposure time is usually used in dark environments.</li> <li>• Short exposure time is usually used in bright environments.</li> </ul>

2D images obtained with different **Exposure Time** values (all other conditions identical):

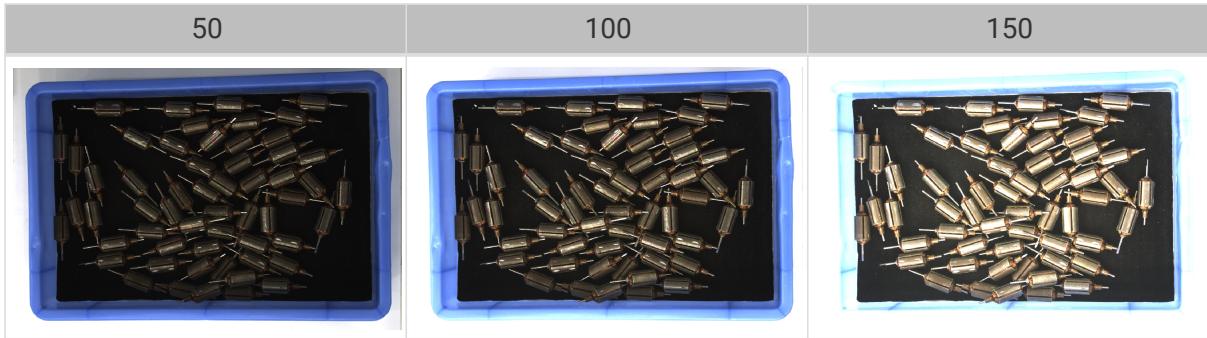


## Auto: Gray Value

Parameter Description	This parameter affects the brightness of the 2D image. Increase the value if the 2D image is too dark and decrease if too bright.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 to 255</li> <li>• Default value: 100</li> </ul>
Instructions	N/A

2D images obtained with different **Gray Value** values (all other conditions identical):



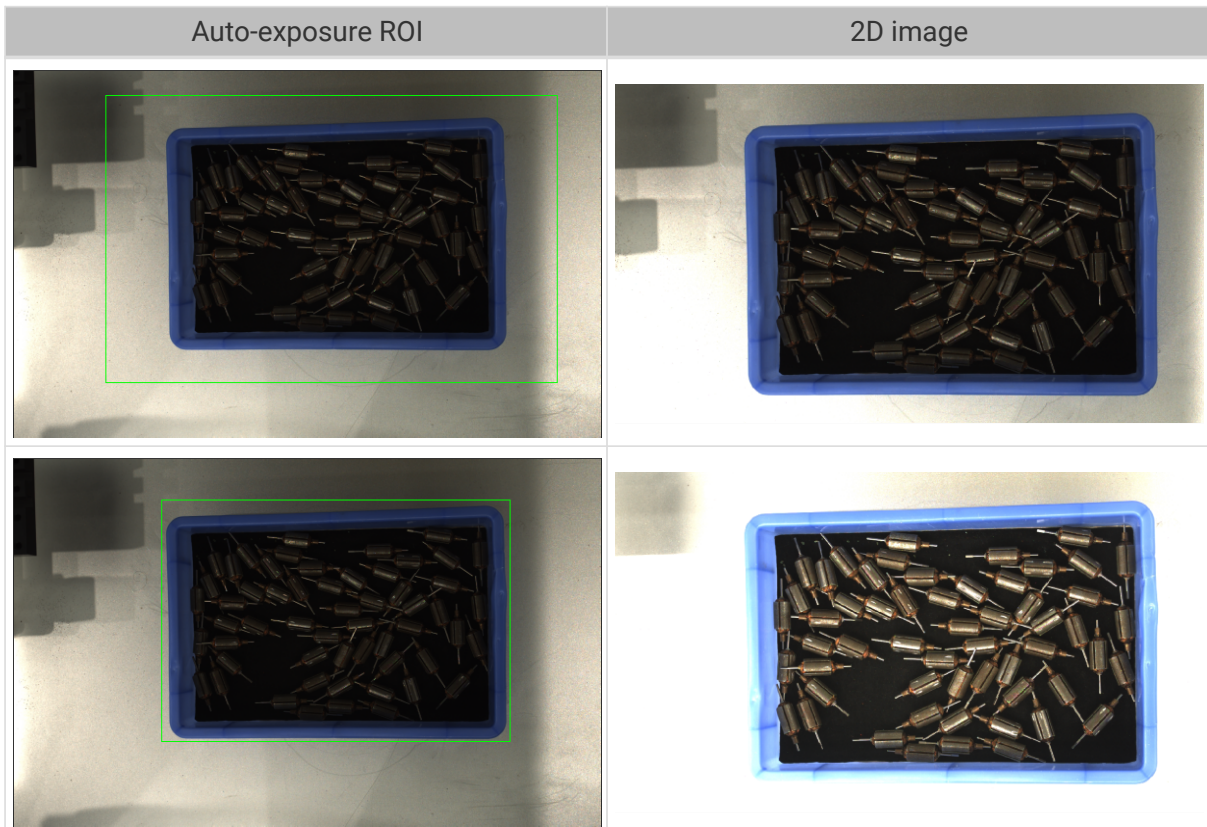


The **Gray Value** of a monochrome image is equivalent to the image brightness; the **Gray Value** of a color image is equivalent to the brightness of each color channel.

### Auto: Auto-Exposure ROI

Parameter Description	<ul style="list-style-type: none"> <li>The exposure time is automatically adjusted based on the lighting, object colors, etc., in the selected region.</li> <li>When an auto-exposure ROI is not set, the exposure time is automatically adjusted based on the entire camera FOV.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set Auto-Exposure ROI</a> below.

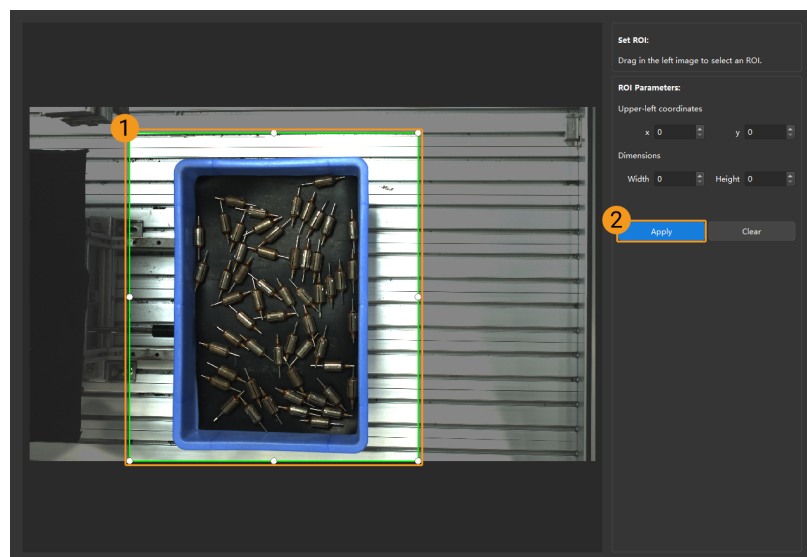
2D images obtained with different **Auto-Exposure ROI** values (all other conditions identical):





### Set Auto-Exposure ROI

1. Double-click [ **Edit** ] to the right of **Auto-Exposure ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set auto-exposure ROI.



 Click [ **Clear** ] to remove the current auto-exposure ROI.

4. Acquire data again and view the 2D image to check the result of automatic exposure adjustment.

### HDR: Tone Mapping

Parameter Description	This function can make the image look more natural. If the 2D image appears very different from the actual objects, please enable this function.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• False (default)</li> <li>• True</li> </ul>




**Instructions** Check to enable Tone Mapping.

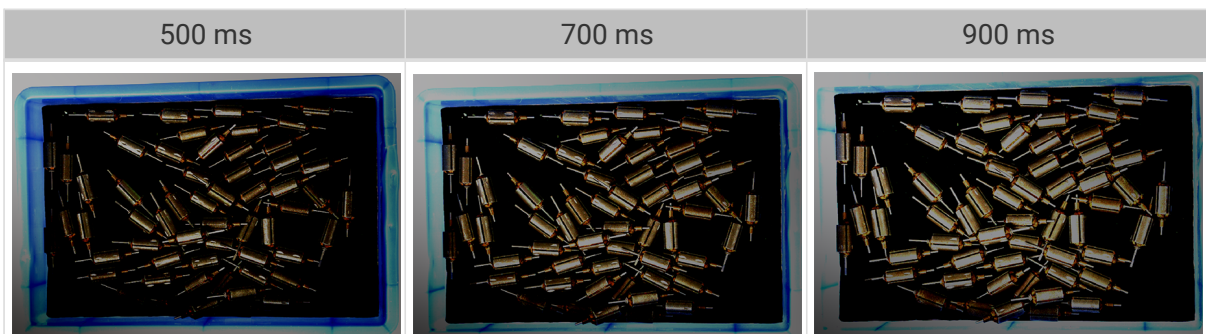
2D images obtained with **Tone Mapping** disabled or enabled (all other conditions identical):



HDR: Exposure Sequence

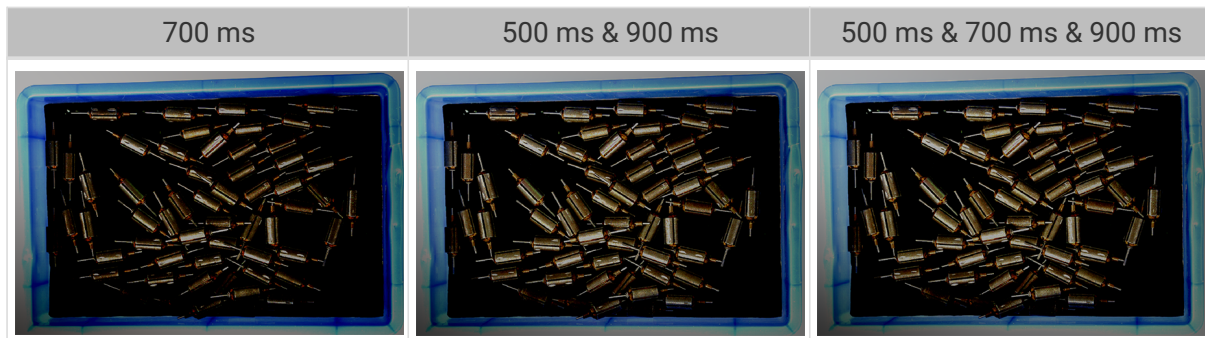
<b>Parameter Description</b>	Set multiple exposure times, and the captured images are merged to generate a 2D image that retains more details in the highlights and shadows.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	N/A
<b>Instructions</b>	<ol style="list-style-type: none"> <li>1. Double-click [ <b>Edit</b> ] to the right of <b>Exposure Sequence</b> to open the editing window of the exposure sequence.</li> <li>2. Click [ <b>+</b> ] to add and set a new exposure time.</li> <li>3. To delete an exposure time, select it and click [ <b>-</b> ].</li> <li>4. After you finish adding the exposure times, click [ <b>Apply</b> ] to apply the exposure sequence.</li> </ol> <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="margin-right: 10px;">  </div> <ul style="list-style-type: none"> <li>◦ [ <b>Cancel</b> ]: do not save the current settings and exit this window.</li> <li>◦ [ <b>Reset</b> ]: clear all the exposure times.</li> </ul> </div>

2D images captured with single exposure times (all other conditions identical):




2D images captured with different exposure sequences consisting of the above exposure times (all

other conditions identical):

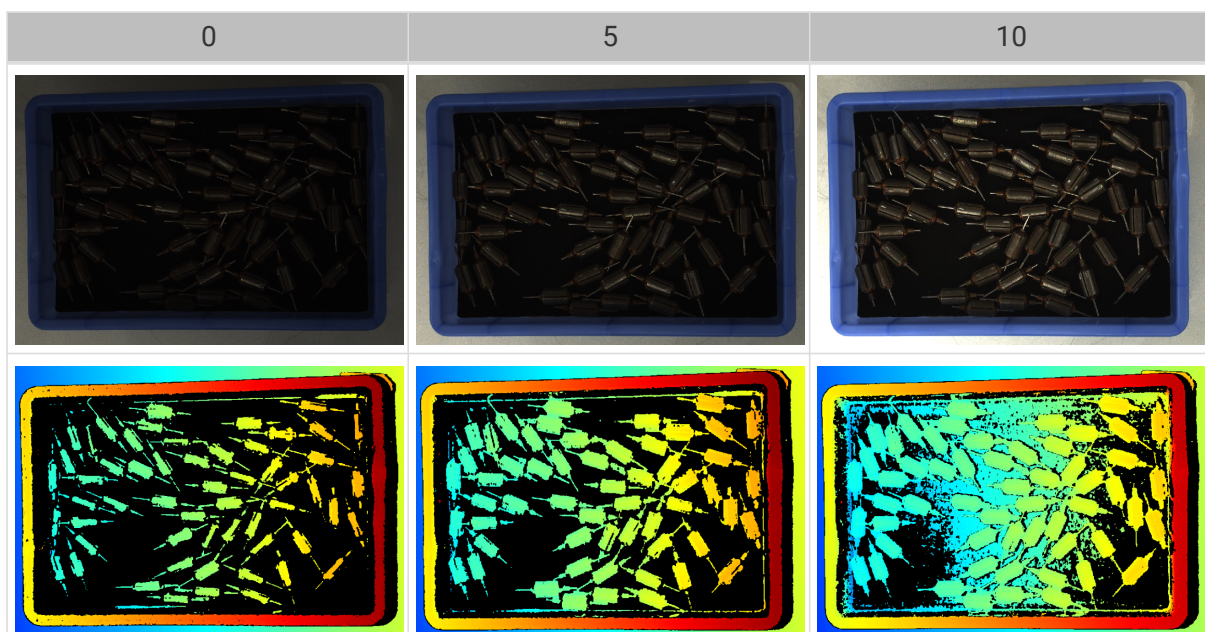


### 3D Parameters

#### Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):



## Parameters for the Depth Map / Point Cloud

In the depth map and point cloud, the needed data should be complete.



Determine which part of the data is needed according to your actual needs. For example, if you need to pick metal bowls with opening facing up by the rim, usually you only need to make sure that the data of the bowl rims is complete.

Parameters in the following categories affect the quality of the depth map and point cloud.

Parameter category	Depth map	Point cloud
3D Parameters	✔	✔
Point Cloud Processing		✔
Depth Range	✔	✔
ROI	✔	✔

### 3D Parameters

The parameters in this category affect the images used for calculating depth data, thus affecting the quality of the depth map and point cloud.

Use **Exposure Assistant** can obtain the recommended exposure parameter values. Double-click [ **Auto Set** ] to the right of **3D Parameters** to open **Exposure Assistant**.

### Exposure Multiplier

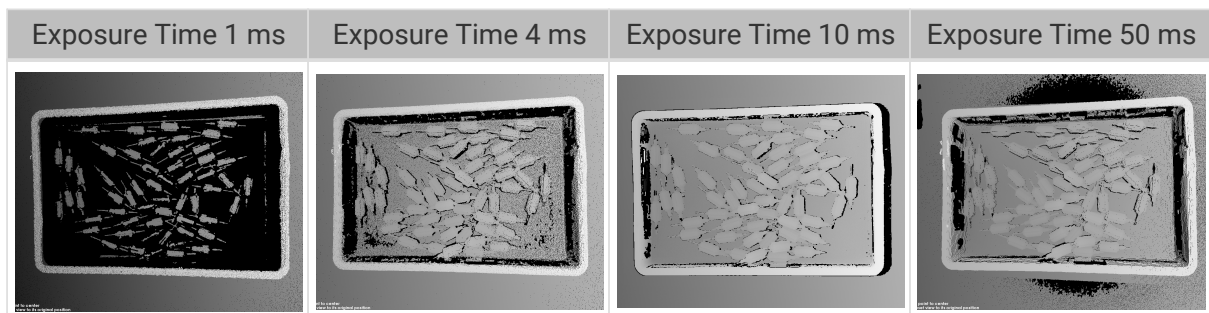
Parameter Description	Set the number of <b>Exposure Time</b> .
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>Value range: 1 to 3</li> <li>Default value: 1</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>When the value of <b>Exposure Multiplier</b> is greater than 1, multiple <b>Exposure Time</b> parameters must be set.</li> <li>All images captured with different exposure times are used for calculating depth. Using multiple exposure times can improve the completeness of depth data but also increases processing time.</li> <li>With multiple exposure times, the amount of time for obtaining the depth map and point cloud increases. Please try to minimize the number of exposure times while ensuring the data quality.</li> </ul>

### Exposure Time

Parameter Description	Set the exposure time for acquiring depth information. The number of <b>Exposure Time</b> to be set depends on the value of <b>Exposure Multiplier</b> .
-----------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------


Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>Value range: 0.1 ms to 99 ms</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>Usually, long exposure time is used for dark objects, and short exposure time is used for light objects.</li> <li>Exposure times too long or too short both lead to loss of depth information.</li> <li>The exposure time of a laser camera must be a multiple of 4. If the entered value is not a multiple of 4, it will be automatically adjusted. The minimum value that can be set is 4 ms for the Laser series and 8 ms for other laser cameras.</li> </ul>

Point clouds obtained under different **Exposure Time** values (all other conditions identical):



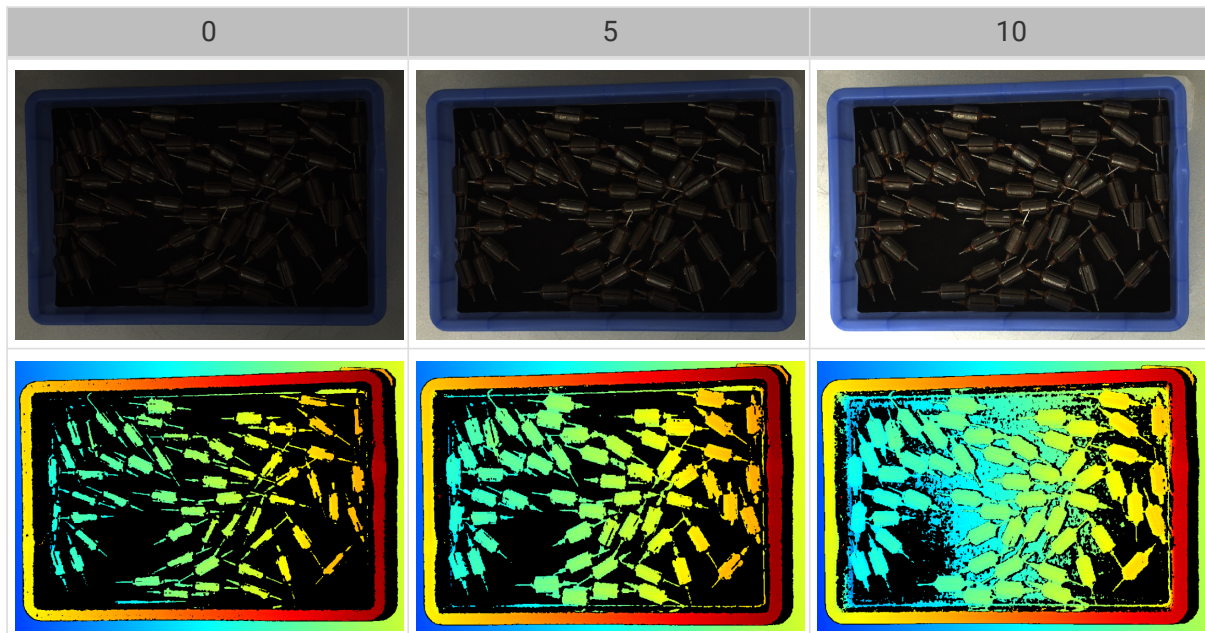
The black regions lack depth information to generate corresponding point cloud.

## Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <div data-bbox="400 1216 459 1272" style="display: inline-block; vertical-align: middle;">  </div> <p>This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>Value range: 0 dB to 16 dB</li> <li>Default value:                             <ul style="list-style-type: none"> <li>DEEP series: 5</li> <li>Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):





## Projector

### Light Brightness

Parameter Description	This parameter affects the brightness of the projected structured light.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• High: high brightness, suitable for dark objects.</li> <li>• Normal (default): medium brightness, suitable for regular objects.</li> <li>• Low: low brightness, suitable for reflective objects.</li> </ul>
Instructions	Adjust this parameter based on the object type.

### Fringe Coding Mode

Parameter Description	Change the structured light patterns used, which affects the data acquisition speed and depth data quality.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Fast (default): faster data acquisition, but the quality of the depth map and point cloud is lower.</li> <li>• Accurate: slower data acquisition, but the quality of the depth map and point cloud is higher.</li> </ul>
Instructions	Adjust this parameter according to your actual needs for data quality and data acquisition speed.

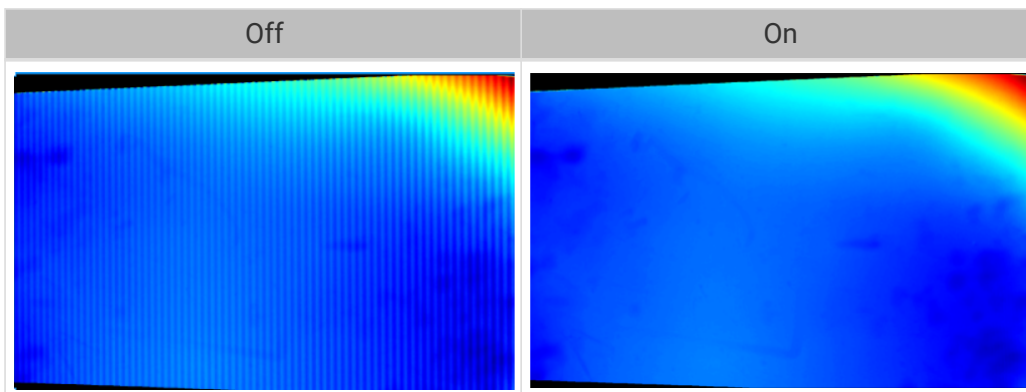
Point clouds obtained with different **Fringe Coding Mode** values (all other conditions identical):



### Anti-Flicker Mode

<b>Parameter Description</b>	Flicker refers to the rapid and periodical change in the intensity of artificial light. This phenomenon can cause fluctuations in the depth data. Such fluctuations can be reduced by adjusting the projection frequency of the structured light.
<b>Visibility</b>	Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• AC50Hz</li> <li>• AC60Hz</li> </ul>
<b>Instructions</b>	Please select the option that corresponds to the frequency of the power supply in your location. The AC frequency in most countries is 50Hz. The AC frequency in the U.S. and some Asian countries is 60Hz.

Depth maps obtained with **Anti-Flicker Mode** off or on (all other conditions identical):



### Point Cloud Processing

Adjusting the parameters in the **Point Cloud Processing** category can improve the quality of the point cloud.

#### Principles for Adjusting Point Cloud Processing Parameters

When adjusting the **Point Cloud Processing** parameters, follow these principles to reduce the camera acquisition time and cycle time:

1. Adjust **Outlier Removal** first. The calculation time for different intensities of this parameter is

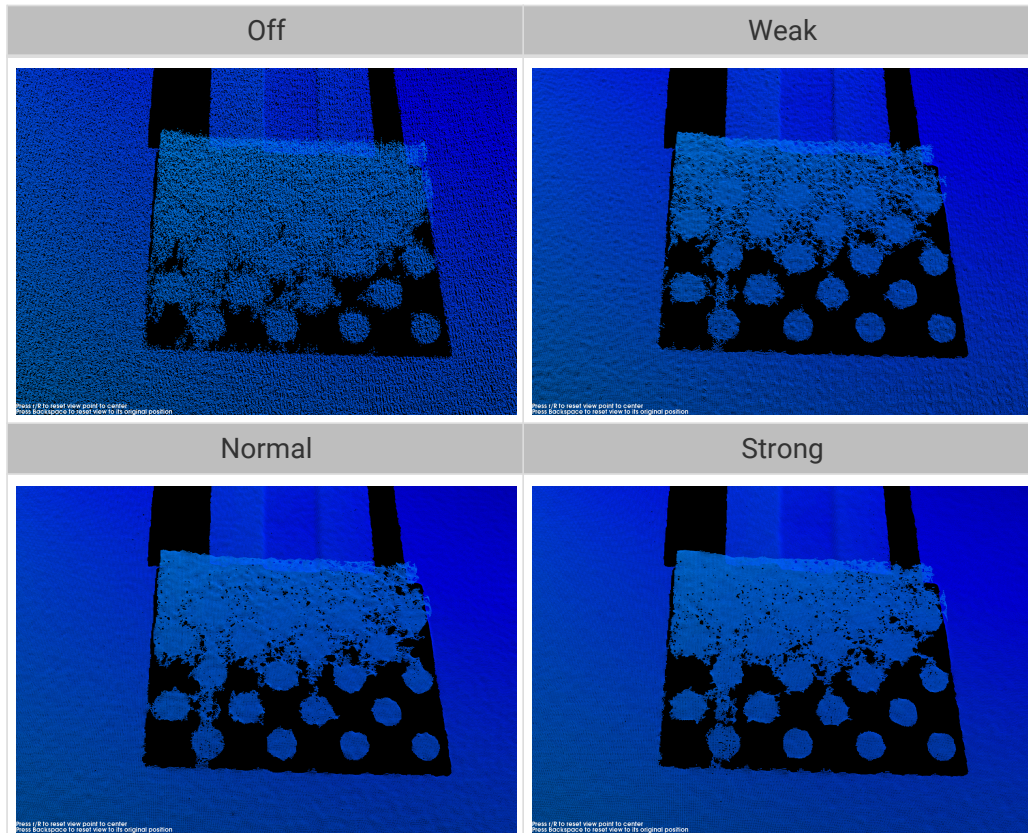
about the same. Using a higher intensity will not add to the calculation time too much.

- It is recommended to use low intensities of **Surface Smoothing** and **Noise Removal**. The higher the intensities of these two parameters, the longer the calculation time.

### Surface Smoothing

Parameter Description	This parameter reduces the depth fluctuation in the point cloud and improve its resemblance to the actual object surface.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• Weak</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Surface Smoothing</b> causes loss of object surface details. Higher intensity causes more object details to be lost. Lower intensity causes fewer object details to be lost.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

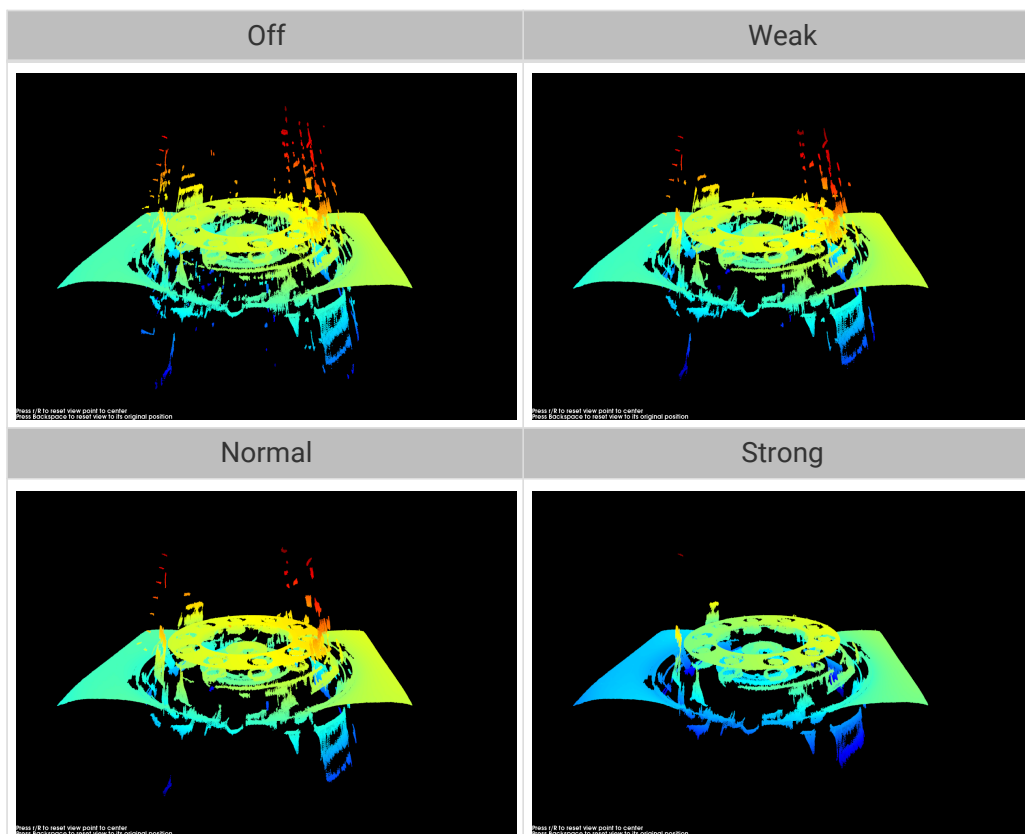
Point clouds obtained with different **Surface Smoothing** values (all other conditions identical):



## Outlier Removal

Parameter Description	This parameter removes the outliers in the point cloud. Outliers are clustered points away from the object point cloud.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Higher intensity removes more outliers, and lower intensity removes fewer outliers.</li> <li>• If the object point cloud contains multiple parts, high intensities of outlier removal might remove some parts. For example, if the object is a cup, outlier removal might remove the point cloud of the handle part.</li> </ul>

Point clouds obtained with different **Outlier Removal** values (all other conditions identical):



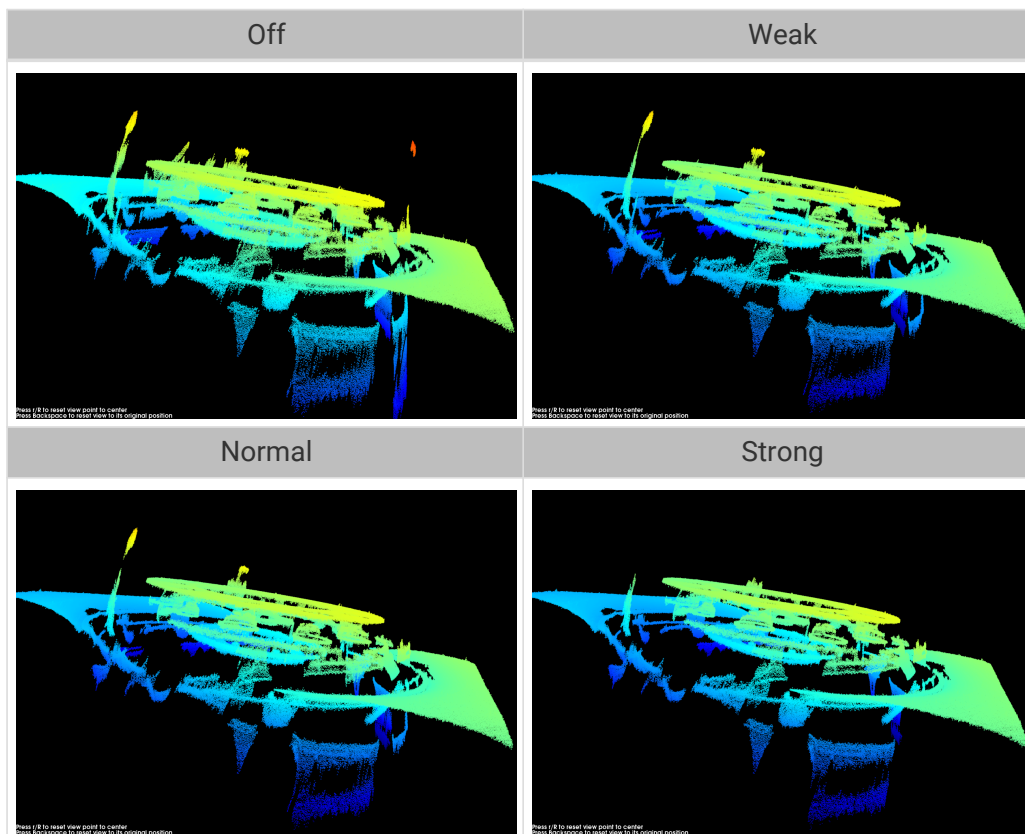
## Noise Removal

Parameter Description	This parameter removes the noise in the point cloud, thus reducing the impact on the precision and accuracy of subsequent calculation. Noise is the scattered points close to the object surface.
Visibility	Beginner, Expert, Guru



Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Higher intensity removes more noise but may also remove some object features. Lower intensity removes less noise but also preserves the object features better.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Noise Removal** values (all other conditions identical):



If this function removes the needed object features, please reduce the intensity. However, more noise will be retained.

## Edge Preservation

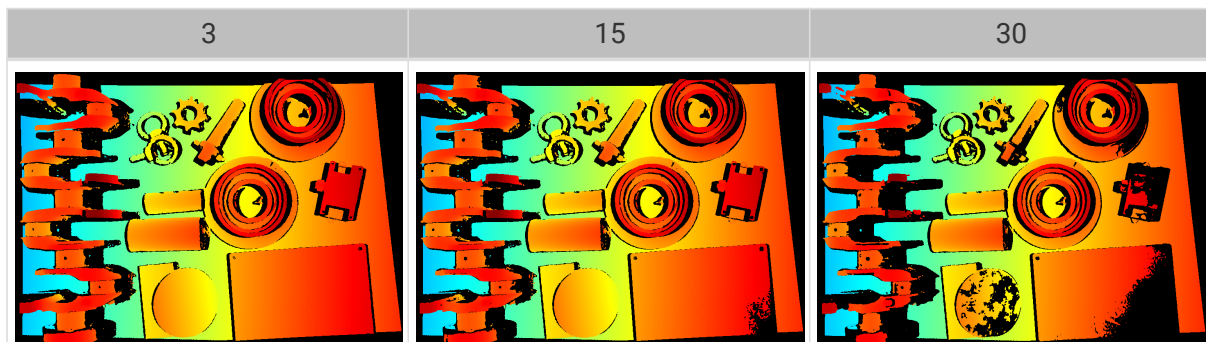
Parameter Description	This parameter preserves the sharpness of object edges during surface smoothing.
Visibility	Guru

Values	<ul style="list-style-type: none"> <li>• Sharp: Preserves the sharpness of object edges as much as possible. However, the effect of surface smoothing will be reduced.</li> <li>• Normal (default): Balances between edge preservation and surface smoothing.</li> <li>• Smooth: Does not preserve the edges. The object surface will be well smoothed, but the object edges will be distorted.</li> </ul>
Instructions	Adjust based on your needs for preserving the edges of workpieces.

### Stripe Contrast Threshold

Parameter Description	This parameter is used to remove noise in the point cloud. Adjust this parameter if the level of noise in the point cloud is still high after adjusting <b>Outlier Removal</b> and <b>Noise Removal</b> .
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 1 to 100</li> <li>• Default value: 3</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Greater value of this parameter results in more points being removed. Smaller value results in fewer points being removed.</li> <li>• Increase the value of this parameter can remove the noise in the point cloud, but may also cause the points of dark objects to be lost.</li> </ul>

Point clouds obtained with different **Stripe Contrast Threshold** values (all other conditions identical):

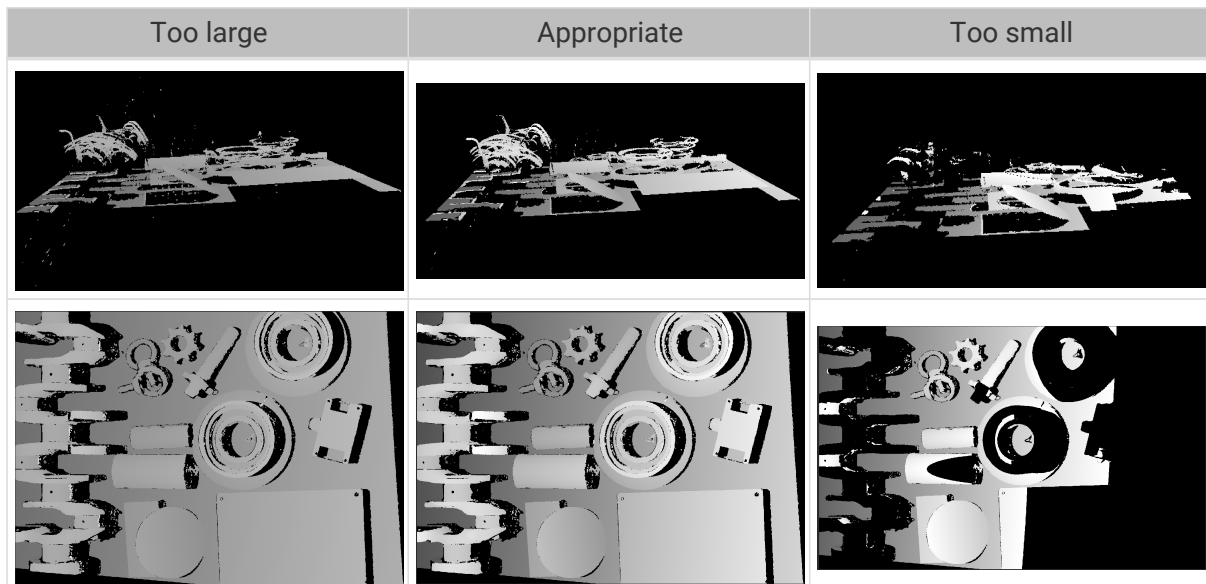


### Depth Range

Parameter Description	Set a Z-direction ROI for the depth map and point cloud. <b>Depth Range</b> can be set within the camera working distance, and the data outside the range is removed from the depth map and point cloud.
Visibility	Beginner, Expert, Guru

Values	<ul style="list-style-type: none"> <li>• Depth Lower Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 4000 mm</li> <li>◦ Default value: 200 mm</li> </ul> </li> <li>• Depth Upper Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 5000 mm</li> <li>◦ Default value: 4000 mm</li> </ul> </li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Depth Range</b> should be adjusted to an appropriate range to ensure the completeness of depth data in the depth map and point cloud. Too large a range may introduce interference, and too small a range may remove the data of key features.</li> <li>• For detailed instructions, please refer to <a href="#">Set Depth Range</a> below.</li> </ul>

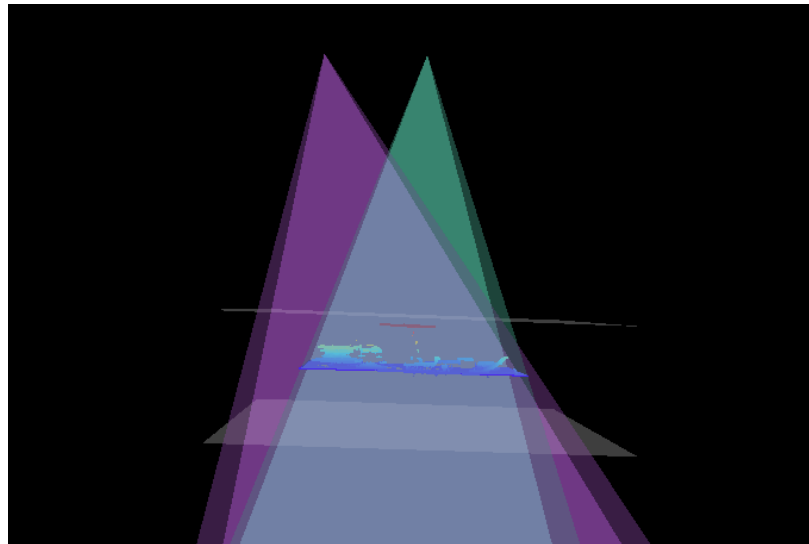
The same point cloud with different **Depth Range** values (all other conditions identical):



## Set Depth Range

Follow these steps to adjust **Depth Range**:

1. Double-click [ **Edit** ] to the right of **Depth Range** to open the **Set Depth Range** window.
2. Click [ **Refresh point cloud** ] at the top of the right panel to obtain the newest point cloud.
3. [Adjust the position of the point cloud](#): adjust the position until you can see the two gray rectangles that represents the upper and lower limits of **Depth Range**.



- Adjust the depth range: drag the handles on the slider to adjust **Depth Range** roughly. Then, enter specific values on the right to fine-tune **Depth Range**.



Judge if the depth range is appropriate: All needed object features are located between the two gray rectangles, and most noise and outliers are located outside.

- Click [ **Save** ] to save the depth range settings.



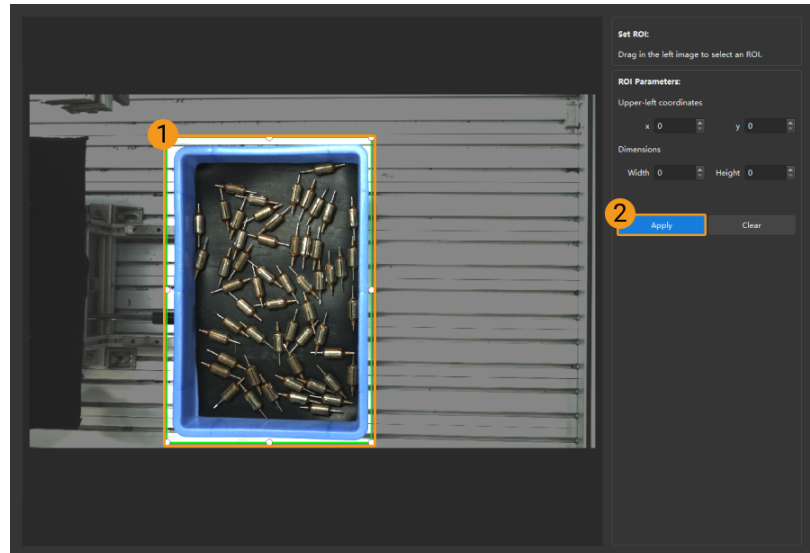
- Click [ **Recommended range** ] to adjust **Depth Range** to the recommended working distance of the current camera.
- Click [ **Reset** ] to restore **Depth Range** to the last saved values.

## ROI

Parameter Description	Set the ROI on the XY plane for the depth map and point cloud. Points outside the selected region are removed.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set ROI</a> below.

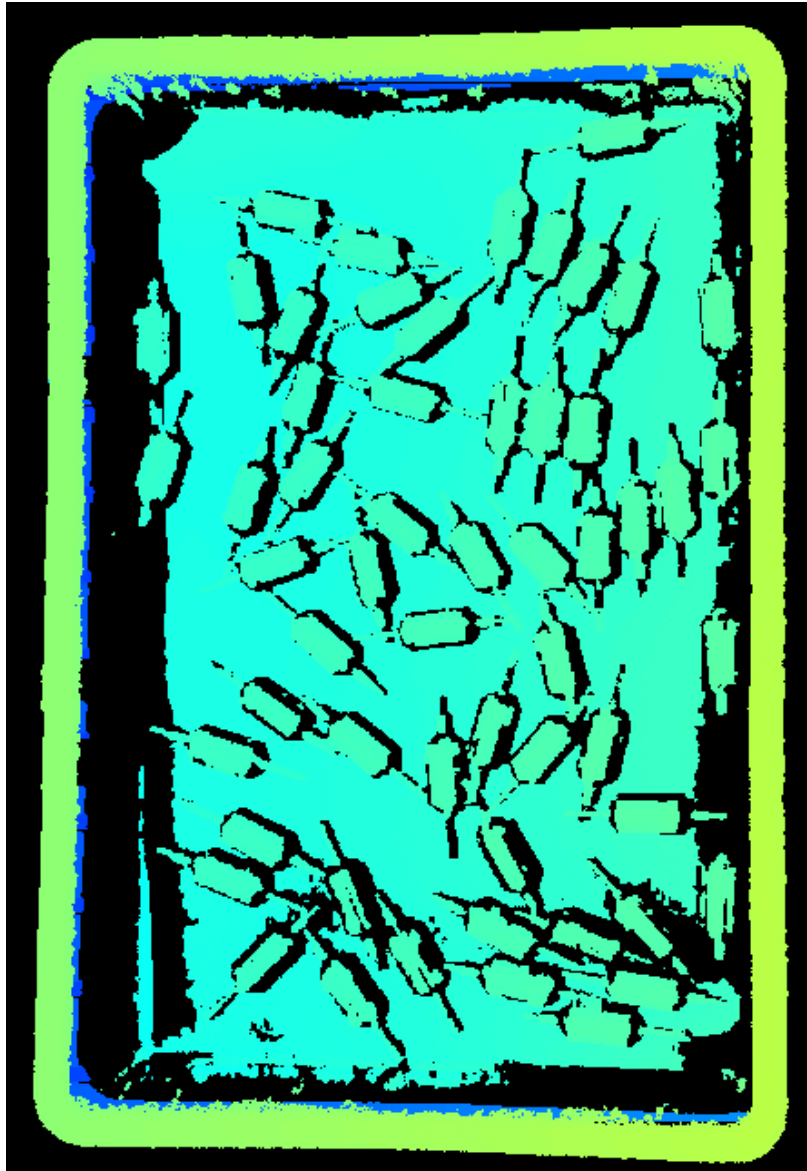
## Set ROI

- Double-click [ **Edit** ] to the right of **ROI** to open the **Set ROI** window.
- Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
- Click [ **Apply** ] to apply the set ROI.



- Click [ Clear ] to remove the current ROI.
- For the DEEP (V4) and LSR (V4) series, the 2D image (depth source) is displayed in this window. If the image is too dark or too bright, please adjust **2D Image (Depth Source) Exposure Mode**.

4. Acquire data again and view the depth map or point cloud to check the result of setting the ROI.



### 5.3.2. Parameters of DEEP / LSR Series

This topic introduces the parameters of the DEEP / LSR series. The parameters are divided into parameters for the 2D image and parameters for the depth map / point cloud, based on the data types that they affect.

#### Parameters for the 2D Image

The DEEP and LSR series provide two types of 2D images: 2D image (texture) and 2D images (depth source). The usage of each type is as follows:

2D image type	Usage
2D image (texture)	Texture the point cloud
2D images (depth source)	Check intrinsic parameters
	Set ROI
	Perform hand-eye calibration

The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.

The quality of the 2D image is affected by parameters in the **2D Parameters** category and the **Gain** parameter in the **3D Parameters** category.



If you are using a color camera, and the color of the image differ significantly from that of the objects, you can adjust the **white balance** setting. For detailed instructions, please refer to [Adjust White Balance](#).

## 2D Parameters

### 2D Image (Texture) Exposure Mode

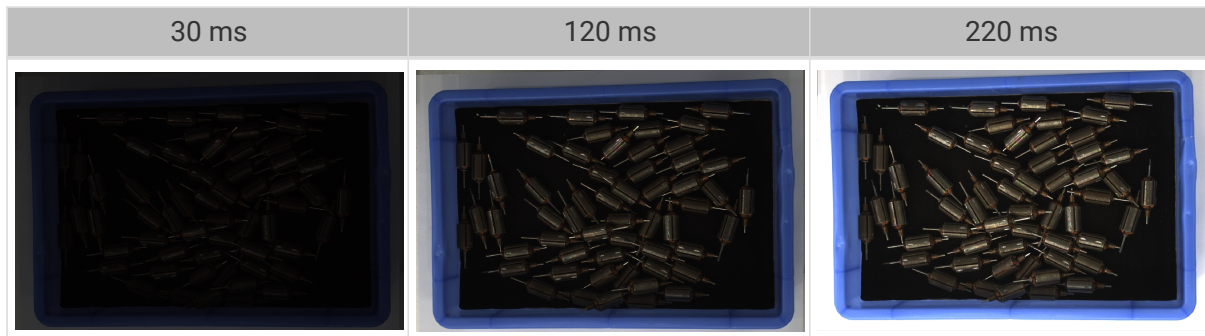
<b>Parameter Description</b>	Set the exposure mode for capturing the 2D image (texture).
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Timed: Set a single exposure time. Usually used in stable lighting conditions.</li> <li>• Auto: The exposure time is automatically adjusted. Usually used in varying lighting conditions.</li> <li>• HDR: Set multiple exposure times and merge the images. Usually used for objects with various colors or textures.</li> </ul>
<b>Instructions</b>	<p>After selecting different options, different parameters are displayed in the <b>2D Parameters</b> category for adjustment:</p> <ul style="list-style-type: none"> <li>• Timed: displays <b>Exposure Time</b>.</li> <li>• Auto: displays <b>Gray Value</b> and <b>Auto-Exposure ROI</b>.</li> <li>• HDR: displays <b>Tone Mapping</b> and <b>Exposure Sequence</b>.</li> </ul>

### Timed: Exposure Time

<b>Parameter Description</b>	<p>This parameter affects the brightness of the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time increases the image brightness.</li> <li>• Short exposure time decreases the image brightness.</li> </ul>
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 999 ms</li> <li>• Default value: 30 ms</li> </ul>
<b>Instructions</b>	<p>Adjust this parameter based on the quality of the 2D image. The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time is usually used in dark environments.</li> <li>• Short exposure time is usually used in bright environments.</li> </ul>

2D images obtained with different **Exposure Time** values (all other conditions identical):

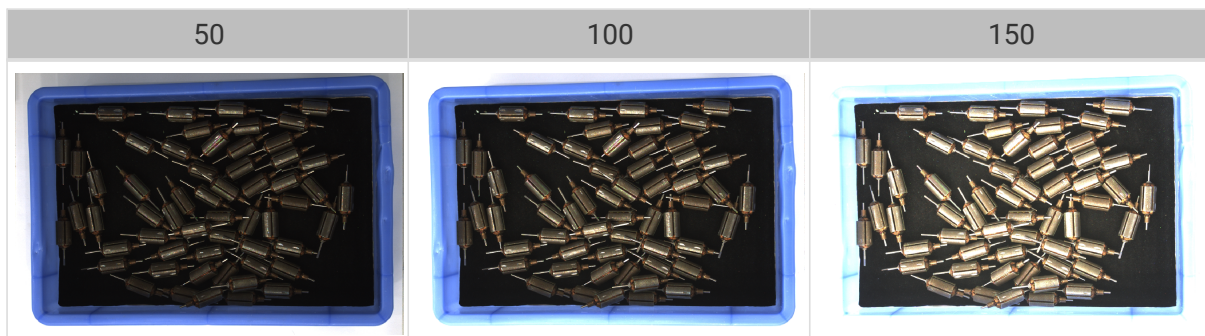




### Auto: Gray Value

Parameter Description	This parameter affects the brightness of the 2D image. Increase the value if the 2D image is too dark and decrease if too bright.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 to 255</li> <li>• Default value: 100</li> </ul>
Instructions	N/A

2D images obtained with different **Gray Value** values (all other conditions identical):



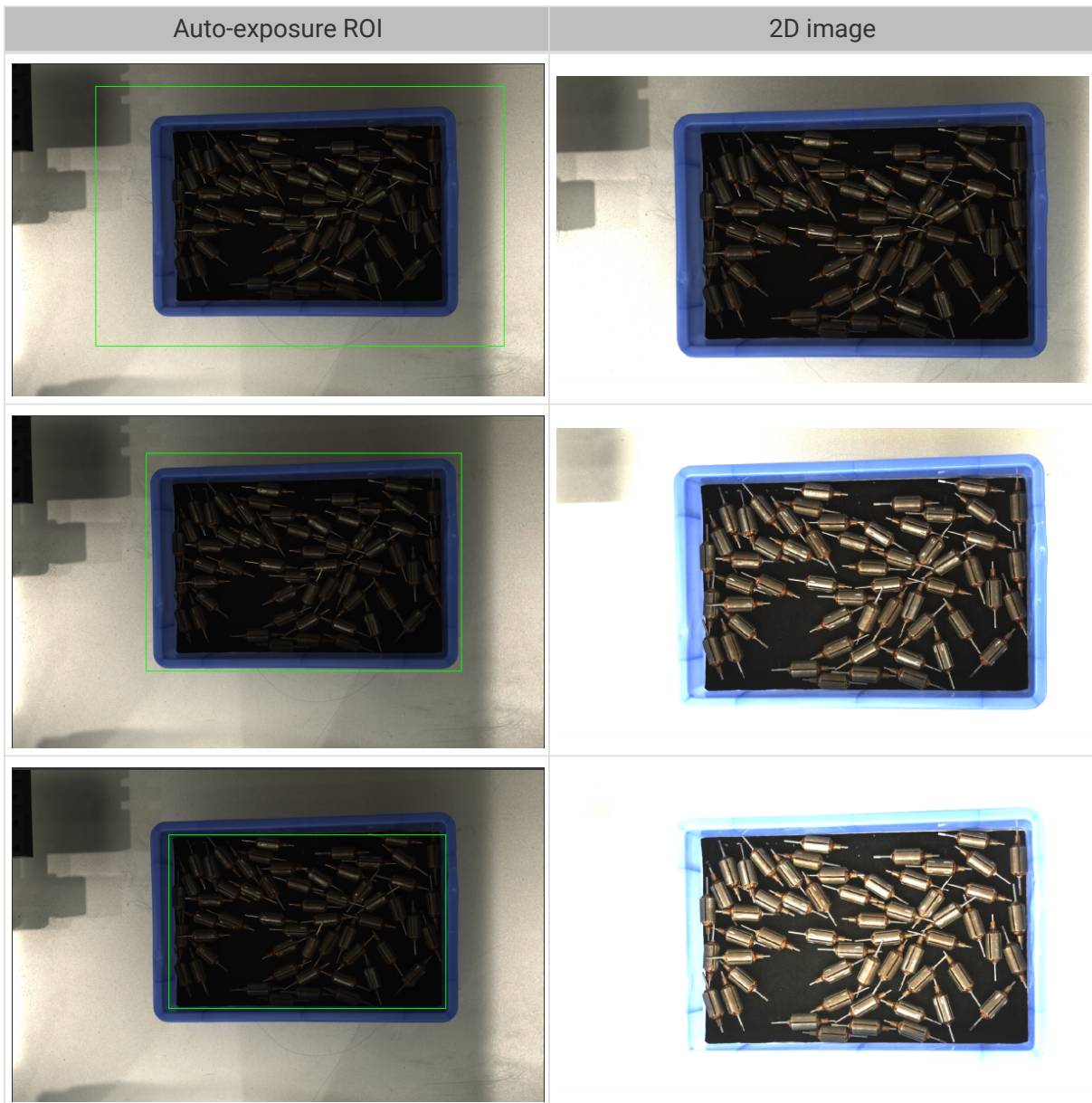
The **Gray Value** of a monochrome image is equivalent to the image brightness; the **Gray Value** of a color image is equivalent to the brightness of each color channel.

### Auto: Auto-Exposure ROI

Parameter Description	<ul style="list-style-type: none"> <li>• The exposure time is automatically adjusted based on the lighting, object colors, etc., in the selected region.</li> <li>• When an auto-exposure ROI is not set, the exposure time is automatically adjusted based on the entire camera FOV.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set Auto-Exposure ROI</a> below.

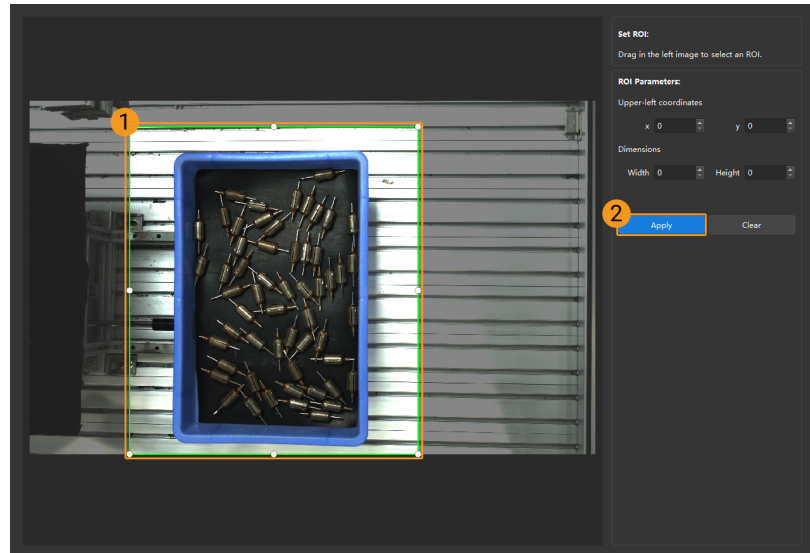
2D images obtained with different **Auto-Exposure ROI** values (all other conditions identical):





### Set Auto-Exposure ROI

1. Double-click [ **Edit** ] to the right of **Auto-Exposure ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set auto-exposure ROI.



 Click [ Clear ] to remove the current auto-exposure ROI.

- Acquire data again and view the 2D image to check the result of automatic exposure adjustment.


### HDR: Tone Mapping

Parameter Description	This function can make the image look more natural. If the 2D image appears very different from the actual objects, please enable this function.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• False (default)</li> <li>• True</li> </ul>
Instructions	Check to enable <b>Tone Mapping</b> .

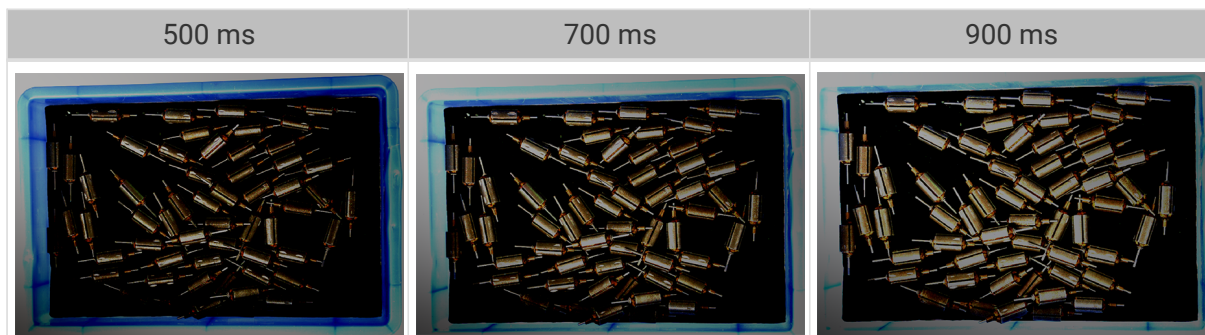
2D images obtained with **Tone Mapping** disabled or enabled (all other conditions identical):



## HDR: Exposure Sequence

Parameter Description	Set multiple exposure times, and the captured images are merged to generate a 2D image that retains more details in the highlights and shadows.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	<ol style="list-style-type: none"> <li>1. Double-click [ <b>Edit</b> ] to the right of <b>Exposure Sequence</b> to open the editing window of the exposure sequence.</li> <li>2. Click [ <b>+</b> ] to add and set a new exposure time.</li> <li>3. To delete an exposure time, select it and click [ <b>-</b> ].</li> <li>4. After you finish adding the exposure times, click [ <b>Apply</b> ] to apply the exposure sequence.</li> </ol> <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="margin-right: 10px;">  </div> <ul style="list-style-type: none"> <li>◦ [ <b>Cancel</b> ]: do not save the current settings and exit this window.</li> <li>◦ [ <b>Reset</b> ]: clear all the exposure times.</li> </ul> </div>

2D images captured with single exposure times (all other conditions identical):



2D images captured with different exposure sequences consisting of the above exposure times (all other conditions identical):



## 2D Image (Depth Source) Exposure Mode

Parameter Description	Set the exposure mode for capturing the 2D images (depth source).
Visibility	Beginner, Expert, Guru

Values	<ul style="list-style-type: none"> <li>• Timed: Set a single exposure time. Usually used in stable lighting conditions.</li> <li>• Flash: Use the projector for supplemental light. Usually used in dark environments.</li> </ul>
Instructions	<p>After selecting different options, different parameters are displayed in the <b>2D Parameters</b> category for adjustment:</p> <ul style="list-style-type: none"> <li>• Timed: displays <b>2D Image (Depth Source) Exposure Time</b>.</li> <li>• Flash: no other parameters need to be adjusted. The projector projects supplemental light automatically during image capturing.</li> </ul>

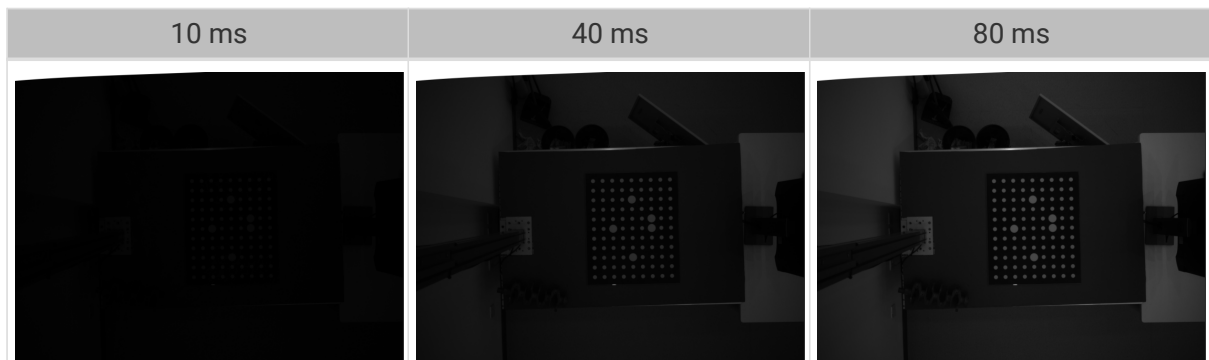


When using a LSR or DEEP series camera with Mech-Vision, the "Color Image" port in Mech-Vision outputs the 2D image (depth source). If you need to adjust the "Color Image" in Mech-Vision, please adjust **2D Image (Depth Source) Exposure Mode**.

### Timed: 2D Image (Depth Source) Exposure Time

Parameter Description	<p>This parameter affects the brightness of the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time increases the image brightness.</li> <li>• Short exposure time decreases the image brightness.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 999 ms</li> <li>• Default value: 30 ms</li> </ul>
Instructions	<p>Adjust this parameter based on the quality of the 2D image. The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time is usually used in dark environments.</li> <li>• Short exposure time is usually used in bright environments.</li> </ul>

2D images obtained with different **2D Image (Depth Source) Exposure Time** values (all other conditions identical):



### 3D Parameters

#### Gain



Parameter Description	This parameter affects the brightness of the captured image. At the same time, more noise is introduced. <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="background-color: #0056b3; color: white; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 5px;">i</div> <div>                     This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.                 </div> </div>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):



### Parameters for the Depth Map / Point Cloud

In the depth map and point cloud, the needed data should be complete.



Determine which part of the data is needed according to your actual needs. For example, if you need to pick metal bowls with opening facing up by the rim, usually you only need to make sure that the data of the bowl rims is complete.

Parameters in the following categories affect the quality of the depth map and point cloud.

Parameter category	Depth map	Point cloud
3D Parameters	✔	✔
Point Cloud Processing		✔

Parameter category	Depth map	Point cloud
Depth Range	✔	✔
ROI	✔	✔

### 3D Parameters

The parameters in this category affect the images used for calculating depth data, thus affecting the quality of the depth map and point cloud.

Use **Exposure Assistant** can obtain the recommended exposure parameter values. Double-click [Auto Set] to the right of **3D Parameters** to open **Exposure Assistant**.

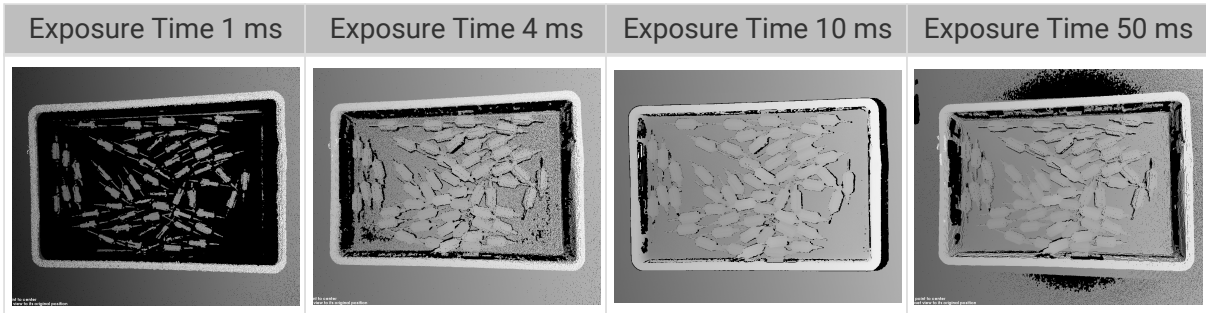
### Exposure Multiplier

<b>Parameter Description</b>	Set the number of <b>Exposure Time</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>Value range: 1 to 3</li> <li>Default value: 1</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>When the value of <b>Exposure Multiplier</b> is greater than 1, multiple <b>Exposure Time</b> parameters must be set.</li> <li>All images captured with different exposure times are used for calculating depth. Using multiple exposure times can improve the completeness of depth data but also increases processing time.</li> <li>With multiple exposure times, the amount of time for obtaining the depth map and point cloud increases. Please try to minimize the number of exposure times while ensuring the data quality.</li> </ul>

### Exposure Time


<b>Parameter Description</b>	Set the exposure time for acquiring depth information. The number of <b>Exposure Time</b> to be set depends on the value of <b>Exposure Multiplier</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>Value range: 0.1 ms to 99 ms</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>Usually, long exposure time is used for dark objects, and short exposure time is used for light objects.</li> <li>Exposure times too long or too short both lead to loss of depth information.</li> <li>The exposure time of a laser camera must be a multiple of 4. If the entered value is not a multiple of 4, it will be automatically adjusted. The minimum value that can be set is 4 ms for the Laser series and 8 ms for other laser cameras.</li> </ul>

Point clouds obtained under different **Exposure Time** values (all other conditions identical):

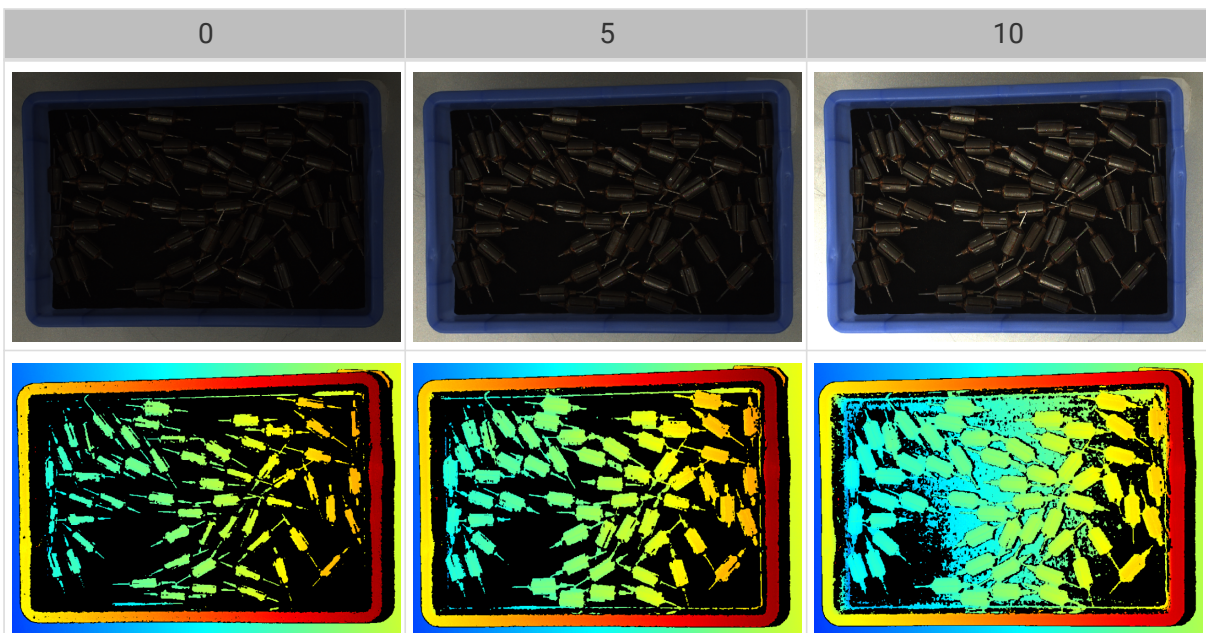


The black regions lack depth information to generate corresponding point cloud.

## Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):



## Laser

## Fringe Coding Mode

<b>Parameter Description</b>	Change the structured light patterns used, which affects the data acquisition speed and depth data quality.
<b>Visibility</b>	Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Fast (default): faster data acquisition, but the quality of the depth map and point cloud is lower.</li> <li>• Accurate: slower data acquisition, but the quality of the depth map and point cloud is higher.</li> </ul>
<b>Instructions</b>	Adjust this parameter according to your actual needs for data quality and data acquisition speed.

Point clouds obtained with different **Fringe Coding Mode** values (all other conditions identical):



## Laser Power

<b>Parameter Description</b>	Set the power of the laser projector, which affects the brightness of the projected structured light.
<b>Visibility</b>	Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 50% to 100%</li> <li>• Default value: 100%</li> </ul>
<b>Instructions</b>	<p>Usually, using the default value is sufficient.</p> <ul style="list-style-type: none"> <li>• Greater value results in higher structured light brightness; smaller value results in lower structured light brightness.</li> <li>• Greater values are suitable for dark objects, and smaller values are suitable for reflective objects.</li> </ul>

## Point Cloud Processing

Adjusting the parameters in the **Point Cloud Processing** category can improve the quality of the point cloud.



## Principles for Adjusting Point Cloud Processing Parameters

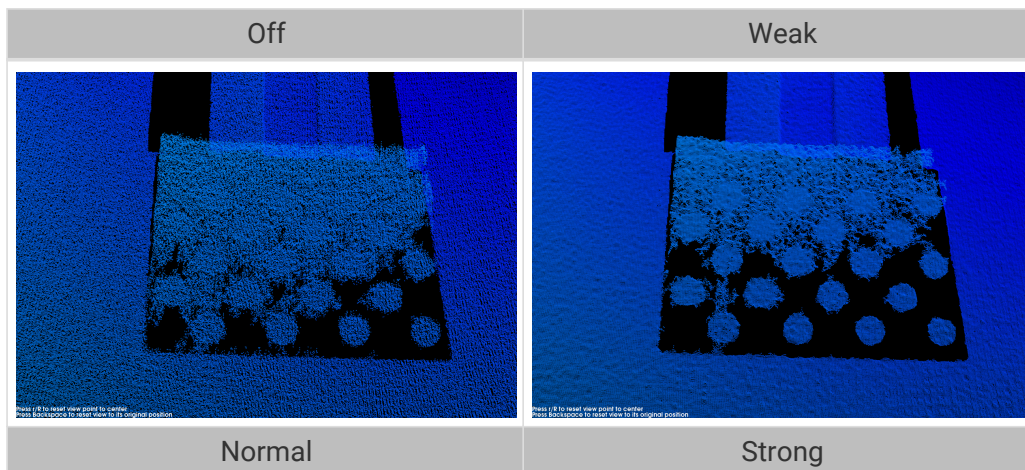
When adjusting the **Point Cloud Processing** parameters, follow these principles to reduce the camera acquisition time and cycle time:

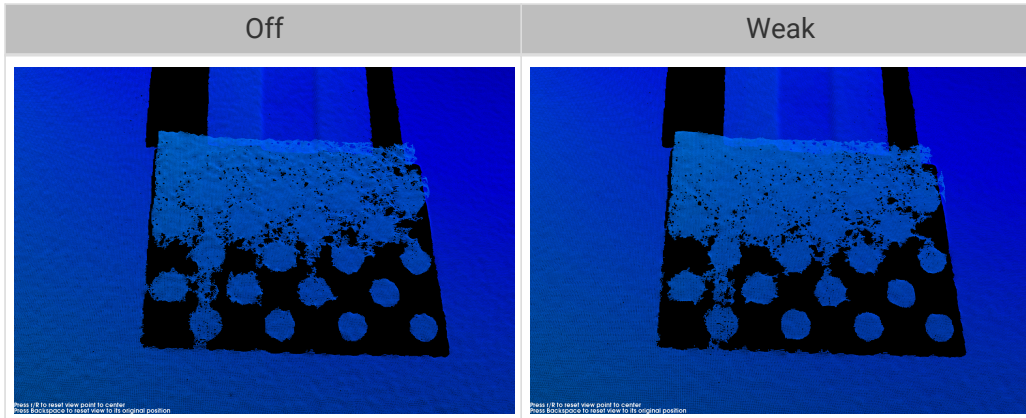
1. Adjust **Outlier Removal** first. The calculation time for different intensities of this parameter is about the same. Using a higher intensity will not add to the calculation time too much.
2. It is recommended to use low intensities of **Surface Smoothing** and **Noise Removal**. The higher the intensities of these two parameters, the longer the calculation time.

### Surface Smoothing

<b>Parameter Description</b>	This parameter reduces the depth fluctuation in the point cloud and improve its resemblance to the actual object surface.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• Weak</li> <li>• Normal</li> <li>• Strong</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• <b>Surface Smoothing</b> causes loss of object surface details. Higher intensity causes more object details to be lost. Lower intensity causes fewer object details to be lost.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Surface Smoothing** values (all other conditions identical):

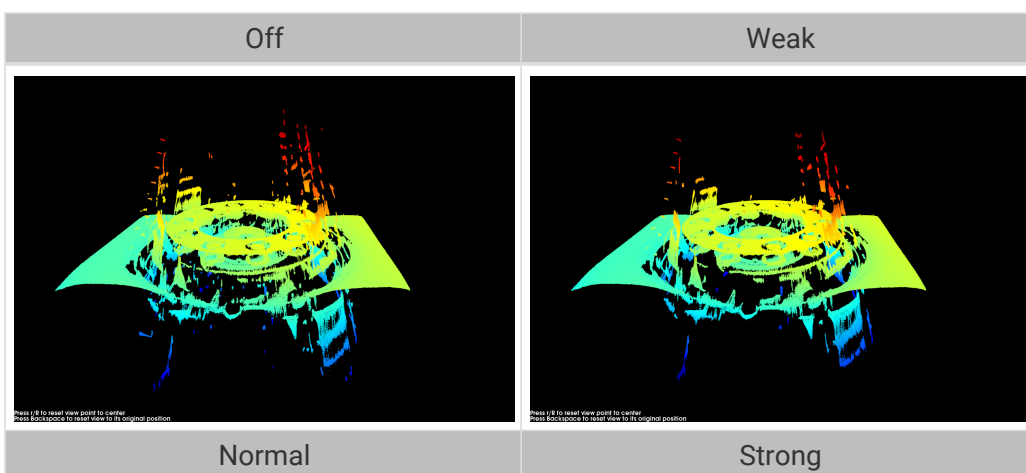


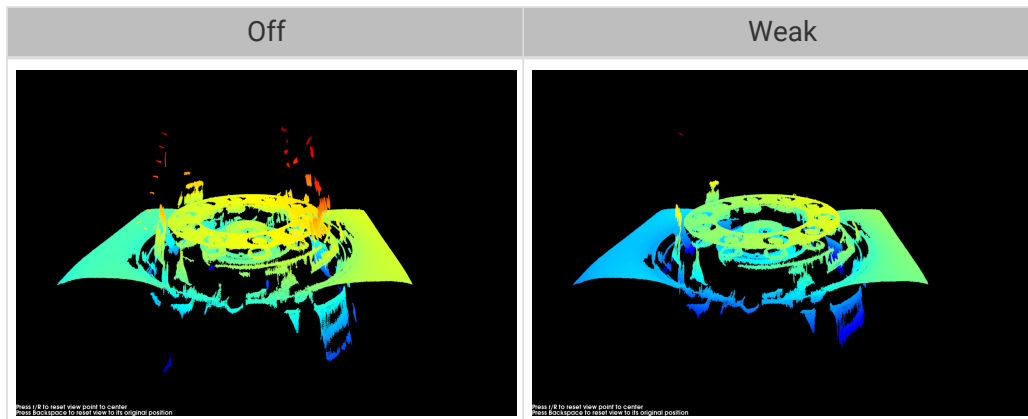


### Outlier Removal

Parameter Description	This parameter removes the outliers in the point cloud. Outliers are clustered points away from the object point cloud.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Higher intensity removes more outliers, and lower intensity removes fewer outliers.</li> <li>• If the object point cloud contains multiple parts, high intensities of outlier removal might remove some parts. For example, if the object is a cup, outlier removal might remove the point cloud of the handle part.</li> </ul>

Point clouds obtained with different **Outlier Removal** values (all other conditions identical):

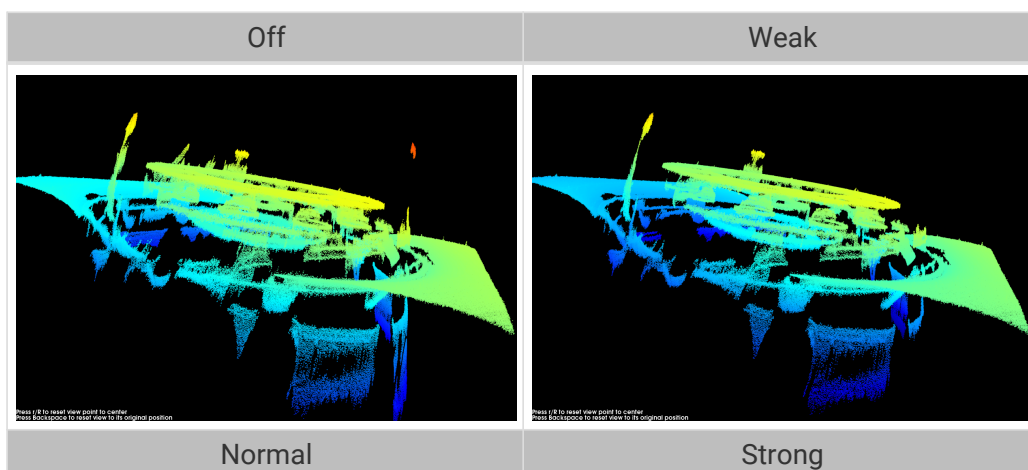


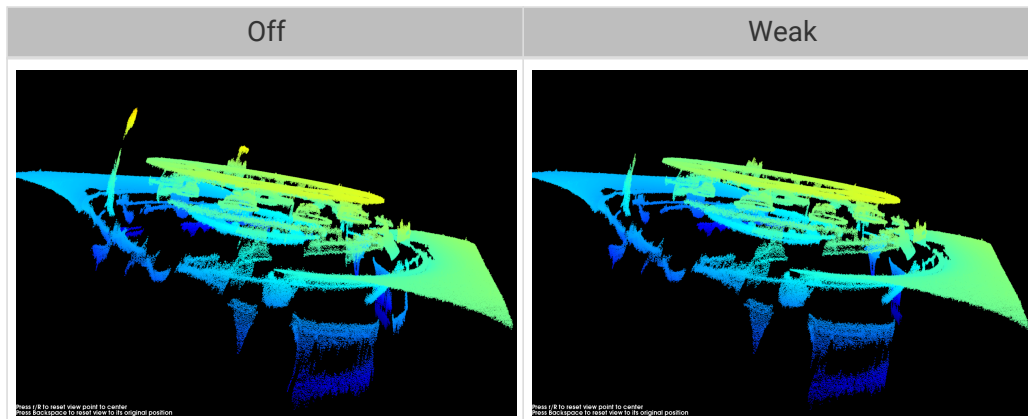


### Noise Removal

Parameter Description	This parameter removes the noise in the point cloud, thus reducing the impact on the precision and accuracy of subsequent calculation. Noise is the scattered points close to the object surface.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Higher intensity removes more noise but may also remove some object features. Lower intensity removes less noise but also preserves the object features better.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Noise Removal** values (all other conditions identical):





If this function removes the needed object features, please reduce the intensity. However, more noise will be retained.

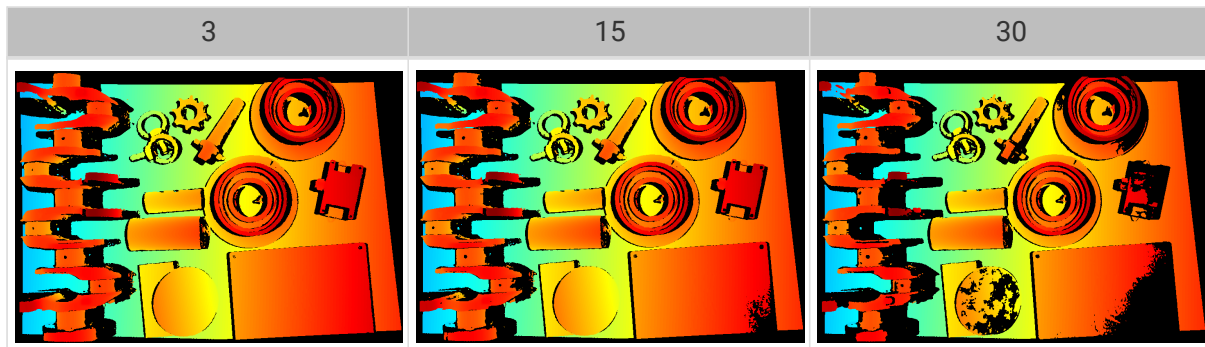
### Edge Preservation

Parameter Description	This parameter preserves the sharpness of object edges during surface smoothing.
Visibility	Guru
Values	<ul style="list-style-type: none"> <li>• Sharp: Preserves the sharpness of object edges as much as possible. However, the effect of surface smoothing will be reduced.</li> <li>• Normal (default): Balances between edge preservation and surface smoothing.</li> <li>• Smooth: Does not preserve the edges. The object surface will be well smoothed, but the object edges will be distorted.</li> </ul>
Instructions	Adjust based on your needs for preserving the edges of workpieces.

### Stripe Contrast Threshold

Parameter Description	This parameter is used to remove noise in the point cloud. Adjust this parameter if the level of noise in the point cloud is still high after adjusting <b>Outlier Removal</b> and <b>Noise Removal</b> .
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 1 to 100</li> <li>• Default value: 3</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Greater value of this parameter results in more points being removed. Smaller value results in fewer points being removed.</li> <li>• Increase the value of this parameter can remove the noise in the point cloud, but may also cause the points of dark objects to be lost.</li> </ul>

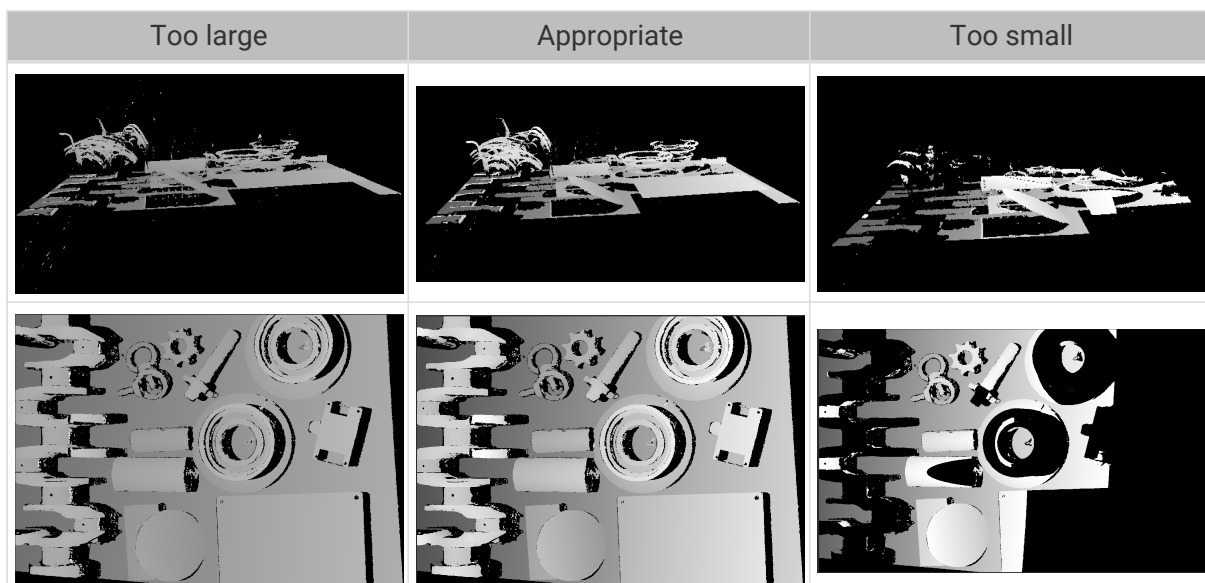
Point clouds obtained with different **Stripe Contrast Threshold** values (all other conditions identical):



### Depth Range

Parameter Description	Set a Z-direction ROI for the depth map and point cloud. <b>Depth Range</b> can be set within the camera working distance, and the data outside the range is removed from the depth map and point cloud.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Depth Lower Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 4000 mm</li> <li>◦ Default value: 200 mm</li> </ul> </li> <li>• Depth Upper Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 5000 mm</li> <li>◦ Default value: 4000 mm</li> </ul> </li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Depth Range</b> should be adjusted to an appropriate range to ensure the completeness of depth data in the depth map and point cloud. Too large a range may introduce interference, and too small a range may remove the data of key features.</li> <li>• For detailed instructions, please refer to <a href="#">Set Depth Range</a> below.</li> </ul>

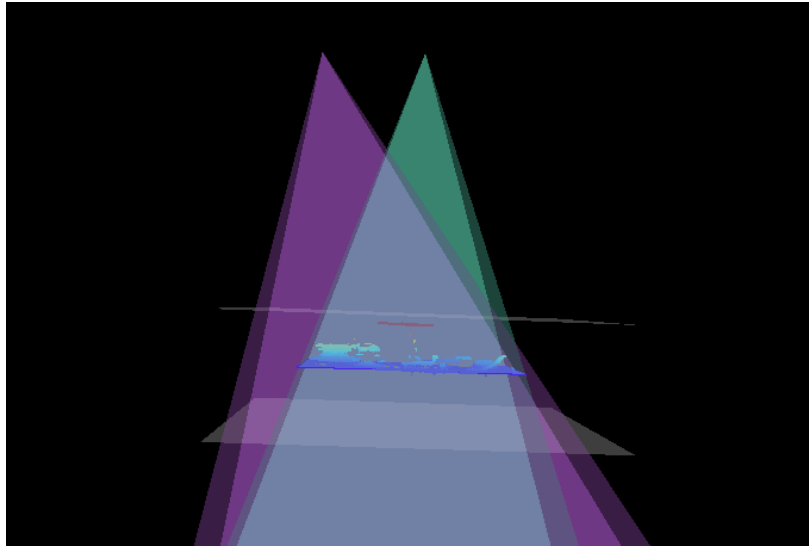
The same point cloud with different **Depth Range** values (all other conditions identical):



## Set Depth Range

Follow these steps to adjust **Depth Range**:

1. Double-click [ **Edit** ] to the right of **Depth Range** to open the **Set Depth Range** window.
2. Click [ **Refresh point cloud** ] at the top of the right panel to obtain the newest point cloud.
3. [Adjust the position of the point cloud](#): adjust the position until you can see the two gray rectangles that represents the upper and lower limits of **Depth Range**.



4. Adjust the depth range: drag the handles on the slider to adjust **Depth Range** roughly. Then, enter specific values on the right to fine-tune **Depth Range**.



Judge if the depth range is appropriate: All needed object features are located between the two gray rectangles, and most noise and outliers are located outside.

5. Click [ **Save** ] to save the depth range settings.



- Click [ **Recommended range** ] to adjust **Depth Range** to the recommended working distance of the current camera.
- Click [ **Reset** ] to restore **Depth Range** to the last saved values.

## ROI

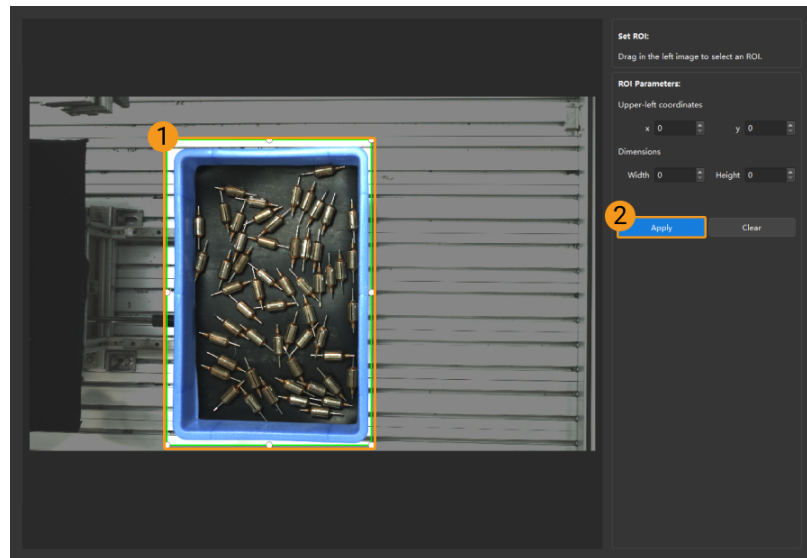
Parameter Description	Set the ROI on the XY plane for the depth map and point cloud. Points outside the selected region are removed.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set ROI</a> below.

## Set ROI

1. Double-click [ **Edit** ] to the right of **ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the

box to adjust the box size.

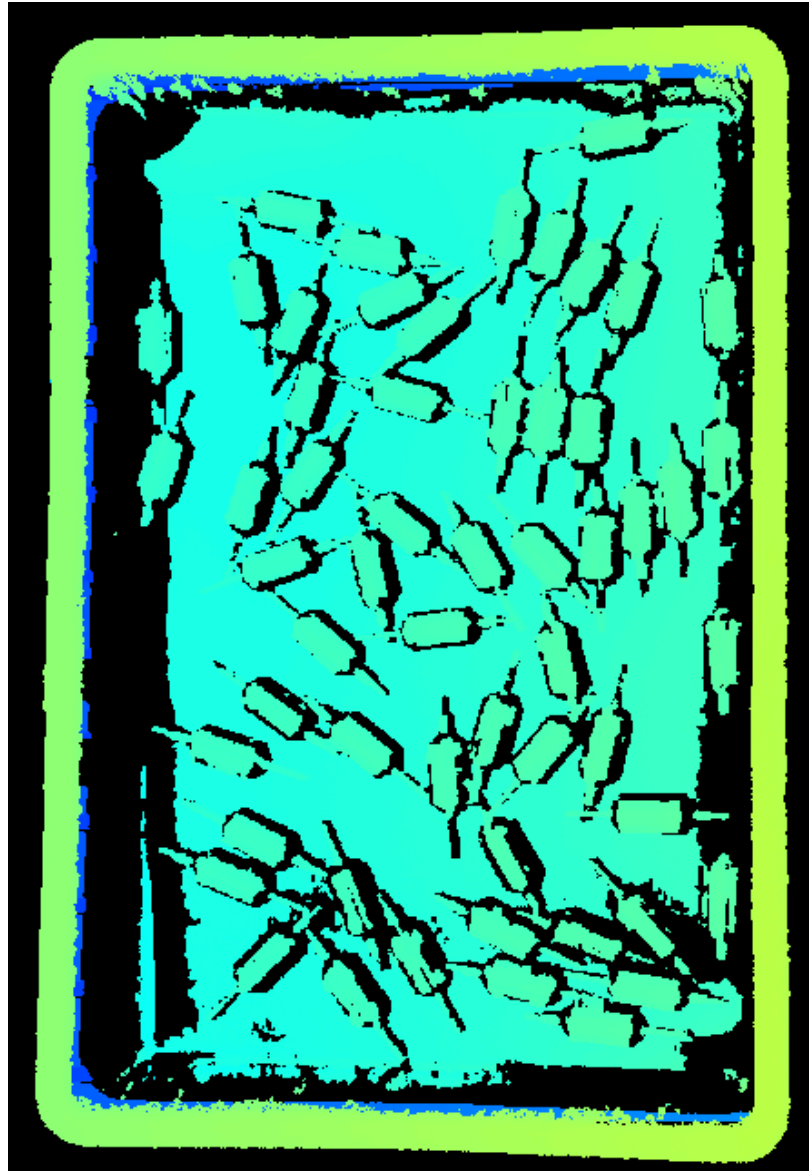
3. Click [ **Apply** ] to apply the set ROI.



- Click [ **Clear** ] to remove the current ROI.
- For the DEEP (V4) and LSR (V4) series, the 2D image (depth source) is displayed in this window. If the image is too dark or too bright, please adjust **2D Image (Depth Source) Exposure Mode**.

4. Acquire data again and view the depth map or point cloud to check the result of setting the ROI.





### 5.3.3. Parameters of UHP-140

This topic introduces the parameters of the UHP-140 series. The parameters are divided into parameters for the 2D image and parameters for the depth map / point cloud, based on the data types that they affect.

#### Parameters for the 2D Image

The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.

The quality of the 2D image is affected by parameters in the **2D Parameters** category and the **Gain** parameter in the **3D Parameters** category.



If you are using a color camera, and the color of the image differ significantly from that of the objects, you can adjust the **white balance** setting. For detailed instructions, please refer to [Adjust White Balance](#).

## 2D Parameters

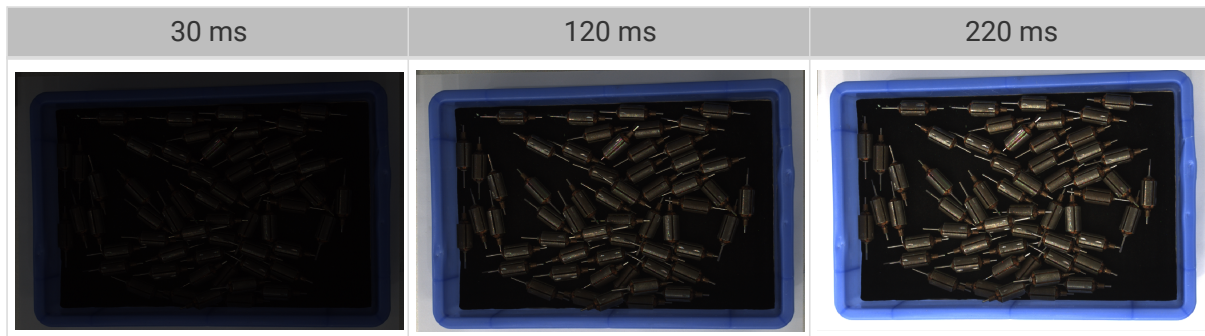
### Exposure Mode

<b>Parameter Description</b>	Set the exposure mode for capturing the 2D image.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Timed: Set a single exposure time. Usually used in stable lighting conditions.</li> <li>• Auto: The exposure time is automatically adjusted. Usually used in varying lighting conditions.</li> <li>• HDR: Set multiple exposure times and merge the images. Usually used for objects with various colors or textures.</li> <li>• Flash: Use the projector for supplemental light. Usually used in dark environments.</li> </ul>
<b>Instructions</b>	<p>After selecting different options, different parameters are displayed in the <b>2D Parameters</b> category for adjustment:</p> <ul style="list-style-type: none"> <li>• Timed: displays <b>Exposure Time</b>.</li> <li>• Auto: displays <b>Gray Value</b> and <b>Auto-Exposure ROI</b>.</li> <li>• HDR: displays <b>Tone Mapping</b> and <b>Exposure Sequence</b>.</li> <li>• Flash: no other parameters need to be adjusted. The projector projects supplemental light automatically during image capturing.</li> </ul>

### Timed: Exposure Time

<b>Parameter Description</b>	<p>This parameter affects the brightness of the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time increases the image brightness.</li> <li>• Short exposure time decreases the image brightness.</li> </ul>
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 999 ms</li> <li>• Default value: 30 ms</li> </ul>
<b>Instructions</b>	<p>Adjust this parameter based on the quality of the 2D image. The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time is usually used in dark environments.</li> <li>• Short exposure time is usually used in bright environments.</li> </ul>

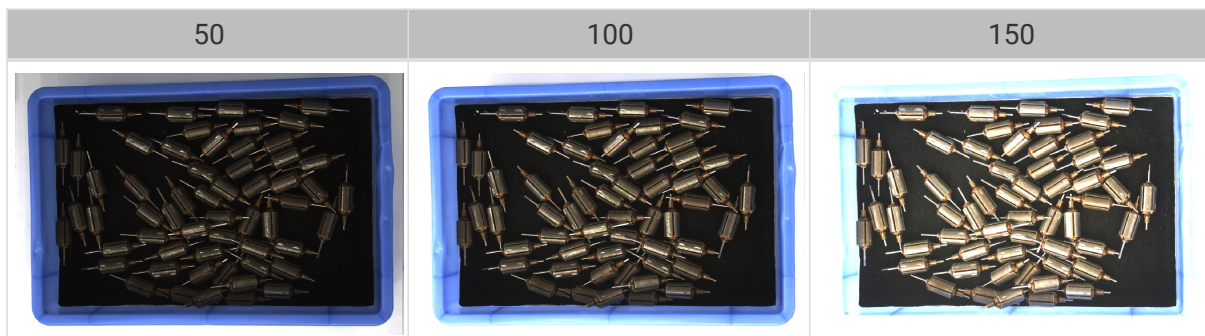
2D images obtained with different **Exposure Time** values (all other conditions identical):



### Auto: Gray Value

Parameter Description	This parameter affects the brightness of the 2D image. Increase the value if the 2D image is too dark and decrease if too bright.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 to 255</li> <li>• Default value: 100</li> </ul>
Instructions	N/A

2D images obtained with different **Gray Value** values (all other conditions identical):

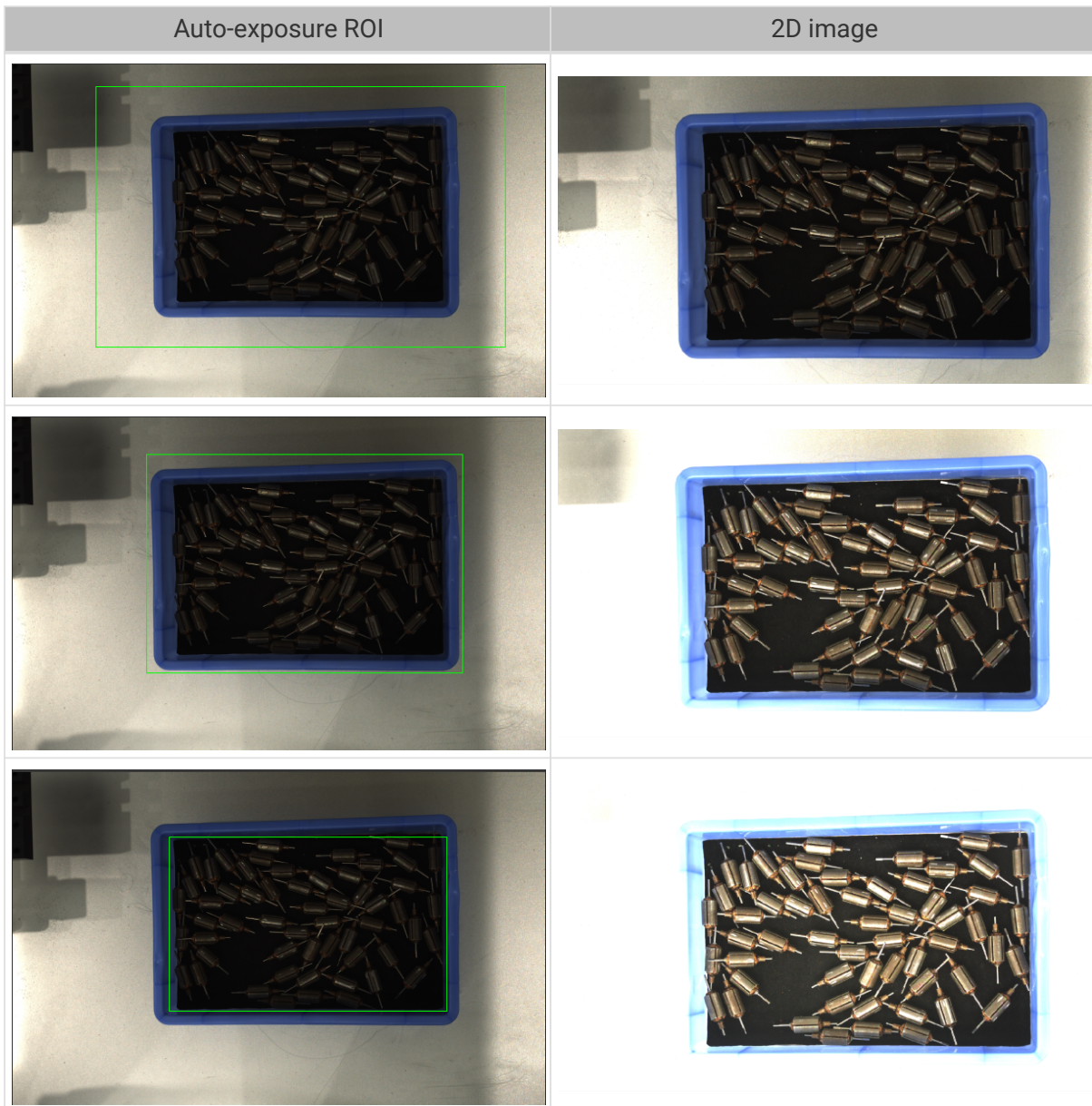


The **Gray Value** of a monochrome image is equivalent to the image brightness; the **Gray Value** of a color image is equivalent to the brightness of each color channel.

### Auto: Auto-Exposure ROI

Parameter Description	<ul style="list-style-type: none"> <li>• The exposure time is automatically adjusted based on the lighting, object colors, etc., in the selected region.</li> <li>• When an auto-exposure ROI is not set, the exposure time is automatically adjusted based on the entire camera FOV.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set Auto-Exposure ROI</a> below.

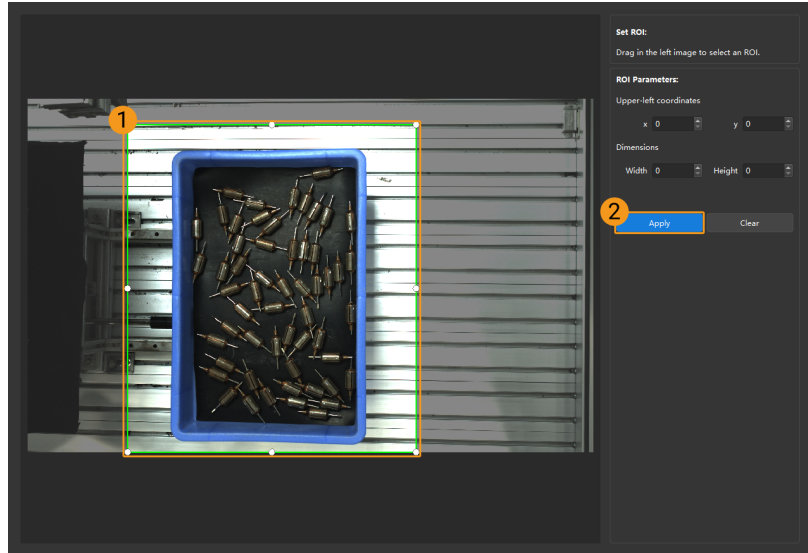
2D images obtained with different **Auto-Exposure ROI** values (all other conditions identical):



### Set Auto-Exposure ROI

1. Double-click [ **Edit** ] to the right of **Auto-Exposure ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set auto-exposure ROI.





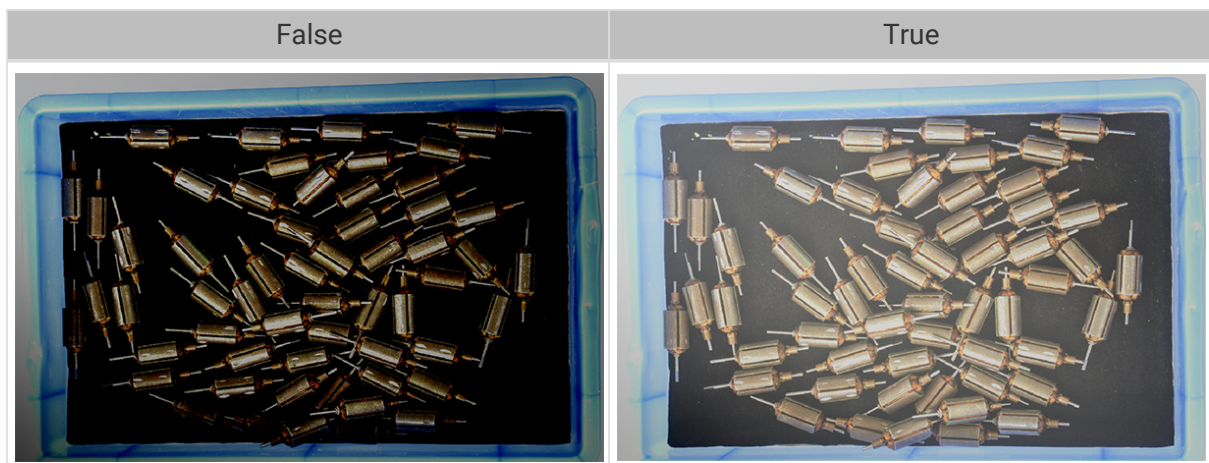
 Click [ Clear ] to remove the current auto-exposure ROI.

- Acquire data again and view the 2D image to check the result of automatic exposure adjustment.


#### HDR: Tone Mapping

Parameter Description	This function can make the image look more natural. If the 2D image appears very different from the actual objects, please enable this function.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• False (default)</li> <li>• True</li> </ul>
Instructions	Check to enable <b>Tone Mapping</b> .

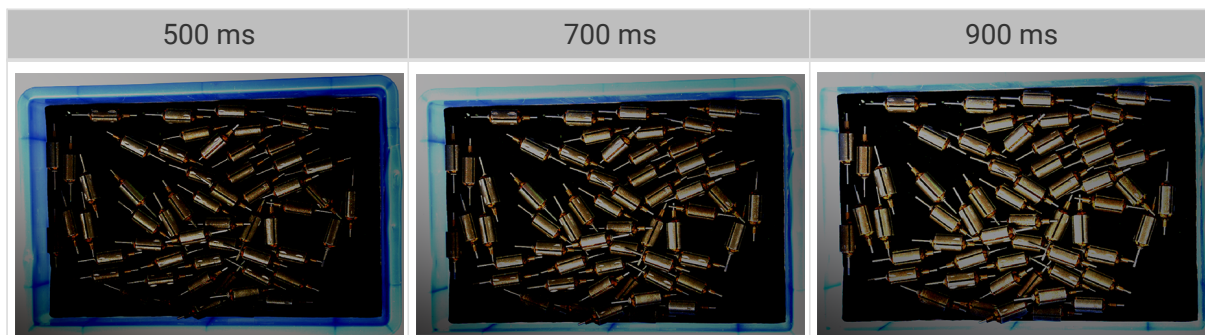
2D images obtained with **Tone Mapping** disabled or enabled (all other conditions identical):



## HDR: Exposure Sequence

Parameter Description	Set multiple exposure times, and the captured images are merged to generate a 2D image that retains more details in the highlights and shadows.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	<ol style="list-style-type: none"> <li>1. Double-click [ <b>Edit</b> ] to the right of <b>Exposure Sequence</b> to open the editing window of the exposure sequence.</li> <li>2. Click [ <b>+</b> ] to add and set a new exposure time.</li> <li>3. To delete an exposure time, select it and click [ <b>-</b> ].</li> <li>4. After you finish adding the exposure times, click [ <b>Apply</b> ] to apply the exposure sequence.</li> </ol> <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="margin-right: 10px;">  </div> <ul style="list-style-type: none"> <li>◦ [ <b>Cancel</b> ]: do not save the current settings and exit this window.</li> <li>◦ [ <b>Reset</b> ]: clear all the exposure times.</li> </ul> </div>

2D images captured with single exposure times (all other conditions identical):




2D images captured with different exposure sequences consisting of the above exposure times (all other conditions identical):

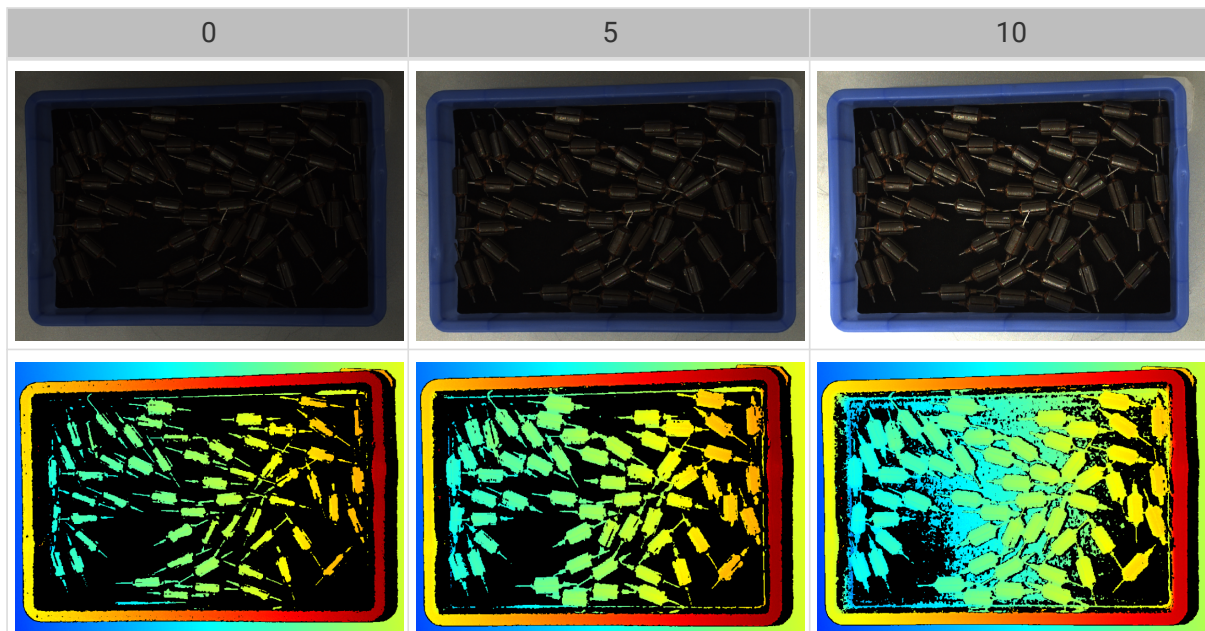


## 3D Parameters

## Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):






### Parameters for the Depth Map / Point Cloud

In the depth map and point cloud, the needed data should be complete.



Determine which part of the data is needed according to your actual needs. For example, if you need to pick metal bowls with opening facing up by the rim, usually you only need to make sure that the data of the bowl rims is complete.

Parameters in the following categories affect the quality of the depth map and point cloud.

Parameter category	Depth map	Point cloud
3D Parameters		
Point Cloud Processing		



Parameter category	Depth map	Point cloud
Depth Range	✔	✔
ROI	✔	✔

### 3D Parameters

The parameters in this category affect the images used for calculating depth data, thus affecting the quality of the depth map and point cloud.

Use **Exposure Assistant** can obtain the recommended exposure parameter values. Double-click [ **Auto Set** ] to the right of **3D Parameters** to open **Exposure Assistant**.

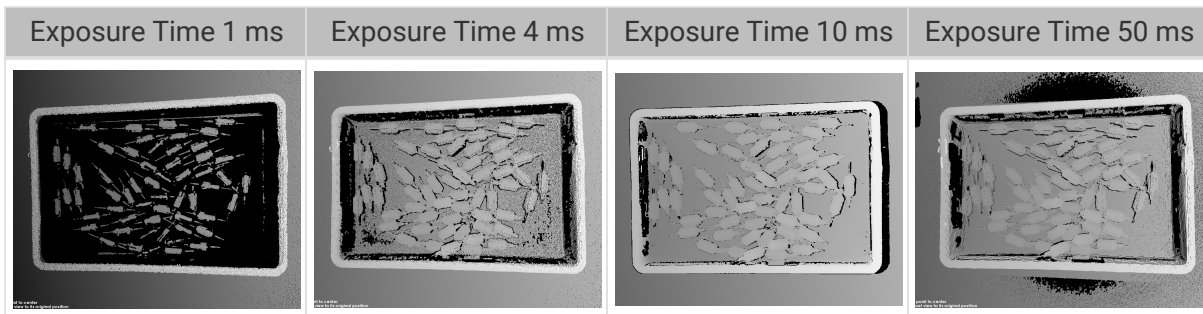
### Exposure Multiplier

<b>Parameter Description</b>	Set the number of <b>Exposure Time</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 1 to 3</li> <li>• Default value: 1</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• When the value of <b>Exposure Multiplier</b> is greater than 1, multiple <b>Exposure Time</b> parameters must be set.</li> <li>• All images captured with different exposure times are used for calculating depth. Using multiple exposure times can improve the completeness of depth data but also increases processing time.</li> <li>• With multiple exposure times, the amount of time for obtaining the depth map and point cloud increases. Please try to minimize the number of exposure times while ensuring the data quality.</li> </ul>

### Exposure Time


<b>Parameter Description</b>	Set the exposure time for acquiring depth information. The number of <b>Exposure Time</b> to be set depends on the value of <b>Exposure Multiplier</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 99 ms</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• Usually, long exposure time is used for dark objects, and short exposure time is used for light objects.</li> <li>• Exposure times too long or too short both lead to loss of depth information.</li> <li>• The exposure time of a laser camera must be a multiple of 4. If the entered value is not a multiple of 4, it will be automatically adjusted. The minimum value that can be set is 4 ms for the Laser series and 8 ms for other laser cameras.</li> </ul>

Point clouds obtained under different **Exposure Time** values (all other conditions identical):




The black regions lack depth information to generate corresponding point cloud.

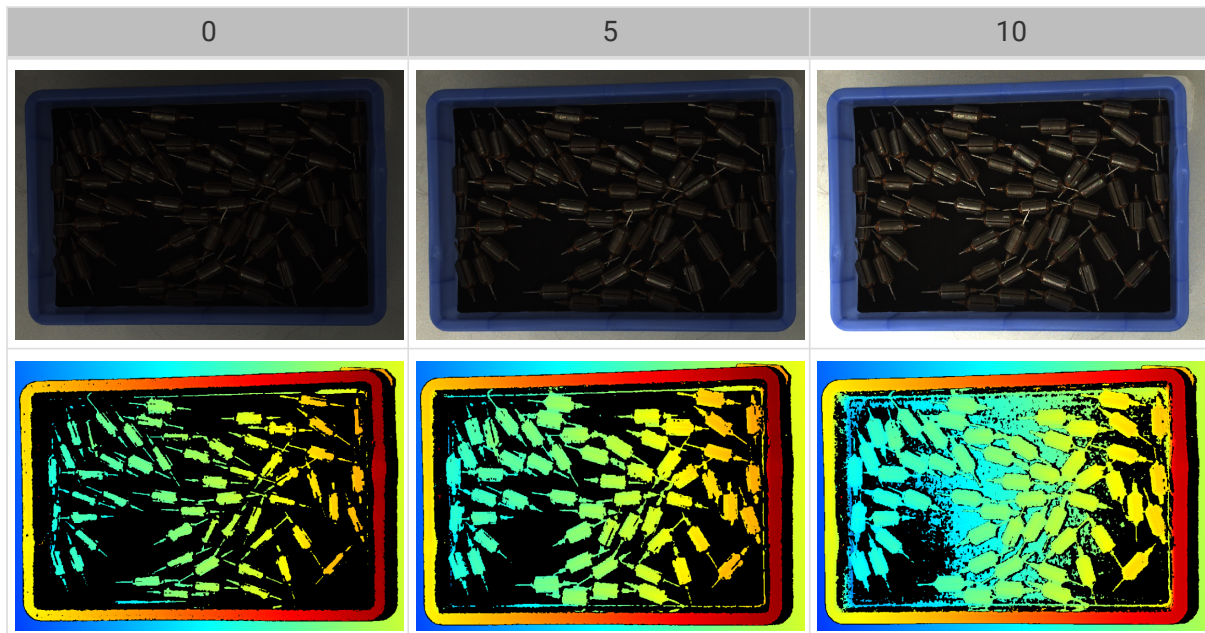
## Capture Mode

Parameter Description	Set the capture mode for the UHP series.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Camera1 (default): Use 2D camera 1 to acquire data.</li> <li>• Camera2: Use 2D camera 2 to acquire data.</li> <li>• Merge: Use both 2D cameras to acquire data. The depth map and point cloud are generated by merging the data.</li> </ul> <p> The <b>Camera1</b> or <b>Merge</b> modes are recommended.</p>
Instructions	<ul style="list-style-type: none"> <li>• This parameter affects the source of the 2D image as well. When <b>Camera1</b> or <b>Merge</b> is selected, the 2D image is acquired with 2D camera 1. When <b>Camera2</b> is selected, the 2D image is acquired with 2D camera 2.</li> <li>• ROI can only be set if <b>Camera1</b> is selected.</li> </ul>

## Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):



## Projector

### Light Brightness

Parameter Description	This parameter affects the brightness of the projected structured light.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• High: high brightness, suitable for dark objects.</li> <li>• Normal (default): medium brightness, suitable for regular objects.</li> <li>• Low: low brightness, suitable for reflective objects.</li> </ul>
Instructions	Adjust this parameter based on the object type.

## Point Cloud Processing

Adjusting the parameters in the **Point Cloud Processing** category can improve the quality of the point cloud.

### Principles for Adjusting Point Cloud Processing Parameters

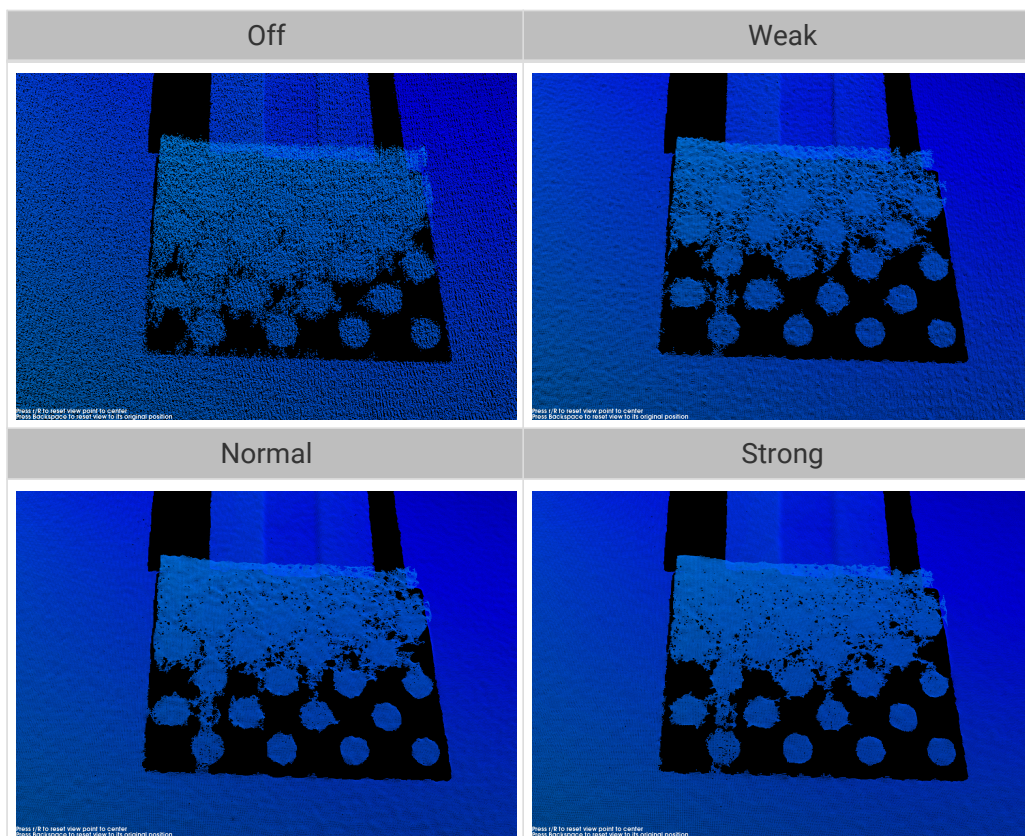
When adjusting the **Point Cloud Processing** parameters, follow these principles to reduce the camera acquisition time and cycle time:

1. Adjust **Outlier Removal** first. The calculation time for different intensities of this parameter is about the same. Using a higher intensity will not add to the calculation time too much.
2. It is recommended to use low intensities of **Surface Smoothing** and **Noise Removal**. The higher the intensities of these two parameters, the longer the calculation time.

## Surface Smoothing

Parameter Description	This parameter reduces the depth fluctuation in the point cloud and improve its resemblance to the actual object surface.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• Weak</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Surface Smoothing</b> causes loss of object surface details. Higher intensity causes more object details to be lost. Lower intensity causes fewer object details to be lost.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Surface Smoothing** values (all other conditions identical):

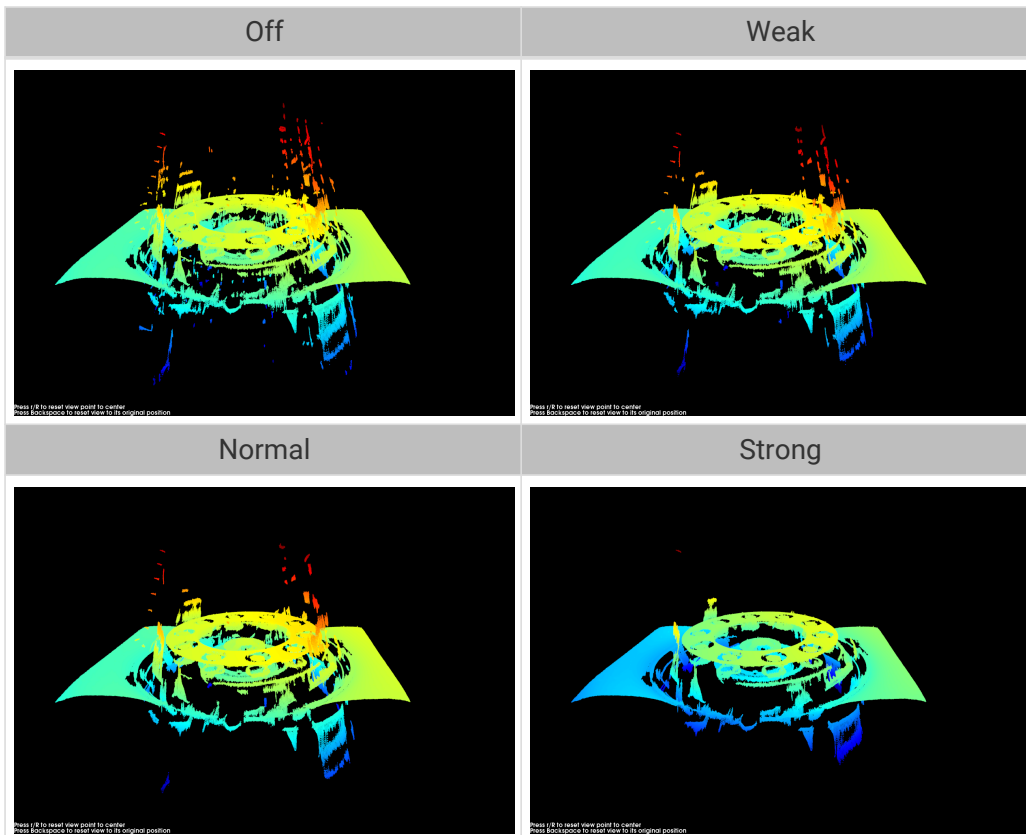


## Outlier Removal

Parameter Description	This parameter removes the outliers in the point cloud. Outliers are clustered points away from the object point cloud.
Visibility	Beginner, Expert, Guru

Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Higher intensity removes more outliers, and lower intensity removes fewer outliers.</li> <li>• If the object point cloud contains multiple parts, high intensities of outlier removal might remove some parts. For example, if the object is a cup, outlier removal might remove the point cloud of the handle part.</li> </ul>

Point clouds obtained with different **Outlier Removal** values (all other conditions identical):



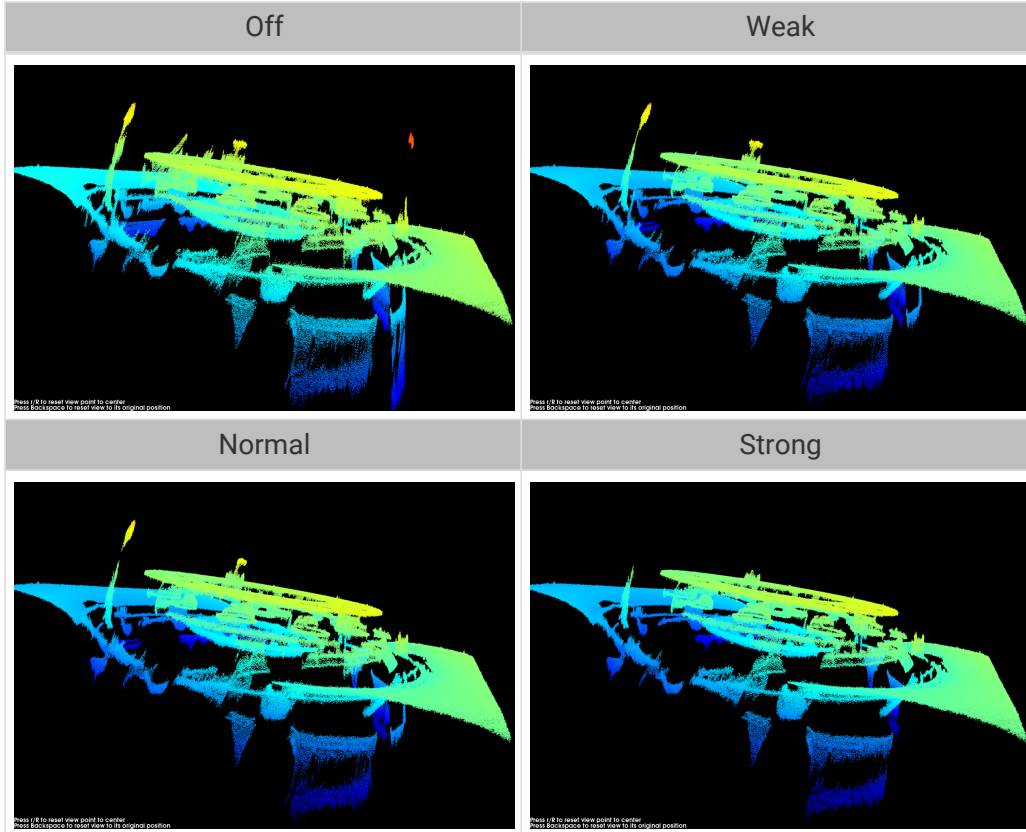
## Noise Removal

Parameter Description	This parameter removes the noise in the point cloud, thus reducing the impact on the precision and accuracy of subsequent calculation. Noise is the scattered points close to the object surface.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>



Instructions	<ul style="list-style-type: none"> <li>Higher intensity removes more noise but may also remove some object features. Lower intensity removes less noise but also preserves the object features better.</li> <li>Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>
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Point clouds obtained with different **Noise Removal** values (all other conditions identical):



If this function removes the needed object features, please reduce the intensity. However, more noise will be retained.

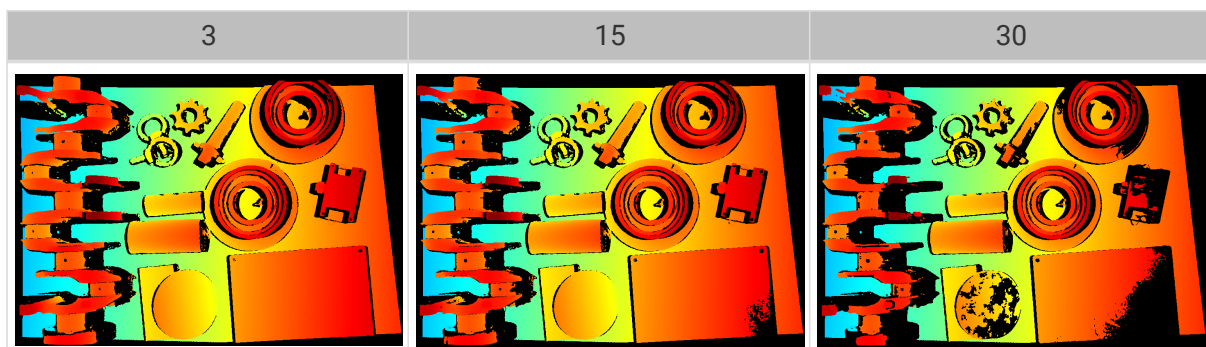
## Edge Preservation

Parameter Description	This parameter preserves the sharpness of object edges during surface smoothing.
Visibility	Guru
Values	<ul style="list-style-type: none"> <li>Sharp: Preserves the sharpness of object edges as much as possible. However, the effect of surface smoothing will be reduced.</li> <li>Normal (default): Balances between edge preservation and surface smoothing.</li> <li>Smooth: Does not preserve the edges. The object surface will be well smoothed, but the object edges will be distorted.</li> </ul>
Instructions	Adjust based on your needs for preserving the edges of workpieces.

## Stripe Contrast Threshold

<b>Parameter Description</b>	This parameter is used to remove noise in the point cloud. Adjust this parameter if the level of noise in the point cloud is still high after adjusting <b>Outlier Removal</b> and <b>Noise Removal</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 1 to 100</li> <li>• Default value: 3</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• Greater value of this parameter results in more points being removed. Smaller value results in fewer points being removed.</li> <li>• Increase the value of this parameter can remove the noise in the point cloud, but may also cause the points of dark objects to be lost.</li> </ul>

Point clouds obtained with different **Stripe Contrast Threshold** values (all other conditions identical):

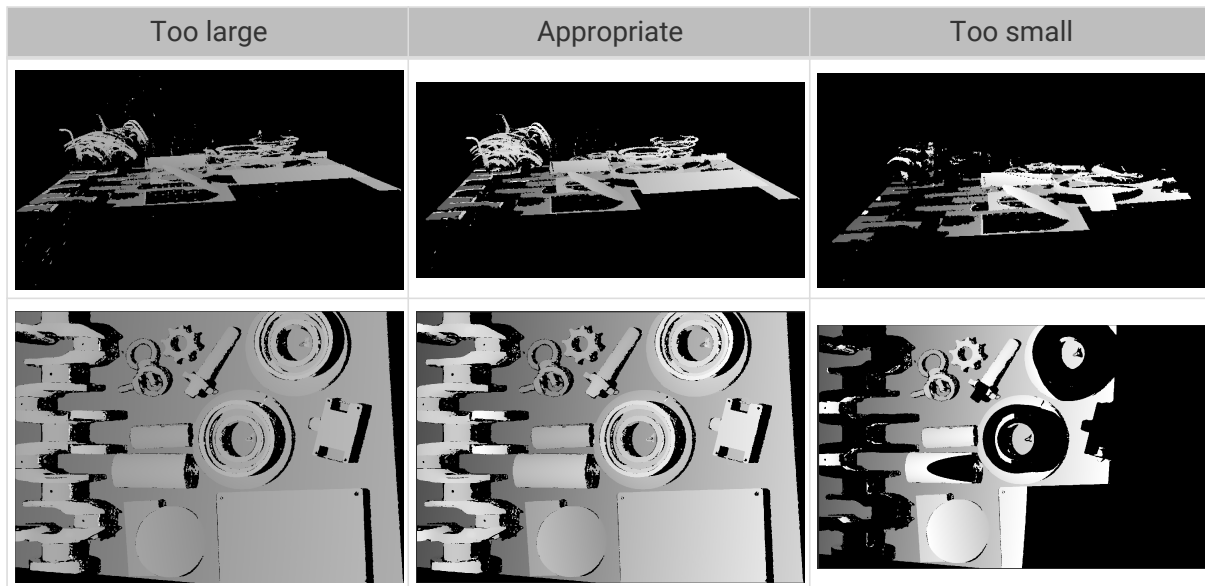


## Depth Range

<b>Parameter Description</b>	Set a Z-direction ROI for the depth map and point cloud. <b>Depth Range</b> can be set within the camera working distance, and the data outside the range is removed from the depth map and point cloud.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Depth Lower Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 4000 mm</li> <li>◦ Default value: 200 mm</li> </ul> </li> <li>• Depth Upper Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 5000 mm</li> <li>◦ Default value: 4000 mm</li> </ul> </li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• <b>Depth Range</b> should be adjusted to an appropriate range to ensure the completeness of depth data in the depth map and point cloud. Too large a range may introduce interference, and too small a range may remove the data of key features.</li> <li>• For detailed instructions, please refer to <a href="#">Set Depth Range</a> below.</li> </ul>

The same point cloud with different **Depth Range** values (all other conditions identical):

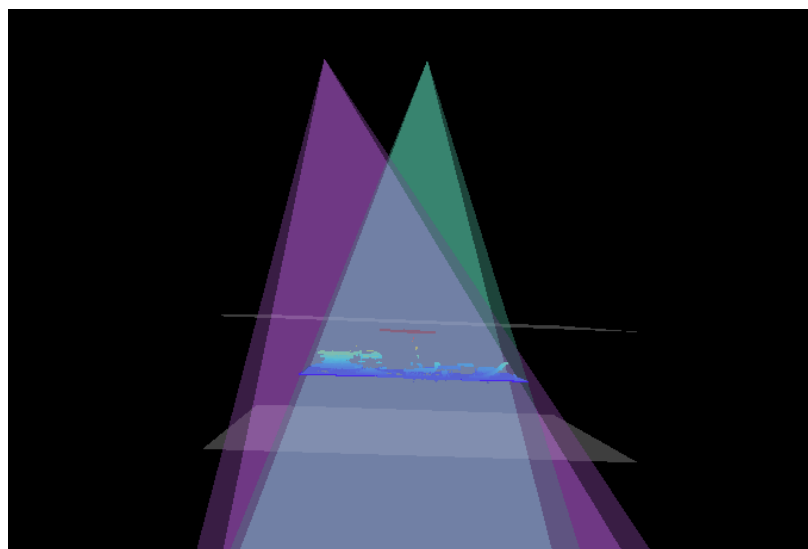




### Set Depth Range

Follow these steps to adjust Depth Range:

1. Double-click [ **Edit** ] to the right of **Depth Range** to open the **Set Depth Range** window.
2. Click [ **Refresh point cloud** ] at the top of the right panel to obtain the newest point cloud.
3. **Adjust the position of the point cloud**: adjust the position until you can see the two gray rectangles that represents the upper and lower limits of **Depth Range**.



4. Adjust the depth range: drag the handles on the slider to adjust **Depth Range** roughly. Then, enter specific values on the right to fine-tune **Depth Range**.



Judge if the depth range is appropriate: All needed object features are located between the two gray rectangles, and most noise and outliers are located outside.

5. Click [ **Save** ] to save the depth range settings.



- Click [ **Recommended range** ] to adjust **Depth Range** to the recommended working distance of the current camera.

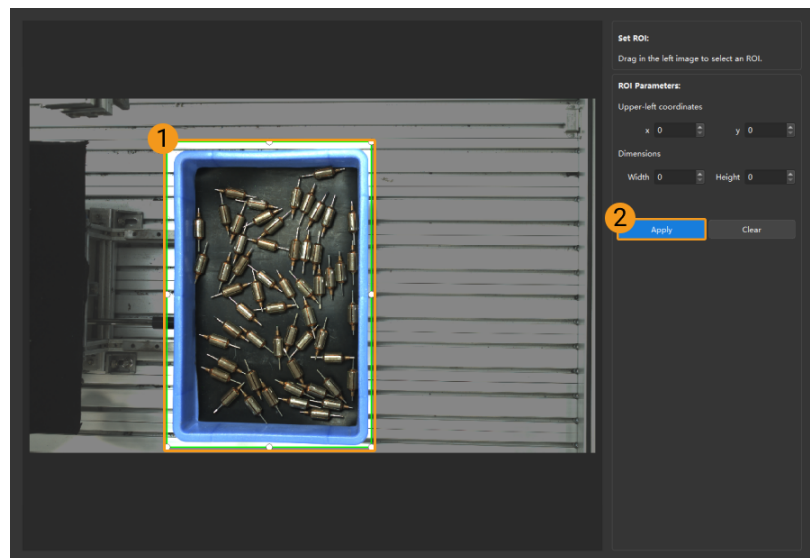
- Click [ **Reset** ] to restore **Depth Range** to the last saved values.

## ROI

<b>Parameter Description</b>	Set the ROI on the XY plane for the depth map and point cloud. Points outside the selected region are removed.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	N/A
<b>Instructions</b>	For detailed instructions, refer to <a href="#">Set ROI</a> below.

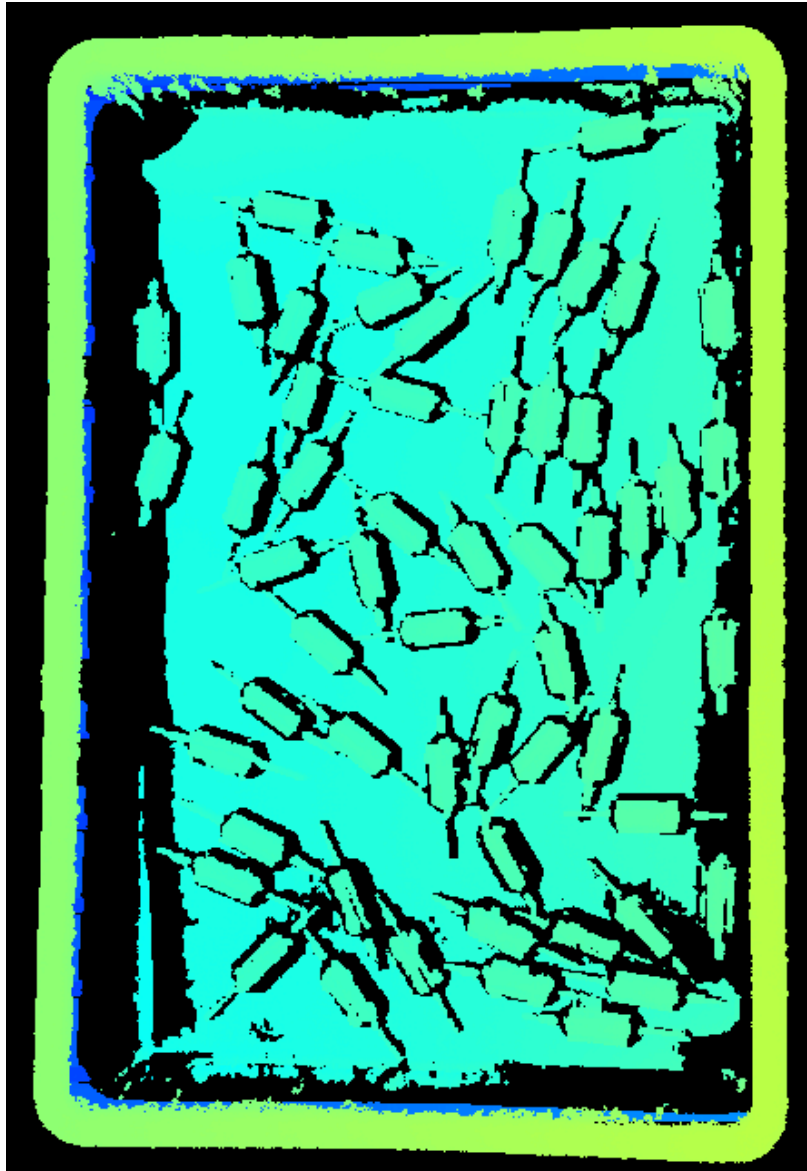
## Set ROI

1. Double-click [ **Edit** ] to the right of **ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set ROI.



- Click [ **Clear** ] to remove the current ROI.
- For the DEEP (V4) and LSR (V4) series, the 2D image (depth source) is displayed in this window. If the image is too dark or too bright, please adjust **2D Image (Depth Source) Exposure Mode**.

4. Acquire data again and view the depth map or point cloud to check the result of setting the ROI.



### 5.3.4. Parameters of V3 Cameras

This topic introduces the parameters of the V3 Cameras. The parameters are divided into parameters for the 2D image and parameters for the depth map / point cloud, based on the data types that they affect.

#### Parameters for the 2D Image

The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.

The quality of the 2D image is affected by parameters in the **2D Parameters** category and the **Gain** parameter in the **3D Parameters** category.



If you are using a color camera, and the color of the image differ significantly from that of the objects, you can adjust the **white balance** setting. For detailed instructions, please refer to [Adjust White Balance](#).

## 2D Parameters

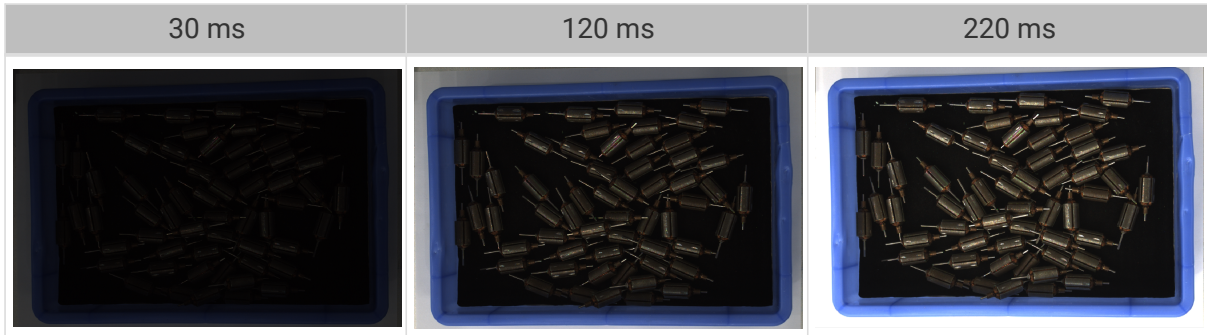
### Exposure Mode

<b>Parameter Description</b>	Set the exposure mode for capturing the 2D image.
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Timed: Set a single exposure time. Usually used in stable lighting conditions.</li> <li>• Auto: The exposure time is automatically adjusted. Usually used in varying lighting conditions.</li> <li>• HDR: Set multiple exposure times and merge the images. Usually used for objects with various colors or textures.</li> <li>• Flash: Use the projector for supplemental light. Usually used in dark environments.</li> </ul>
<b>Instructions</b>	<p>After selecting different options, different parameters are displayed in the <b>2D Parameters</b> category for adjustment:</p> <ul style="list-style-type: none"> <li>• Timed: displays <b>Exposure Time</b>.</li> <li>• Auto: displays <b>Gray Value</b> and <b>Auto-Exposure ROI</b>.</li> <li>• HDR: displays <b>Tone Mapping</b> and <b>Exposure Sequence</b>.</li> <li>• Flash: no other parameters need to be adjusted. The projector projects supplemental light automatically during image capturing.</li> </ul>

### Timed: Exposure Time

<b>Parameter Description</b>	<p>This parameter affects the brightness of the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time increases the image brightness.</li> <li>• Short exposure time decreases the image brightness.</li> </ul>
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 999 ms</li> <li>• Default value: 30 ms</li> </ul>
<b>Instructions</b>	<p>Adjust this parameter based on the quality of the 2D image. The 2D image should not be too bright or too dark, and the surface features of the target object should be clearly visible in the image.</p> <ul style="list-style-type: none"> <li>• Long exposure time is usually used in dark environments.</li> <li>• Short exposure time is usually used in bright environments.</li> </ul>

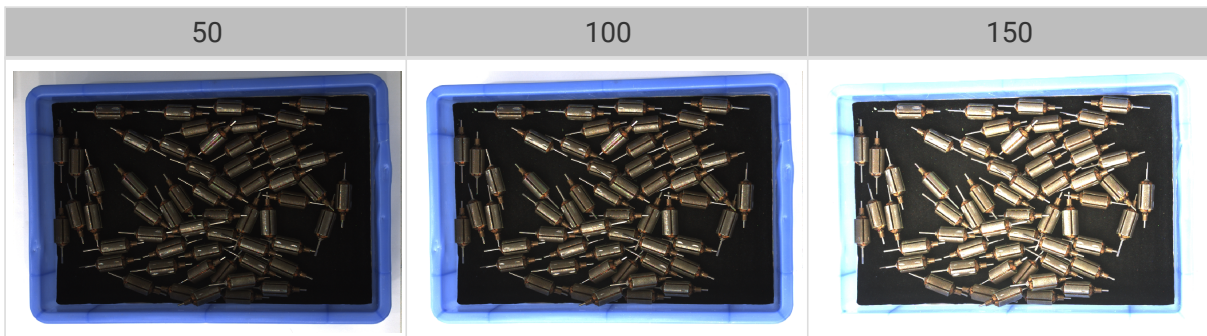
2D images obtained with different **Exposure Time** values (all other conditions identical):



#### Auto: Gray Value

Parameter Description	This parameter affects the brightness of the 2D image. Increase the value if the 2D image is too dark and decrease if too bright.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 to 255</li> <li>• Default value: 100</li> </ul>
Instructions	N/A

2D images obtained with different **Gray Value** values (all other conditions identical):



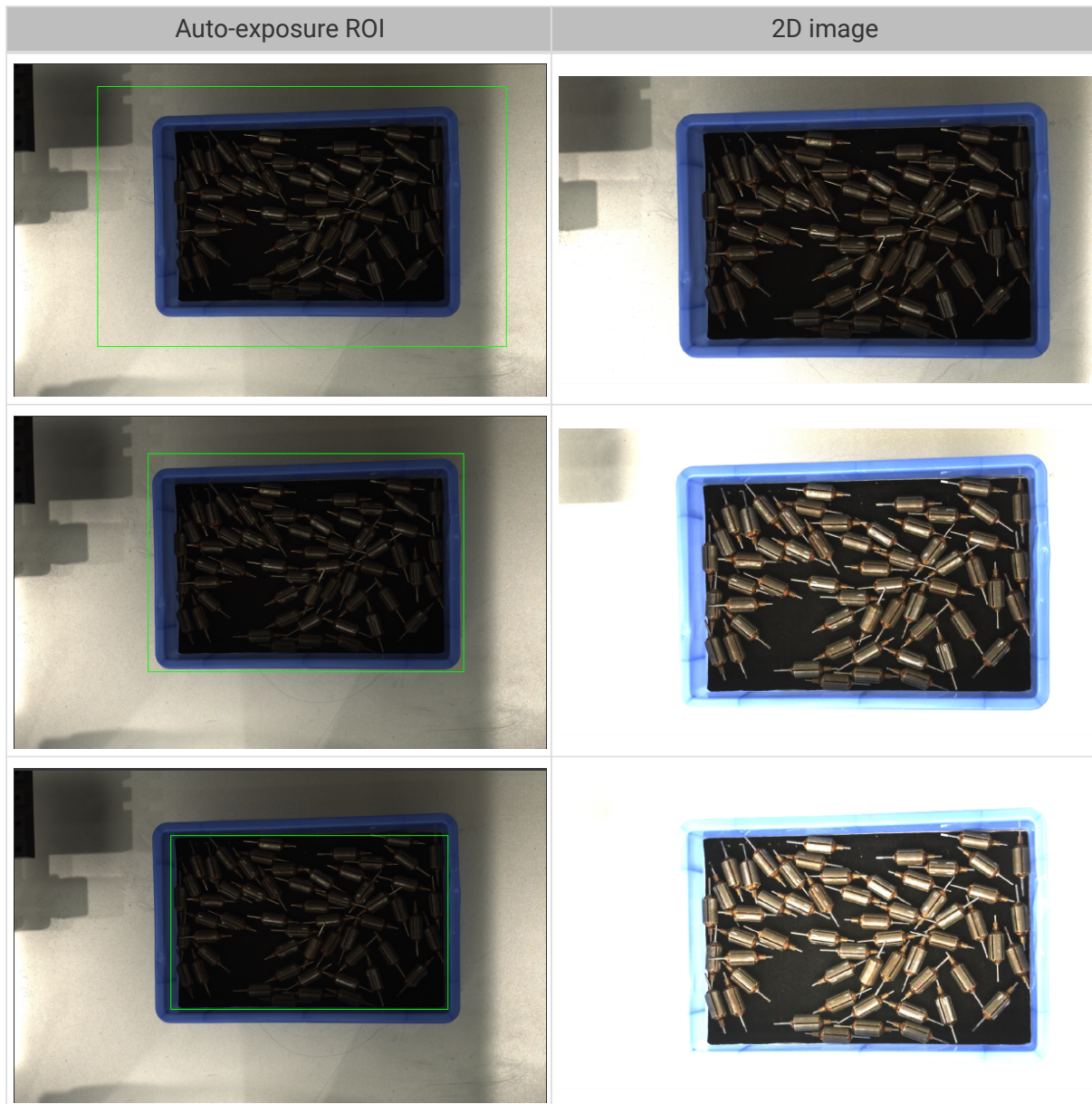
The **Gray Value** of a monochrome image is equivalent to the image brightness; the **Gray Value** of a color image is equivalent to the brightness of each color channel.

#### Auto: Auto-Exposure ROI

Parameter Description	<ul style="list-style-type: none"> <li>• The exposure time is automatically adjusted based on the lighting, object colors, etc., in the selected region.</li> <li>• When an auto-exposure ROI is not set, the exposure time is automatically adjusted based on the entire camera FOV.</li> </ul>
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set Auto-Exposure ROI</a> below.

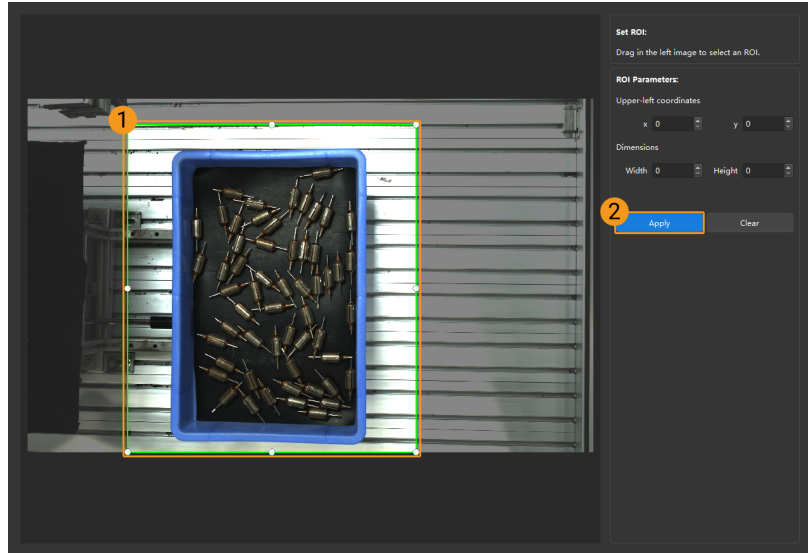
2D images obtained with different **Auto-Exposure ROI** values (all other conditions identical):





### Set Auto-Exposure ROI

1. Double-click [ **Edit** ] to the right of **Auto-Exposure ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set auto-exposure ROI.



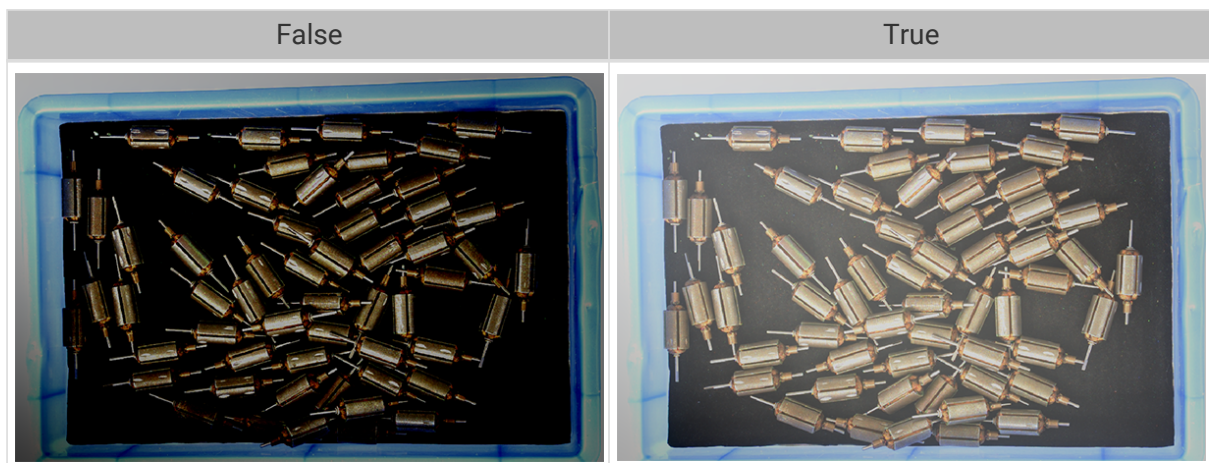
 Click [ Clear ] to remove the current auto-exposure ROI.

- Acquire data again and view the 2D image to check the result of automatic exposure adjustment.

#### HDR: Tone Mapping


Parameter Description	This function can make the image look more natural. If the 2D image appears very different from the actual objects, please enable this function.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• False (default)</li> <li>• True</li> </ul>
Instructions	Check to enable <b>Tone Mapping</b> .

2D images obtained with **Tone Mapping** disabled or enabled (all other conditions identical):

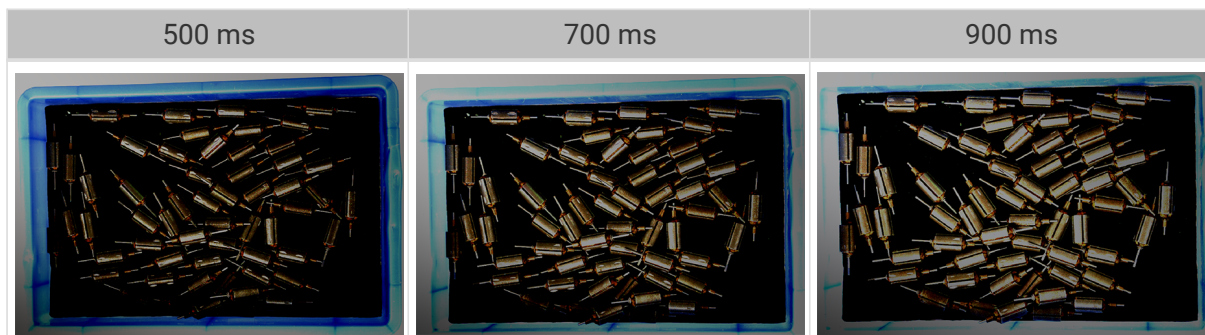




## HDR: Exposure Sequence

Parameter Description	Set multiple exposure times, and the captured images are merged to generate a 2D image that retains more details in the highlights and shadows.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	<ol style="list-style-type: none"> <li>1. Double-click [ <b>Edit</b> ] to the right of <b>Exposure Sequence</b> to open the editing window of the exposure sequence.</li> <li>2. Click [ <b>+</b> ] to add and set a new exposure time.</li> <li>3. To delete an exposure time, select it and click [ <b>-</b> ].</li> <li>4. After you finish adding the exposure times, click [ <b>Apply</b> ] to apply the exposure sequence.</li> </ol> <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="margin-right: 10px;">  </div> <ul style="list-style-type: none"> <li>◦ [ <b>Cancel</b> ]: do not save the current settings and exit this window.</li> <li>◦ [ <b>Reset</b> ]: clear all the exposure times.</li> </ul> </div>

2D images captured with single exposure times (all other conditions identical):




2D images captured with different exposure sequences consisting of the above exposure times (all other conditions identical):

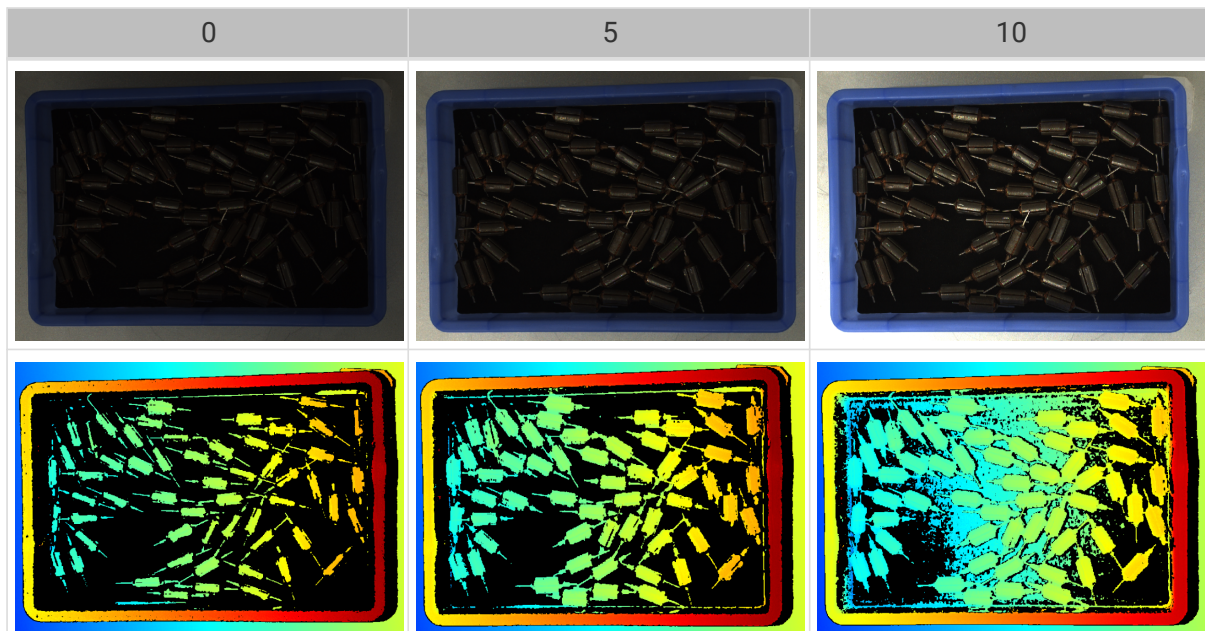


## 3D Parameters

### Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):






### Parameters for the Depth Map / Point Cloud

In the depth map and point cloud, the needed data should be complete.



Determine which part of the data is needed according to your actual needs. For example, if you need to pick metal bowls with opening facing up by the rim, usually you only need to make sure that the data of the bowl rims is complete.

Parameters in the following categories affect the quality of the depth map and point cloud.

Parameter category	Depth map	Point cloud
3D Parameters		
Point Cloud Processing		

Parameter category	Depth map	Point cloud
Depth Range	✔	✔
ROI	✔	✔

### 3D Parameters

The parameters in this category affect the images used for calculating depth data, thus affecting the quality of the depth map and point cloud.

Use **Exposure Assistant** can obtain the recommended exposure parameter values. Double-click [ **Auto Set** ] to the right of **3D Parameters** to open **Exposure Assistant**.

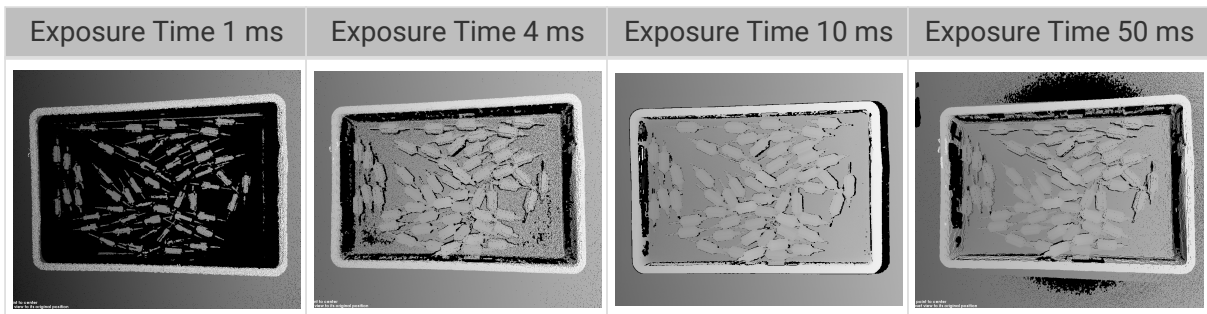
### Exposure Multiplier

<b>Parameter Description</b>	Set the number of <b>Exposure Time</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 1 to 3</li> <li>• Default value: 1</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• When the value of <b>Exposure Multiplier</b> is greater than 1, multiple <b>Exposure Time</b> parameters must be set.</li> <li>• All images captured with different exposure times are used for calculating depth. Using multiple exposure times can improve the completeness of depth data but also increases processing time.</li> <li>• With multiple exposure times, the amount of time for obtaining the depth map and point cloud increases. Please try to minimize the number of exposure times while ensuring the data quality.</li> </ul>

### Exposure Time

<b>Parameter Description</b>	Set the exposure time for acquiring depth information. The number of <b>Exposure Time</b> to be set depends on the value of <b>Exposure Multiplier</b> .
<b>Visibility</b>	Beginner, Expert, Guru
<b>Values</b>	<ul style="list-style-type: none"> <li>• Value range: 0.1 ms to 99 ms</li> </ul>
<b>Instructions</b>	<ul style="list-style-type: none"> <li>• Usually, long exposure time is used for dark objects, and short exposure time is used for light objects.</li> <li>• Exposure times too long or too short both lead to loss of depth information.</li> <li>• The exposure time of a laser camera must be a multiple of 4. If the entered value is not a multiple of 4, it will be automatically adjusted. The minimum value that can be set is 4 ms for the Laser series and 8 ms for other laser cameras.</li> </ul>

Point clouds obtained under different **Exposure Time** values (all other conditions identical):

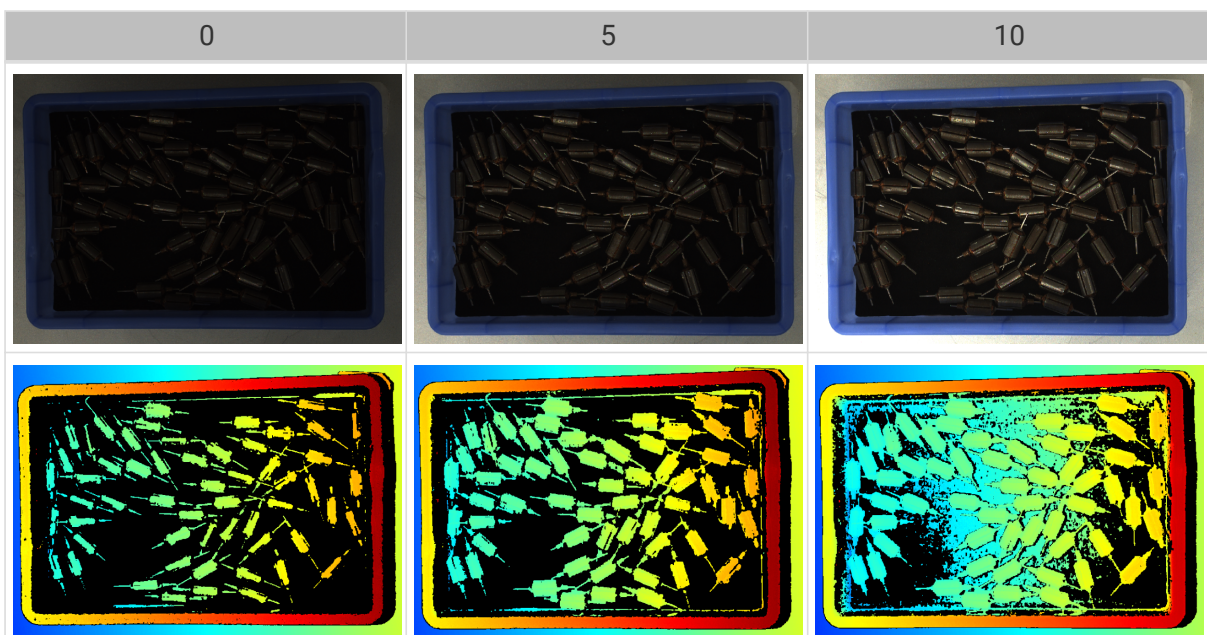


**i** The black regions lack depth information to generate corresponding point cloud.

## Gain

Parameter Description	<p>This parameter affects the brightness of the captured image. At the same time, more noise is introduced.</p> <p><b>i</b> This parameter affects the quality of the depth map and point cloud by changing the brightness of <a href="#">the images used for calculating depth data</a>.</p>
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 0 dB to 16 dB</li> <li>• Default value:                             <ul style="list-style-type: none"> <li>◦ DEEP series: 5</li> <li>◦ Other cameras: 0</li> </ul> </li> </ul>
Instructions	When the expected brightness cannot be reached by adjusting <b>Exposure Time</b> , adjust this parameter.

2D images and depth maps obtained with different **Gain** values (all other conditions identical):



## Projector

Available for: Nano (V3), Pro (V3) and Log (V3) series.



## Light Brightness

Parameter Description	This parameter affects the brightness of the projected structured light.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• High: high brightness, suitable for dark objects.</li> <li>• Normal (default): medium brightness, suitable for regular objects.</li> <li>• Low: low brightness, suitable for reflective objects.</li> </ul>
Instructions	Adjust this parameter based on the object type.

## Fringe Coding Mode

Available for: Nano (V3) and Pro XS (V3).

Parameter Description	Change the structured light patterns used, which affects the data acquisition speed and depth data quality.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Fast (default): faster data acquisition, but the quality of the depth map and point cloud is lower.</li> <li>• Accurate: slower data acquisition, but the quality of the depth map and point cloud is higher.</li> </ul>
Instructions	Adjust this parameter according to your actual needs for data quality and data acquisition speed.

Point clouds obtained with different **Fringe Coding Mode** values (all other conditions identical):



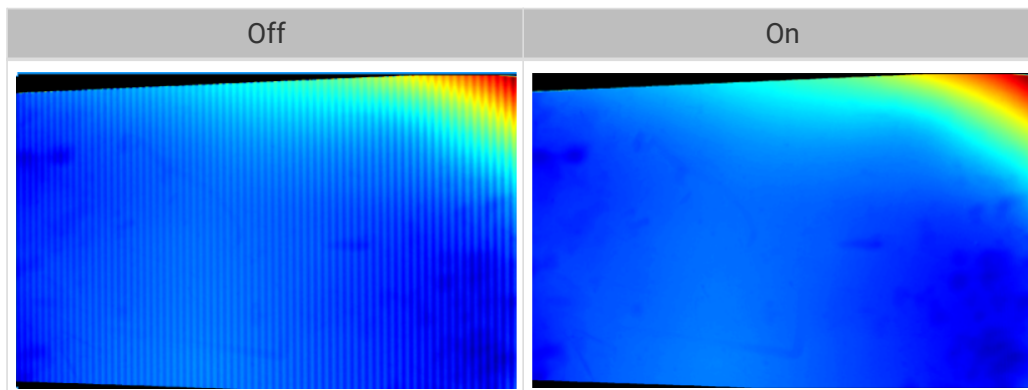
## Anti-Flicker Mode

Available for: Nano (V3).

Parameter Description	Flicker refers to the rapid and periodical change in the intensity of artificial light. This phenomenon can cause fluctuations in the depth data. Such fluctuations can be reduced by adjusting the projection frequency of the structured light.
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Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• AC50Hz</li> <li>• AC60Hz</li> </ul>
Instructions	Please select the option that corresponds to the frequency of the power supply in your location. The AC frequency in most countries is 50Hz. The AC frequency in the U.S. and some Asian countries is 60Hz.

Depth maps obtained with **Anti-Flicker Mode** off or on (all other conditions identical):



## Laser

Available for: Laser (V3) series.

## Fringe Coding Mode

Parameter Description	Change the structured light patterns used, which affects the data acquisition speed and depth data quality.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Fast (default): faster data acquisition, but the quality of the depth map and point cloud is lower.</li> <li>• Accurate: slower data acquisition, but the quality of the depth map and point cloud is higher.</li> </ul>
Instructions	Adjust this parameter according to your actual needs for data quality and data acquisition speed.

Point clouds obtained with different **Fringe Coding Mode** values (all other conditions identical):



### Laser Power

Parameter Description	Set the power of the laser projector, which affects the brightness of the projected structured light.
Visibility	Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Value range: 50% to 100%</li> <li>• Default value: 100%</li> </ul>
Instructions	<p>Usually, using the default value is sufficient.</p> <ul style="list-style-type: none"> <li>• Greater value results in higher structured light brightness; smaller value results in lower structured light brightness.</li> <li>• Greater values are suitable for dark objects, and smaller values are suitable for reflective objects.</li> </ul>

### Point Cloud Processing

Adjusting the parameters in the **Point Cloud Processing** category can improve the quality of the point cloud.

#### Principles for Adjusting Point Cloud Processing Parameters

When adjusting the **Point Cloud Processing** parameters, follow these principles to reduce the camera acquisition time and cycle time:

1. Adjust **Outlier Removal** first. The calculation time for different intensities of this parameter is about the same. Using a higher intensity will not add to the calculation time too much.
2. It is recommended to use low intensities of **Surface Smoothing** and **Noise Removal**. The higher the intensities of these two parameters, the longer the calculation time.

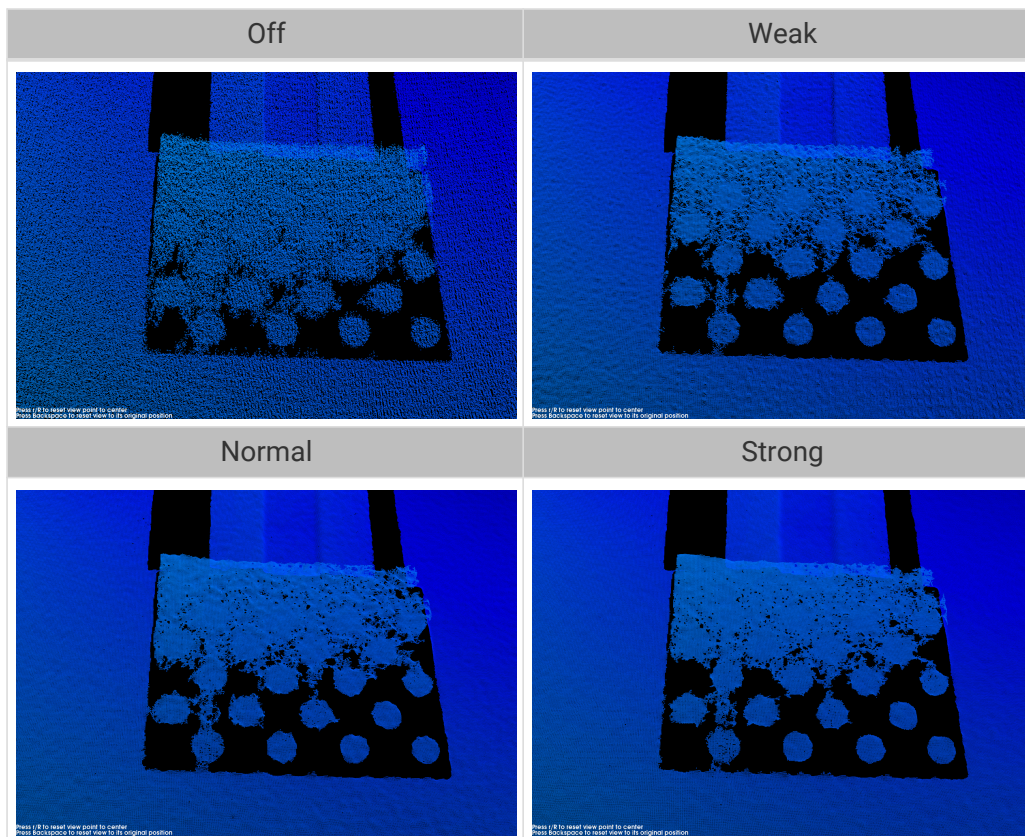
### Surface Smoothing

Parameter Description	This parameter reduces the depth fluctuation in the point cloud and improve its resemblance to the actual object surface.
Visibility	Beginner, Expert, Guru



Values	<ul style="list-style-type: none"> <li>• Off (default)</li> <li>• Weak</li> <li>• Normal</li> <li>• Strong</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Surface Smoothing</b> causes loss of object surface details. Higher intensity causes more object details to be lost. Lower intensity causes fewer object details to be lost.</li> <li>• Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Surface Smoothing** values (all other conditions identical):

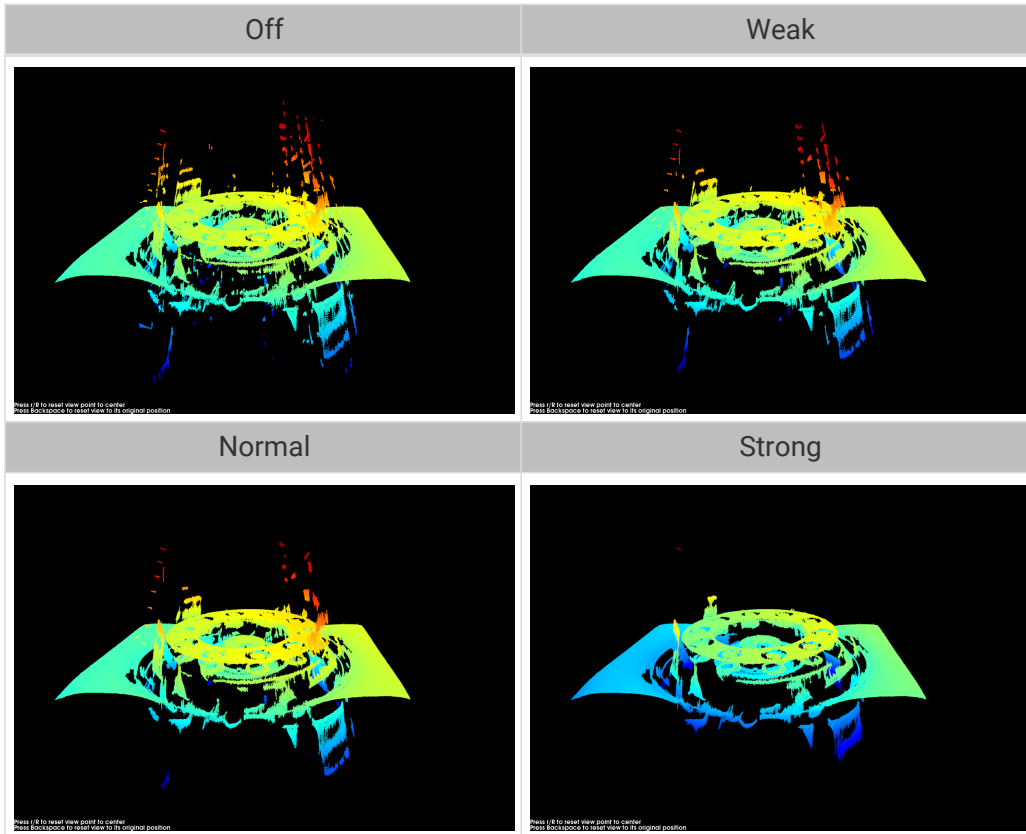


### Outlier Removal

Parameter Description	This parameter removes the outliers in the point cloud. Outliers are clustered points away from the object point cloud.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Off</li> <li>• Weak (default)</li> <li>• Normal</li> <li>• Strong</li> </ul>

Instruction s	<ul style="list-style-type: none"> <li>Higher intensity removes more outliers, and lower intensity removes fewer outliers.</li> <li>If the object point cloud contains multiple parts, high intensities of outlier removal might remove some parts. For example, if the object is a cup, outlier removal might remove the point cloud of the handle part.</li> </ul>
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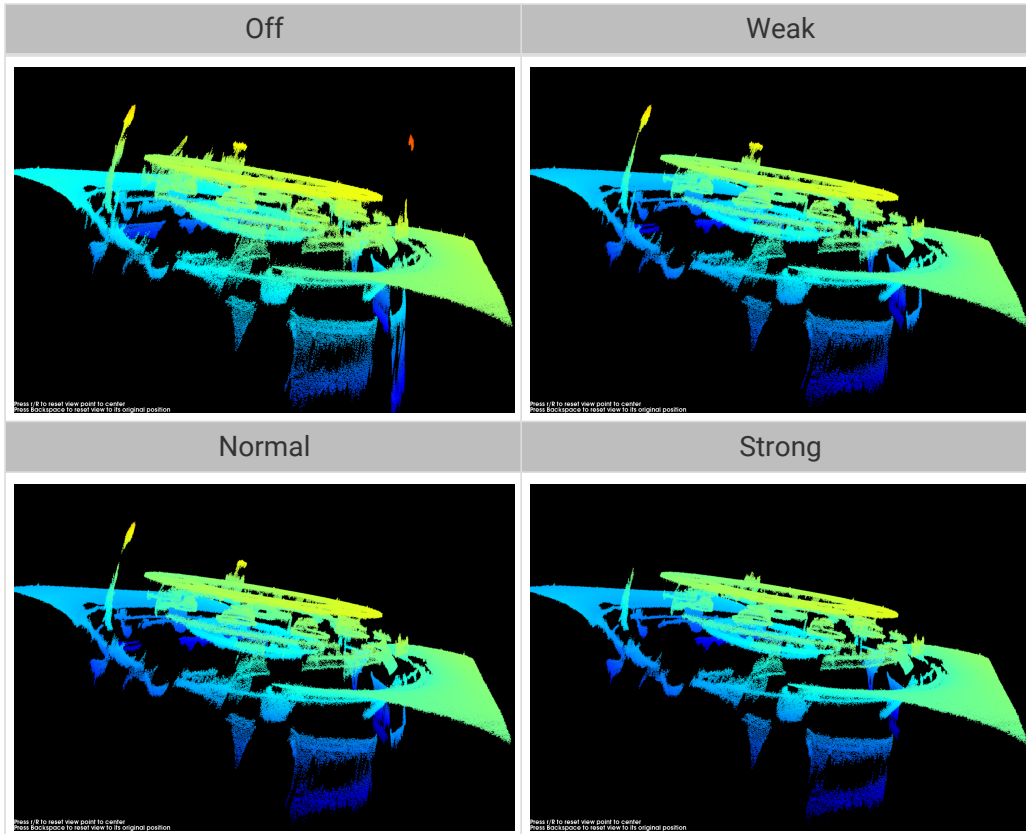
Point clouds obtained with different **Outlier Removal** values (all other conditions identical):



## Noise Removal

Parameter Description	This parameter removes the noise in the point cloud, thus reducing the impact on the precision and accuracy of subsequent calculation. Noise is the scattered points close to the object surface.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>Off</li> <li>Weak (default)</li> <li>Normal</li> <li>Strong</li> </ul>
Instruction s	<ul style="list-style-type: none"> <li>Higher intensity removes more noise but may also remove some object features. Lower intensity removes less noise but also preserves the object features better.</li> <li>Higher intensity results in slower calculation, and lower intensity results in faster calculation.</li> </ul>

Point clouds obtained with different **Noise Removal** values (all other conditions identical):



If this function removes the needed object features, please reduce the intensity. However, more noise will be retained.

## Edge Preservation

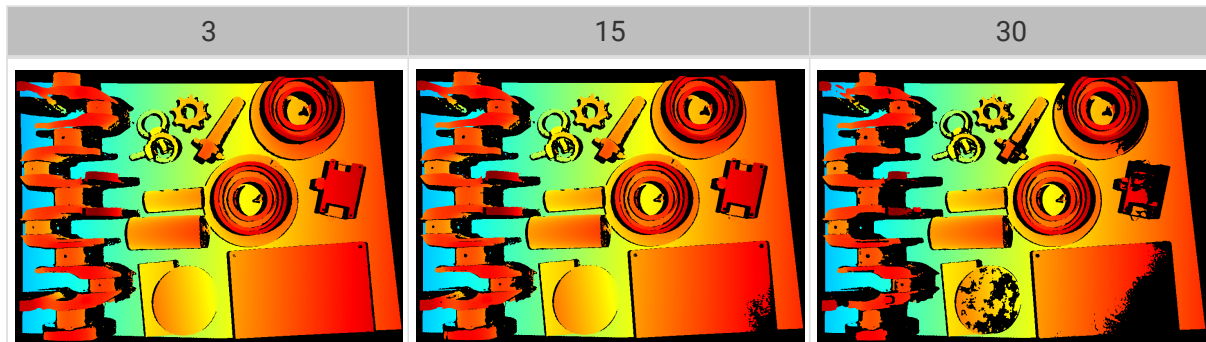
Parameter Description	This parameter preserves the sharpness of object edges during surface smoothing.
Visibility	Guru
Values	<ul style="list-style-type: none"> <li>• Sharp: Preserves the sharpness of object edges as much as possible. However, the effect of surface smoothing will be reduced.</li> <li>• Normal (default): Balances between edge preservation and surface smoothing.</li> <li>• Smooth: Does not preserve the edges. The object surface will be well smoothed, but the object edges will be distorted.</li> </ul>
Instructions	Adjust based on your needs for preserving the edges of workpieces.

## Stripe Contrast Threshold

Parameter Description	This parameter is used to remove noise in the point cloud. Adjust this parameter if the level of noise in the point cloud is still high after adjusting <b>Outlier Removal</b> and <b>Noise Removal</b> .
Visibility	Beginner, Expert, Guru

Values	<ul style="list-style-type: none"> <li>• Value range: 1 to 100</li> <li>• Default value: 3</li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• Greater value of this parameter results in more points being removed. Smaller value results in fewer points being removed.</li> <li>• Increase the value of this parameter can remove the noise in the point cloud, but may also cause the points of dark objects to be lost.</li> </ul>

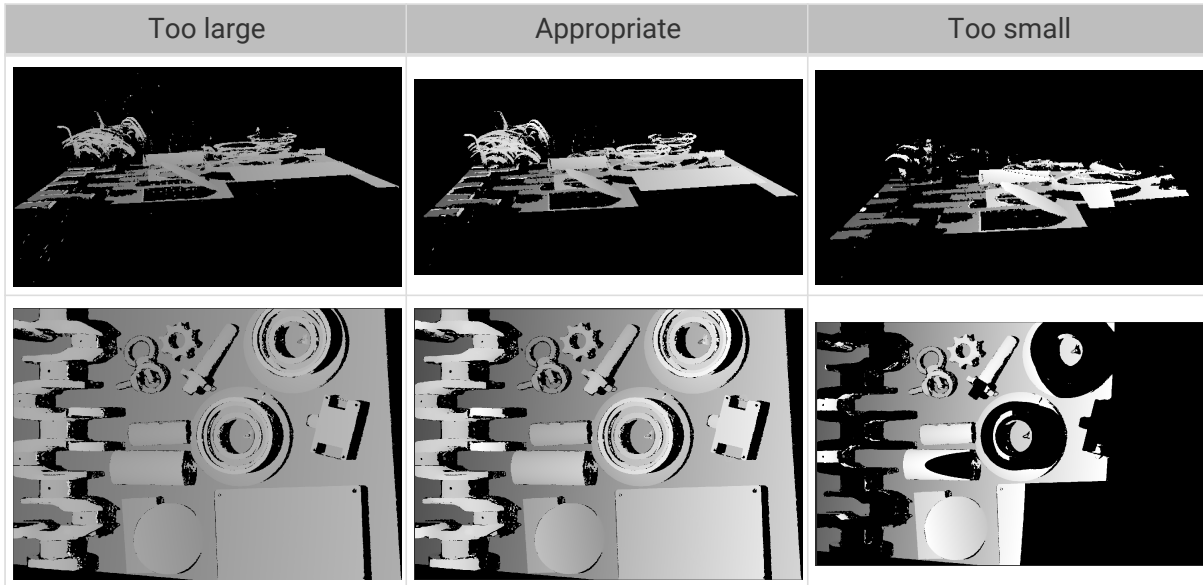
Point clouds obtained with different **Stripe Contrast Threshold** values (all other conditions identical):



### Depth Range

Parameter Description	Set a Z-direction ROI for the depth map and point cloud. <b>Depth Range</b> can be set within the camera working distance, and the data outside the range is removed from the depth map and point cloud.
Visibility	Beginner, Expert, Guru
Values	<ul style="list-style-type: none"> <li>• Depth Lower Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 4000 mm</li> <li>◦ Default value: 200 mm</li> </ul> </li> <li>• Depth Upper Limit:                             <ul style="list-style-type: none"> <li>◦ Value range: 1 mm to 5000 mm</li> <li>◦ Default value: 4000 mm</li> </ul> </li> </ul>
Instructions	<ul style="list-style-type: none"> <li>• <b>Depth Range</b> should be adjusted to an appropriate range to ensure the completeness of depth data in the depth map and point cloud. Too large a range may introduce interference, and too small a range may remove the data of key features.</li> <li>• For detailed instructions, please refer to <a href="#">Set Depth Range</a> below.</li> </ul>

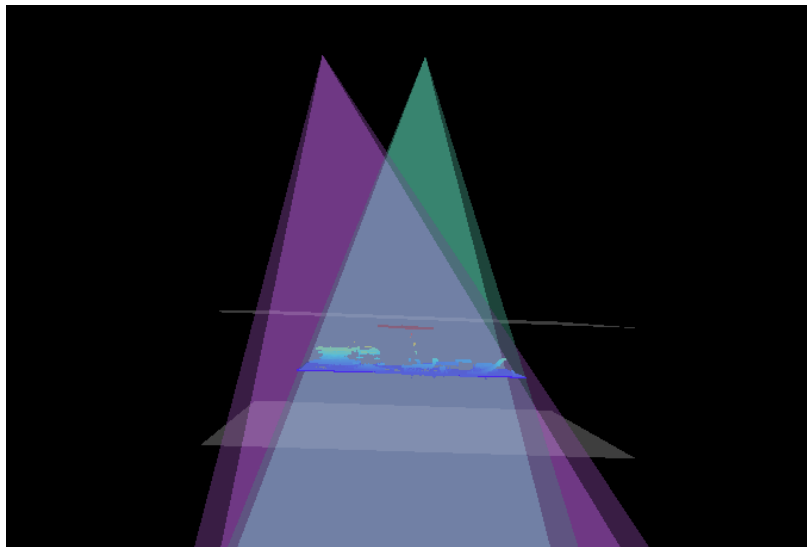
The same point cloud with different **Depth Range** values (all other conditions identical):



### Set Depth Range

Follow these steps to adjust Depth Range:

1. Double-click [ **Edit** ] to the right of **Depth Range** to open the **Set Depth Range** window.
2. Click [ **Refresh point cloud** ] at the top of the right panel to obtain the newest point cloud.
3. **Adjust the position of the point cloud**: adjust the position until you can see the two gray rectangles that represents the upper and lower limits of **Depth Range**.



4. Adjust the depth range: drag the handles on the slider to adjust **Depth Range** roughly. Then, enter specific values on the right to fine-tune **Depth Range**.



Judge if the depth range is appropriate: All needed object features are located between the two gray rectangles, and most noise and outliers are located outside.

5. Click [ **Save** ] to save the depth range settings.



- Click [ **Recommended range** ] to adjust **Depth Range** to the recommended working distance of the current camera.

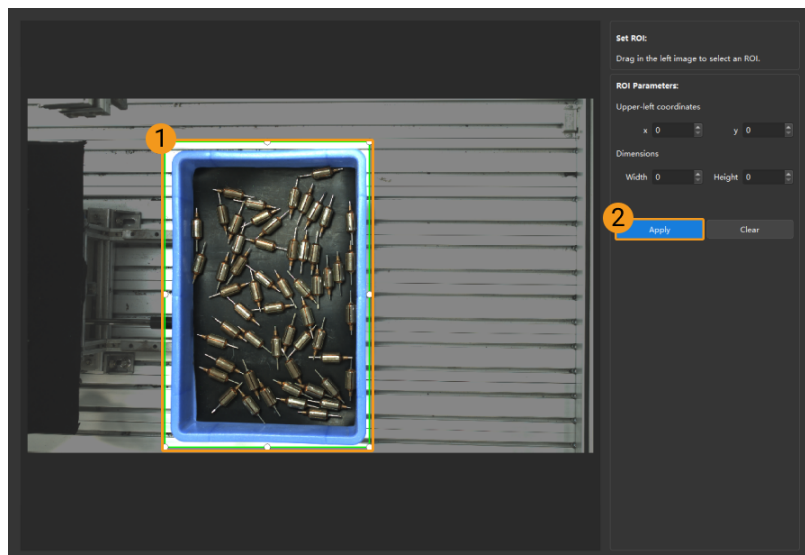
- Click [ **Reset** ] to restore **Depth Range** to the last saved values.

## ROI

Parameter Description	Set the ROI on the XY plane for the depth map and point cloud. Points outside the selected region are removed.
Visibility	Beginner, Expert, Guru
Values	N/A
Instructions	For detailed instructions, refer to <a href="#">Set ROI</a> below.

## Set ROI

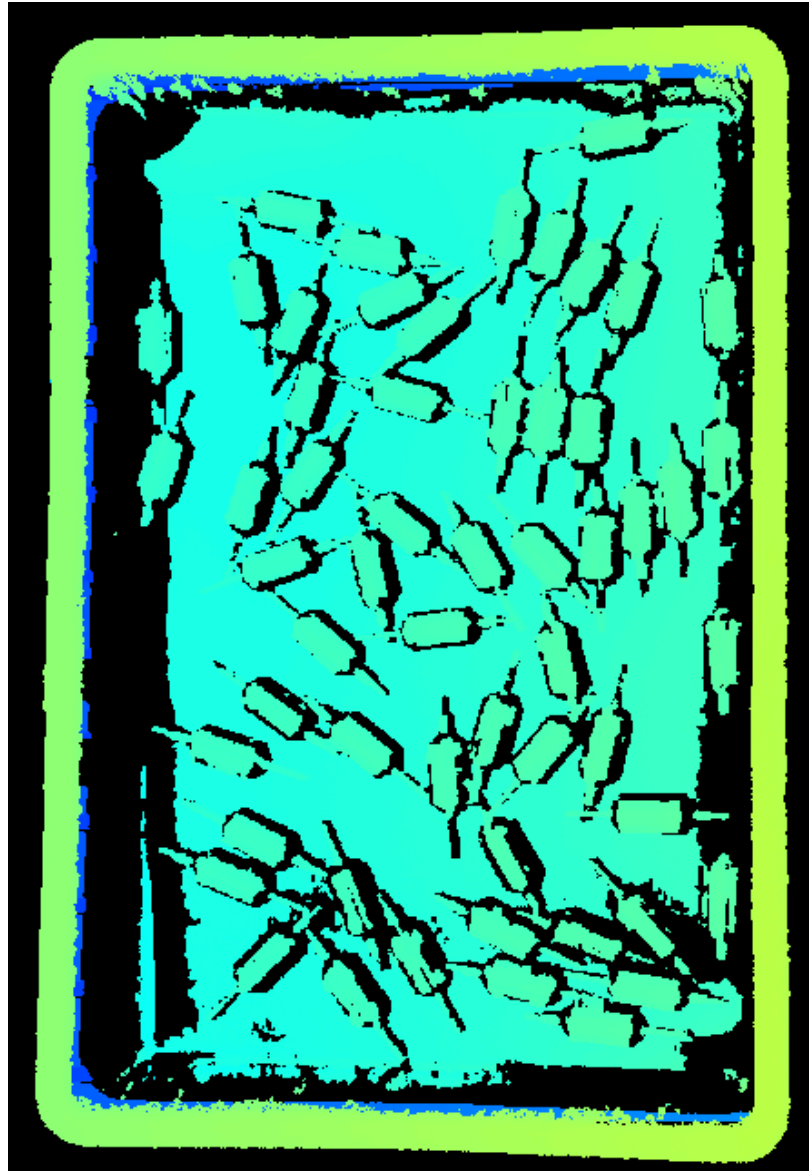
1. Double-click [ **Edit** ] to the right of **ROI** to open the **Set ROI** window.
2. Select and adjust the ROI on the left. Drag the selection box to move it. Drag the handles on the box to adjust the box size.
3. Click [ **Apply** ] to apply the set ROI.



- Click [ **Clear** ] to remove the current ROI.
- For the DEEP (V4) and LSR (V4) series, the 2D image (depth source) is displayed in this window. If the image is too dark or too bright, please adjust **2D Image (Depth Source) Exposure Mode**.

4. Acquire data again and view the depth map or point cloud to check the result of setting the ROI.





## 5.4. Tools

Mech-Eye Viewer provides a series of tools that facilitates you in using the camera. This topic introduces the functions and usages of the tools and provides detailed instructions.

Tool	Function
<a href="#">Intrinsic Parameter Tool</a>	Check if the camera intrinsic parameters are accurate, correct the intrinsic parameters, and reset to factory intrinsic parameters.
<a href="#">Exposure Assistant</a>	Obtain the recommended combination of exposure parameter values in <b>3D Parameters</b> .
<a href="#">Depth Analyzer</a>	Check the quality of the depth data.
<a href="#">Check and Configure 2D Cameras</a>	Check and configure the 2D cameras.
<a href="#">Camera Firmware Upgrade</a>	Update the camera firmware.

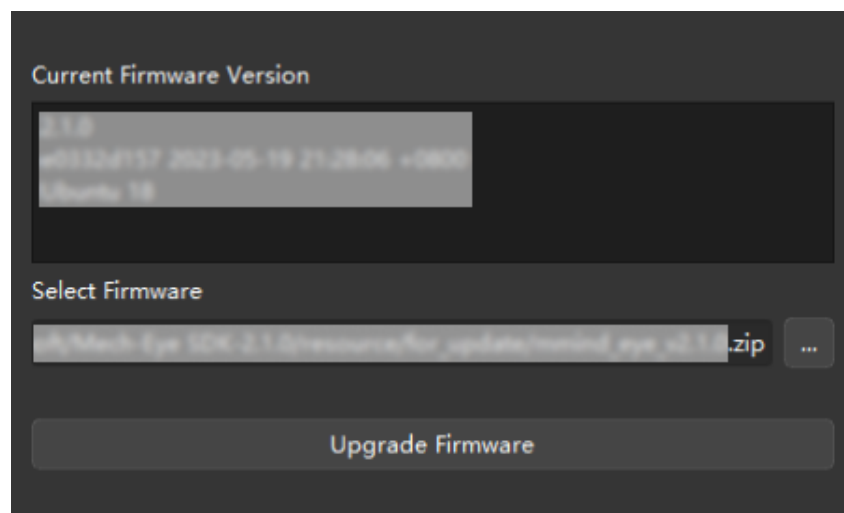
Tool	Function
FOV Calculator	Calculate camera FOV based on the working distance.
Custom Reference Frame	Define a custom reference frame used for displaying the depth map and point cloud.
Camera Controller	Check the project firmware version, time, and temperature of the camera and change the image resolution.
Full Pallet Simulator	Check if the top layer of a full load on a pallet is entirely located within the camera FOV.

Check the **Toolbar** option in the **View** menu to display the toolbar that provide quick access to the tools.

Click [**More Tools**] in the toolbar to select which tools to be displayed. Click [**OK**] to save the changes.


### 5.4.1. Camera Firmware Upgrade

The version of the camera firmware must be consistent with that of Mech-Eye Viewer for the camera to be connected in Mech-Eye Viewer. Follow these steps to upgrade the camera firmware.



1. Click Tool > Camera Firmware Upgrade to open **Camera Firmware Upgrade**.
2. (Optional): Select the firmware upgrade file: Usually, the file does not to be selected manually. For special situations, click [...] to the right of **Select Firmware** to select the firmware upgrade file.
3. Click [**Upgrade Firmware**], and then click [**Yes**] in the pop-up window to upgrade the firmware.
4. Click [**Yes**] in the pop-up window to restart the camera.



The camera restart may take several minutes. Please wait until it completes. Click  in the upper left to update the list.

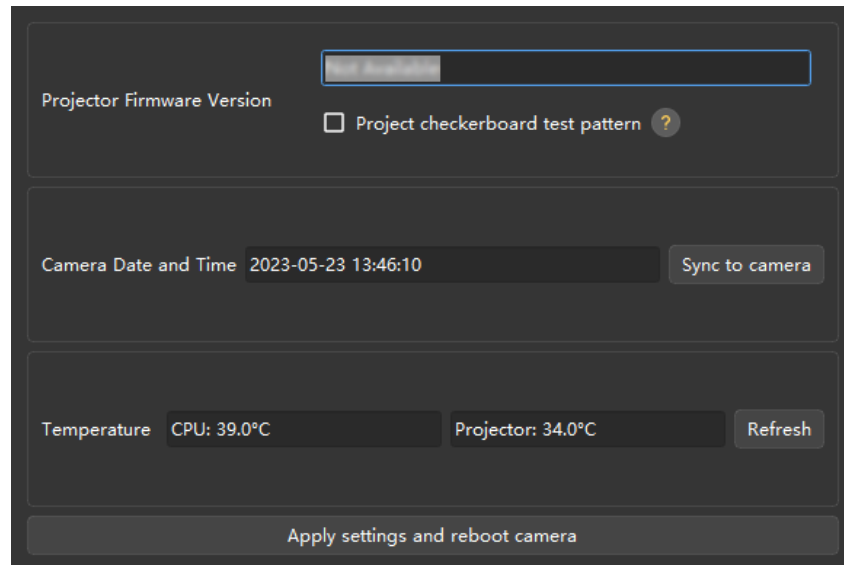
5. When the camera shows up in the list, and the firmware version displayed in its info card is the latest version, firmware upgrade is completed.

6. Click [ **Connect** ] to connect to this camera.

 If the upgrade failed, please retry. If the upgrade still fails, please contact Technical Support.


### 5.4.2. Camera Controller

This tool is used for checking the project firmware version, time, and temperature of the camera and change the image resolution.



#### Check Camera Information

You can check the following information in **Camera Controller**.

- Projector firmware version: the projector firmware version of the currently connected camera.
  - Project chessboard test pattern: Check this option to project a chessboard pattern used for checking the connection and focus of the projector.
    -  This option is only available for DLP cameras.
      - If the pattern is successfully projected, the project is connected.
      - If the pattern is clear and not blurry, the projector is in focus.
      - If the pattern is not projected or is blurry, please contact Technical Support.
- Camera Date and Time: the date and time stored in the camera.
  - Click [ **Sync to camera** ] to sync the computer's date and time to the camera.
- Temperature: the temperatures of the CPU and projector.

Click [ **Refresh** ] to obtain the latest temperature data.

#### Change Image Resolution

 This function is available in the **Administrator** account.


The resolution of the 2D image or depth map is adjustable for some camera models. Using the lower resolution can speed up data acquisition effectively and thus better cope with applications with short cycle time.

- LSR (V4) series: The resolution of the 2D image can be either 4000 × 3000 or 2000 × 1500.
- DEEP (V4) series: The resolution of the depth map can be either 2048 × 1536 or 1024 × 768.

Please follow these steps to change the image resolution of the camera:

1. Switch to the **Administrator** account and open **Camera Controller**.
2. In the **Resolution** section, select the needed resolution from the drop-down menu of **2D image** or **Depth map**.
3. Click [ **Apply settings and reboot camera** ] at the bottom, and then click [ **Yes** ] in the pop-up window to restart the camera.



The camera restart may take several minutes. Please wait until it completes. Click  in the upper left to update the list.

4. After the camera is displayed in the list again, connect to the camera. The 2D image or depth map that you acquire now will have the selected resolution.

### 5.4.3. Intrinsic Parameter Tool

This tool is used to check if the camera intrinsic parameters are accurate, to correct the intrinsic parameters, and to reset to factory intrinsic parameters. The coordinates of points are accurate only if the intrinsic parameters are accurate.



For projects with high accuracy requirements, you can enable the high-accuracy mode, in which stricter standards are used to check the intrinsic parameters. High-accuracy mode is available in the **Administrator** account. If needed, please contact Technical Support.

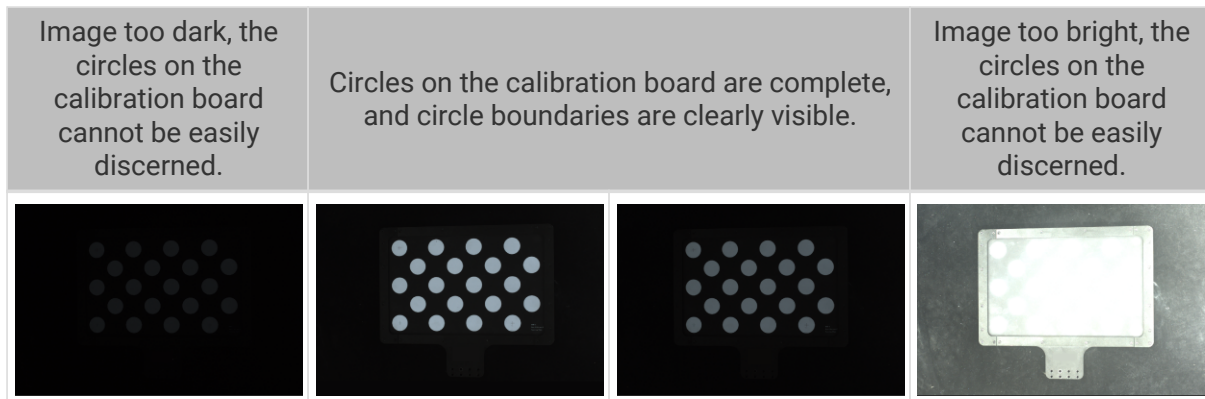
#### Preparation

Before checking the intrinsic parameters, please prepare the calibration board that came with the camera.

Place the calibration board within the camera FOV and obtain the 2D image and depth map of the calibration board. Make sure the obtained 2D image and depth map satisfy the following requirements:

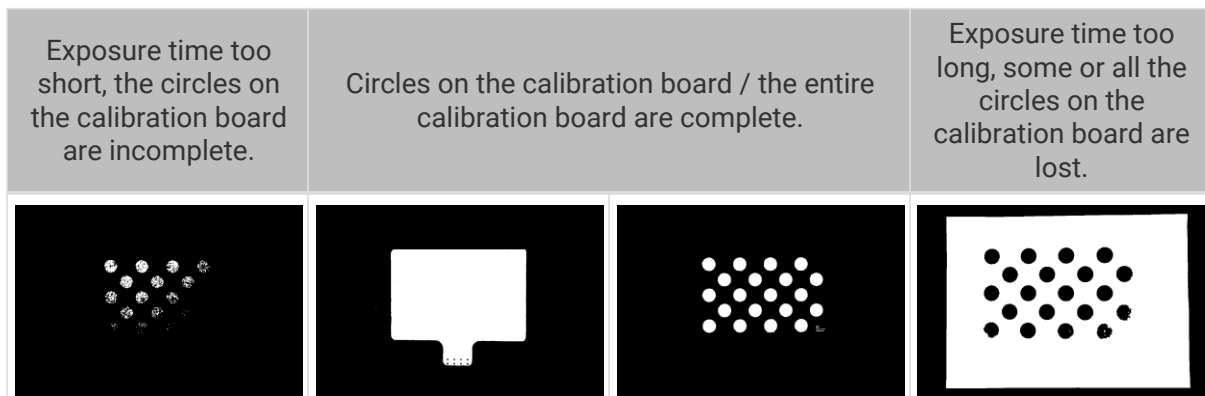
- The region containing the circles on the calibration board is completely captured.
- The 2D image is not too bright or too dark, and the circles on the calibration board are clear and complete.
- The circles on the calibration board in the depth map are complete.

Examples of 2D images of the calibration board:



If the obtained 2D image does not satisfy the requirements, please adjust the [parameters for the 2D image](#).

Examples of depth maps of the calibration board:



If the obtained depth map does not satisfy the requirements, please adjust the [parameters for the depth map](#).

### Check Intrinsic Parameters

Click the **Tool** menu in the menu bar and select **Intrinsic Parameter Tool** to open the **Intrinsic Parameter Tool** window.

To use **Intrinsic Parameter Tool** to check the camera intrinsic parameters, please follow these steps.

1. In **1. Place calibration board and check image quality**, click [ **Acquire images** ] to obtain the 2D image and depth map of the calibration board. Check if the images satisfy the requirements.
2. In **2. Select model of placed calibration board**, set the specifications of the calibration board:
  - If using a standard calibration board, select the model from the drop-down menu.
  - If using a customized calibration board, select **Customized** first, and then set the model, rows, columns and spacing according to the information provided by the engineer.
3. In **3. Check intrinsic parameters**, click [ **Check intrinsic parameters** ] to start checking the camera intrinsic parameters. When the check is completed, a window of the check results will pop up.
  - If the check results are displayed in green, then the check is passed, and the camera functions properly.

- If the check results are displayed in red, or an error message is displayed, then the errors in the intrinsic parameters are large, or the check has failed. Please troubleshoot according to the instructions in the window.



For projects with high accuracy requirements, you can use the **high-accuracy mode**: switch to the **Administrator** account, in **Intrinsic Parameter Tool**, check **High-accuracy mode** in **3. Check intrinsic parameters**, and place the calibration board according to the displayed distance. If the calibration board is not placed at the designated distance, the intrinsic parameter check may fail.

## Troubleshoot Common Problems

The following issues may be encountered while checking the intrinsic parameters.

### Errors in the Intrinsic Parameters Are Large

#### Symptom:

The intrinsic parameter check results are displayed in red, indicating that the errors in the intrinsic parameters are large.

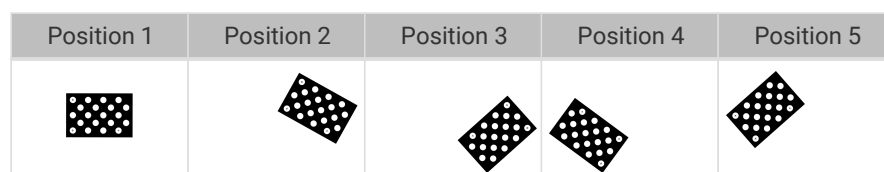
#### Solution:

Please try the following solutions:

1. Check if the calibration board specifications are correct.
  - If incorrect, enter the correct specifications. Then, check the intrinsic parameters again.
  - If correct, proceed to the next step.
2. Check if the 2D image and depth map meet the image requirements. Please refer to the [image requirements](#).
  - If the 2D image does not satisfy the requirements, please adjust the [parameters for the 2D image](#). If the depth map does not satisfy the requirements, please adjust the [parameters for the depth map](#). Then, check the intrinsic parameters again.
  - If the images satisfy the requirements, proceed to the next step.
3. Use the **Correct intrinsic parameters** function to correct the intrinsic parameters. Please follow these steps:
  - a. Place the calibration board within the camera FOV.
  - b. Check the **Correct Intrinsic Parameters** option, and then click [ **Acquire data** ].
  - c. Move the calibration board, and click [ **Acquire data** ] again.



- Please add at least 3 sets of data.
- When moving the calibration board, make sure the orientation of the board is changed along with the position. The recommended positions are the center and four corners of the FOV, as shown below.



- d. After adding the data, click [ **Correct intrinsic parameters** ]. When the correction is



completed, a window of the correction results will pop up.

- If the correction succeeded, click [ **Check intrinsic parameters** ] in this window to check the intrinsic parameters again.
- If the correction failed, click [ **Confirm** ] in this window, and retry the correction or contact Technical Support.

## Circles on the Calibration Board not Detected


### Symptom:

The intrinsic parameter check result window displays this message: **Circles on the calibration board not detected.**

### Solution:

Please try the following solutions:

1. Check if the calibration board specifications are correct.
  - If incorrect, enter the correct specifications. Then, check the intrinsic parameters again.
  - If correct, proceed to the next step.
2. Check if the 2D image and depth map meet the image requirements. Please refer to the [image requirements](#).
  - If the 2D image does not satisfy the requirements, please adjust the [parameters for the 2D image](#). If the depth map does not satisfy the requirements, please adjust the [parameters for the depth map](#). Then, check the intrinsic parameters again.
  - If the images satisfy the requirements, proceed to the next step.
3. Use the **Draw aid circle** to facilitate the detection. Please follow these steps:
  - a. In **3. Check Intrinsic Parameters**, click [ **Draw aid circle** ].
  - b. Find a complete circle on the calibration board in the 2D image. Click while holding the **Ctrl** key and then move diagonally up or down to adjust the size of the aid circle. Click again to finish drawing the aid circle.
 


    - Only one aid circle can be drawn. The aid circle should be as close possible to the boundary of the circle on the calibration board.
    - If you need to re-draw the aid circle, click [ **Draw aid circle** ] again.
    - To zoom the 2D image, move the cursor onto the 2D image and scroll the mouse wheel.
  - c. In **3. Check Intrinsic Parameters**, click [ **Check intrinsic parameters** ] to check the intrinsic parameters again.
    - If the check succeeded, the troubleshooting has been completed.
    - If the intrinsic parameter check result window still displays **Circles on the calibration board not detected**, proceed to the next step.
4. Use the **Edit Feature Detection Parameters** function to facilitate the detection. Please follow these steps:
  - a. In **3. Check Intrinsic Parameters**, click **Edit Feature Detection Parameters (Advanced)**.
  - b. Adjust the displayed feature detection parameters according to the actual situation.

- c. If not all the circles on the calibration board can be captured, check **Allow absence of some circles**, and adjust the newly displayed feature detection parameters.
- d. In **3. Check Intrinsic Parameters**, click [ **Check intrinsic parameters** ] to check the intrinsic parameters again.
  - If the check succeeded, the troubleshooting has been completed.
  - If the intrinsic parameter check result window still displays **Circles on the calibration board not detected**, please contact Technical Support.

### Valid Feature Points Not Found in Depth Map

#### Symptom:

The intrinsic parameter check result window displays this message: **Valid feature points not found in depth map.**

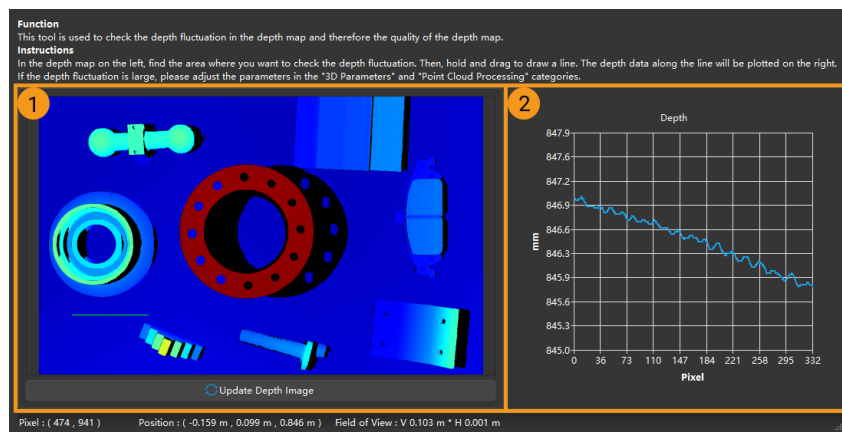
#### Solution:

Check if the depth map satisfies the requirements. Please refer to the [image requirements](#).

- If the depth map does not satisfy the requirements, please adjust the [parameters for the depth map](#). Then, check the intrinsic parameters again.
- If the depth map satisfies the requirements, please contact Technical Support.

### 5.4.4. Depth Analyzer

This tool is used to check the depth fluctuation in the depth map and therefore the quality of the depth map.



Follow these steps to check the depth fluctuation in the depth map:

1. Click Tools > Depth Analyzer to open **Depth Analyzer**.
2. In the depth map on the left (① in the above figure), find the area where you want to check the depth fluctuation.
3. Hold the left mouse button and drag to draw a line. The depth data along the line will be plotted on the right (② in the above figure).
4. Check the fluctuation of the depth values in the plot:
  - If the fluctuation is small compared to the actual depth of the scene, then the quality of the

depth data is good.

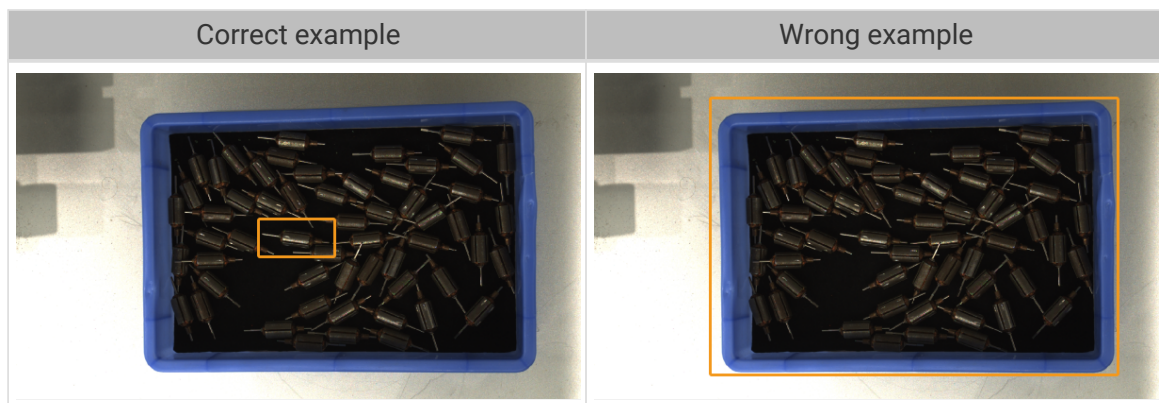
- If the fluctuation is large compared to the actual depth of the scene, then the quality of the depth data is poor. Please adjust the parameters in the **3D Parameters** and **Point Cloud Processing** categories to improve the quality of the depth data.

#### 5.4.5. Exposure Assistant

This tool is used for obtaining the recommended values for the **Exposure Multiplier** and **Exposure Time** parameters in the **3D Parameters** category.

Follow these steps to obtain the recommended values for the **Exposure Multiplier** and **Exposure Time** parameters:

1. Double-click [ **Auto Set** ] to the right of **3D Parameters** in the parameter panel, or click Tools > Exposure Assistant, to open **Exposure Assistant**.
2. In the **Point Cloud Scanning** page, click [ **Scan Once** ] in the lower right to acquire data, and then click [ **Next Step** ] after the data is successfully acquired.
3. In the **Set ROI** page, adjust the ROI, and try to ensure that only one target object is included in the ROI. Drag the selection box to move it. Drag the handles on the box to adjust the box size. Then, click [ **Next Step** ] to apply the ROI.



4. In the **Auto Exposure** page, click [ **Start** ] to start calculating the parameter values. The calculated exposure times are displayed in **Result**.
5. Click [ **Finish** ], and a **Confirm** window will pop up. If you want to apply the calculation result directly to the **3D Parameters** category, click [ **Yes** ] in the pop-up window.

#### 5.4.6. FOV Calculator

This tool is used for helping determine the mounting height of the camera based on your needs for camera FOV. Based on the entered working distance, this tool calculates the FOV height and width at this distance for the camera.

The calculation result is for reference only.

#### Calculate Camera FOV

Please follow these steps calculate the camera FOV:

1. Select the camera model in **Select camera model**.



If the model in use is not listed in the drop-down menu, click **Other models** at the bottom of the menu to view more models.

2. Enter the working distance in the **Enter working distance** field. The **FOV height** and **FOV width** are calculated based on the entered working distance. If the calculated FOV does not meet your needs, proceed to the next step.



- The range of the working distance is the recommended working distance of the selected camera model. Refer to [Camera Working Distance](#).
- The entered working distance must be within the above range. Otherwise, the entered value will be automatically adjusted.

3. Click the arrow buttons to the right or scroll the mouse wheel to adjust the working distance, until the calculated FOV meets your needs. Use this working distance to estimate the appropriate mounting height of the camera.

### Camera Working Distance

The following table lists the default values and ranges of camera working distances (unit: m).

Camera model	Working distance	
	Default value	Value range
DEEP	3	1.2–3.5
LSR L	2.5	1.2–3
LSR S	1	0.5–1.5
Log M	2	0.8–2
Log S	1	0.5–1
NANO	0.5	0.3–0.6
PRO M	2	1–2
PRO S	1	0.5–1
PRO XS	0.5	0.3–0.6
UHP-140	0.3	0.28–0.32
Deep	3	1.2–3.5
Laser L	2.5	1.5–3
Laser L Enhanced	2.5	1.5–3
Pro M Enhanced	2	0.8–2
Pro S Enhanced	1	0.5–1

#### 5.4.7. Full Pallet Simulator

This tool is used for checking if the top layer of a full load on a pallet is entirely located within the camera FOV. The camera mounting height can be adjusted according to the result.



- This tool can only be used for applications where the camera is mounted perpendicularly above the pallet.
- The displayed result is for reference only.

## Preparation

Before using **Full Pallet Simulator**, please complete the following preparation:

- Check the dimensions of the full load.
- Check if any limitations on the camera mounting location exist, such as the maximum mounting height allowed.
- Prepare and place the pallet within the camera FOV, acquire the point cloud of the pallet, and check the point cloud quality.
- Adjust the position of the pallet so that the edges of the pallet point cloud are parallel to the sides of the camera FOV.
- Set an [ROI](#) to retain only the point cloud of the pallet.

## Instructions

1. Click Tools > Full Pallet Simulator to open **Full Pallet Simulator**.
2. [Adjust the position of the point cloud](#) until you can see the entire point cloud from the side.
3. Click [ **Create cuboid** ] to add a cuboid that represents the full load.



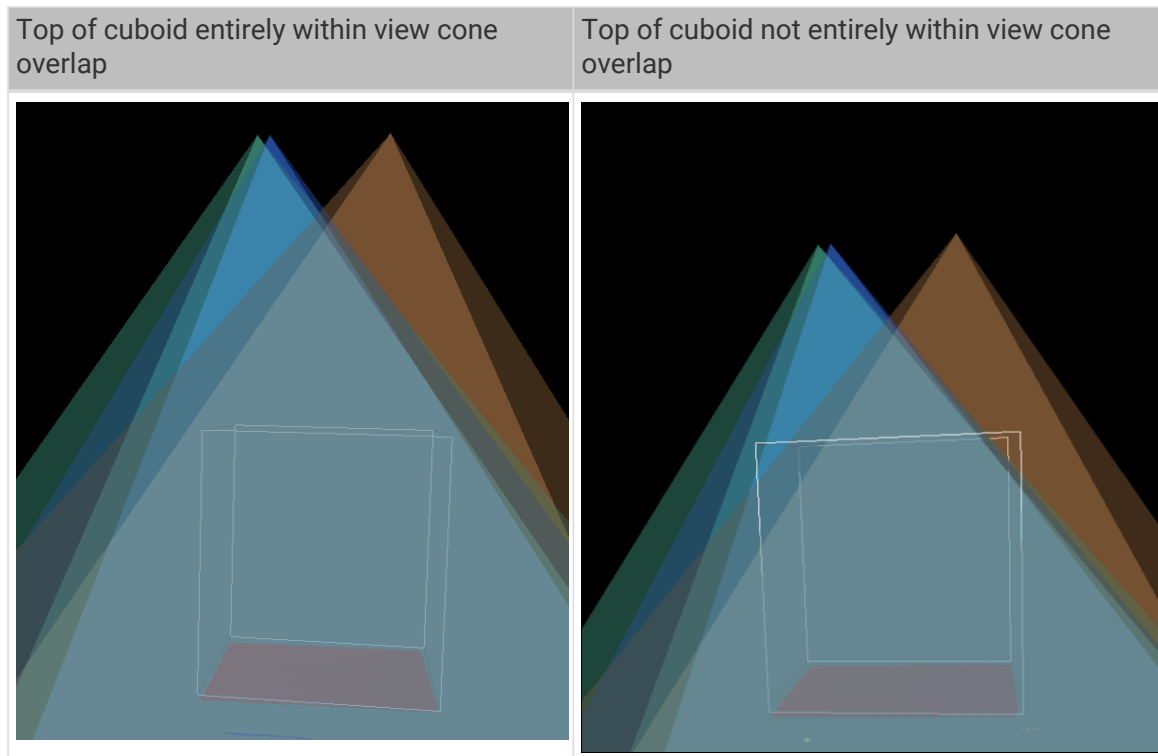
The cuboid cannot be rotated. If the edges of the cuboid and those of the pallet point cloud are not aligned, please exit **Full Pallet Simulator**, adjust the position of the pallet, and acquire data again.

4. In **Cuboid Dimensions**, enter the actual dimensions of the full load.
5. (Optional) Adjust the position of the cuboid: if the bottom of the cuboid is not on the pallet point cloud, please adjust the **z** value in **Center of Cuboid Bottom**, until the cuboid bottom is on the pallet point cloud.



Please record the amount of **z** adjustment made.


6. Rotate the point cloud and check if the top of the cuboid is confined to the space where the view cones overlap. Use the examples below as a reference.




#### 7. Evaluate camera mounting height:

- If the top of the cuboid is entirely confined to the view cone overlap, the camera mounting height is appropriate.
- If the top of the cuboid is not entirely confined to the view cone overlap, the camera is mounted too low. Please proceed to the next step.

#### 8. Increase the **z** value in **Center of Cuboid Bottom**, until the top of the cuboid is entirely confined to the view cone overlap.


 Please record the amount of **z** adjustment made.

#### 9. Calculate the amount of adjustment for the camera mounting height: the camera mounting height should be raised by (the **z** adjustment in step 8 - the **z** adjustment in step 5).

 Modifications in **Full Pallet Simulator** are not saved. Please make sure you recorded the **z** adjustments.

### 5.4.8. Custom Reference Frame

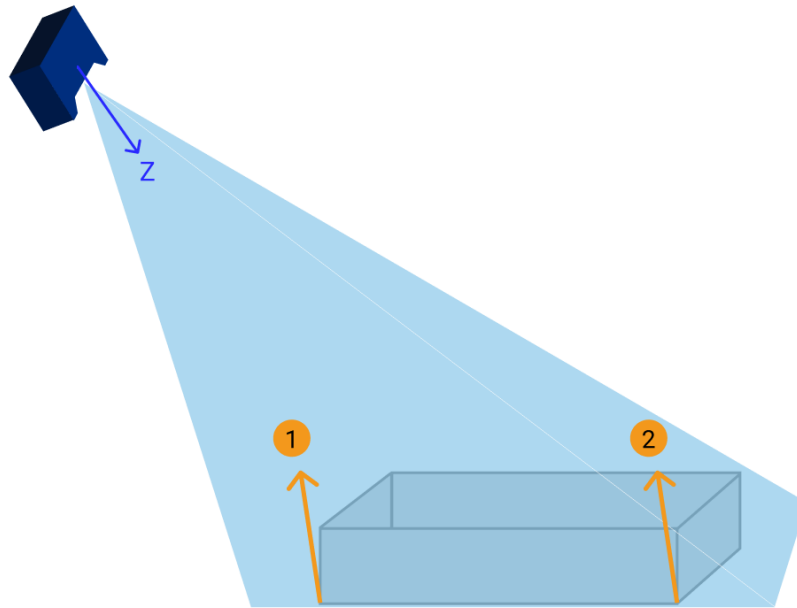
This tool is used to define a custom reference frame for display. The depth map and point cloud can be displayed in the custom reference frame.

 The custom reference frame only affects the display in Mech-Eye Viewer and does not affect the actual data in the depth map and point cloud.

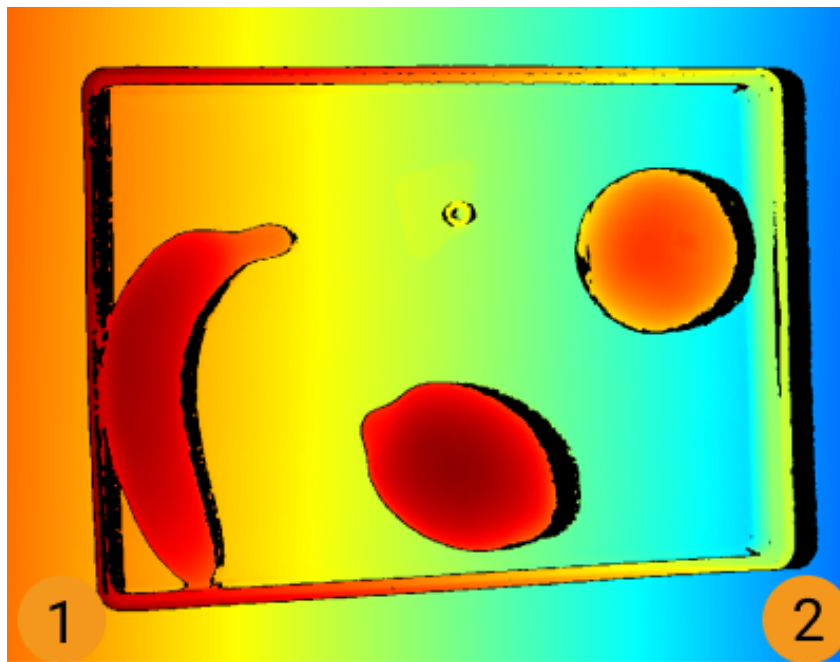
#### Suitable Scenarios

A custom reference frame is suited for scenarios where the camera is not mounted directly above the target object, as shown below.

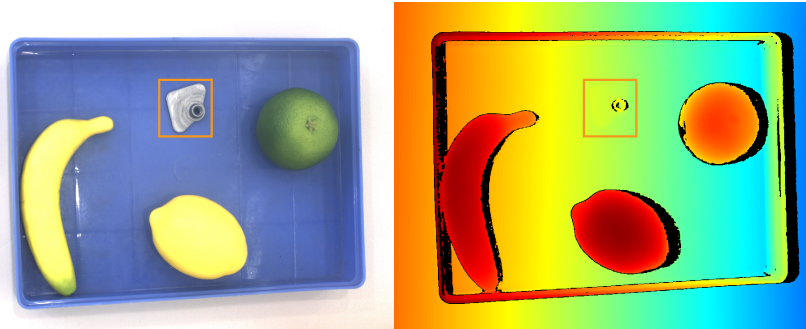




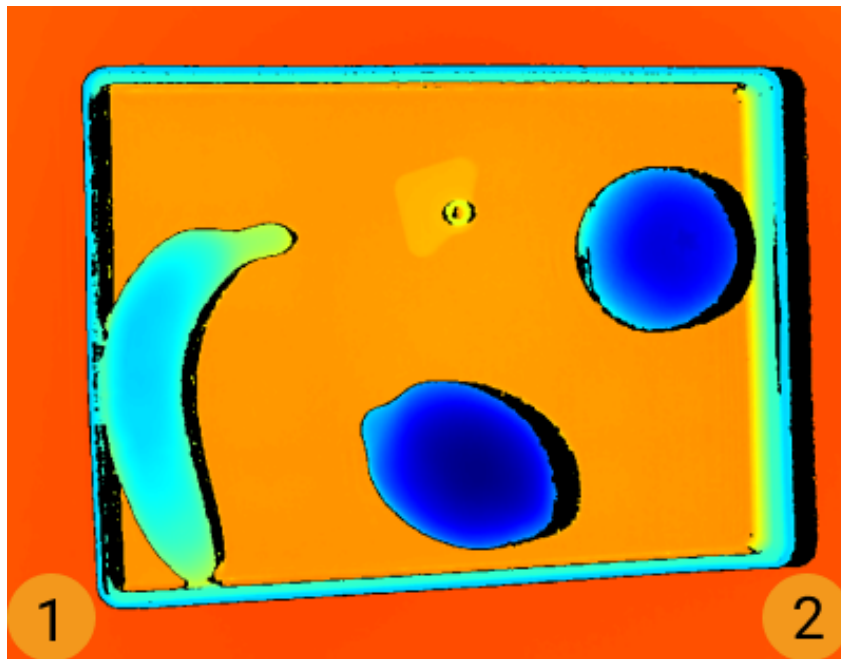
In the above figure, Points ① and ② are at the same height in the eye of an observer. However, since the Z-axis of the camera reference frame is not perpendicular to the plane where the target object is located, the depth values of the two points differ in the obtained depth map and point cloud.



In addition, in the camera reference frame, the thickness of a flat, thin object is “subsumed” by the depth change of the surface where the object is located, making it difficult to observe the object itself.



By defining a custom reference frame, you can adjust the display of the depth map and point cloud, making the depth values of points ① and ② the same and the thin target object easily observable, as shown below.



## Instructions

Follow these steps to define a custom reference frame:

1. [Adjust the position of the point cloud](#) and find the surface to be used as the XY-plane of the custom reference frame.
2. Hold the **Shift** key and click on the point cloud to select 3 points. The 3 points serve the following functions:
  - The first point is the origin of the reference frame.
  - The second point determines the positive direction of the X-axis.
  - The third point determines the positive direction of the Y-axis.
3. After the 3 points are selected, the reference frame is generated according to the right-hand rule. Rotate and zoom the point cloud to check if the reference frame meets your needs:
  - Check if the three points are located on the same surface.
  - Check if the orientation of the Z-axis is correct.


If not, Click [ **Reset** ] in the lower right, and then repeat step 2.

4. Click [ **OK** ] to save the custom reference frame.

### Use the Custom Reference Frame

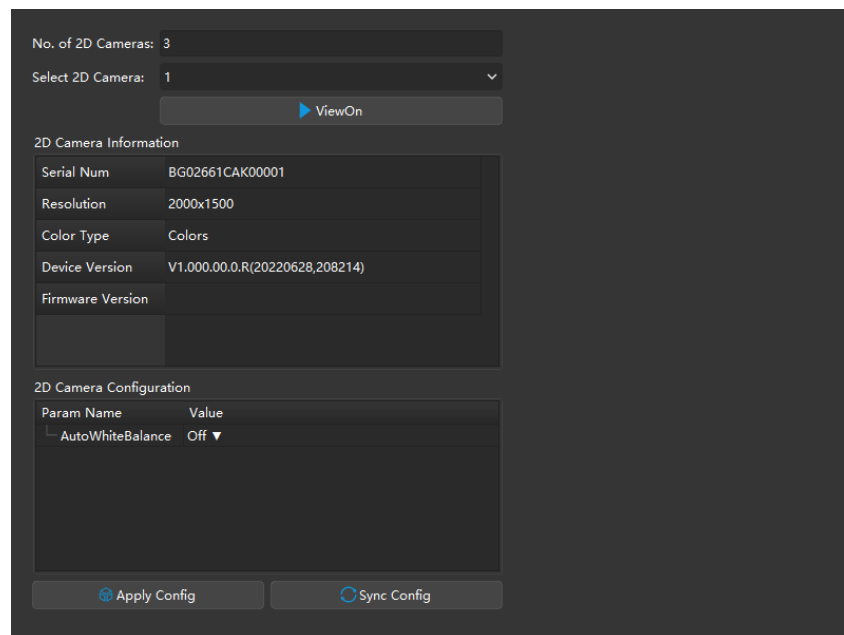
To display the depth map and point cloud in the custom reference frame, follow these steps:

1. In the data display area, switch to **Depth Map** or **Point Cloud**.
2. At the top of the left panel, click the **Reference Frame** drop-down menu and select **Custom**. The depth map and point cloud will be displayed in the custom reference frame.

 The reference frame setting is simultaneously applied to both depth map and point cloud.

### 5.4.9. Check and Configure 2D Cameras

This tool is used for checking and configuring the 2D cameras of a Mech-Eye Industrial 3D Camera.




#### Check 2D Camera Information

In the **2D Camera Information** section, you can check the serial number, resolution, color type, device version, and firmware version of a 2D camera.

To check the above information of a 2D camera, select the 2D camera in the **Select 2D Camera** menu first.

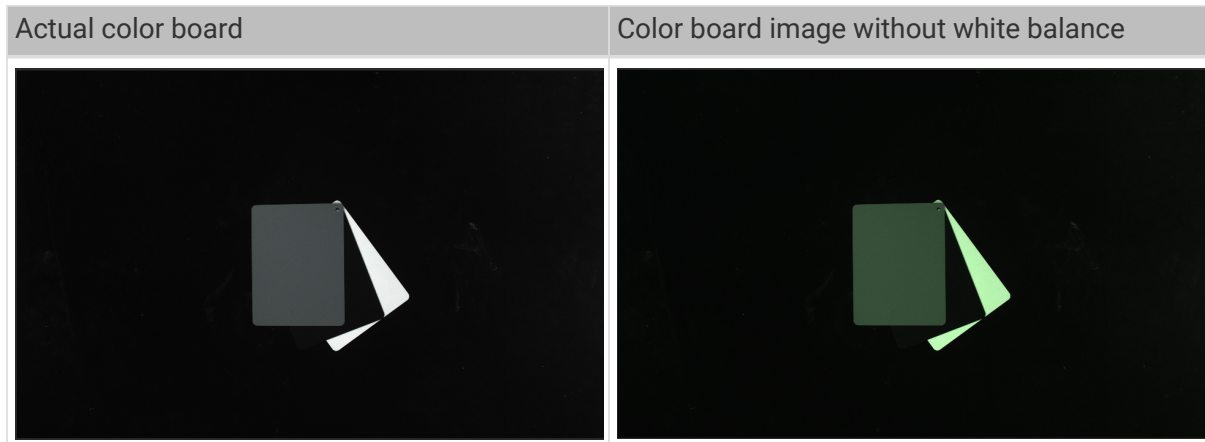
#### Adjust White Balance

 Only available for color 2D cameras. Select a 2D camera and then check the **Color Type** in **2D Camera Information** to see if it is a color 2D camera.

If the color of the obtained 2D image differs significantly from that of the objects, you can adjust the white balance setting. Otherwise, distorted color of the 2D image will result in distorted color in the textured point cloud and affect subsequent processing. For deep learning, if 2D images with

distorted color are used for model training, the distortions will be extracted and trained as the object features, thus affecting the model performance on object recognition.

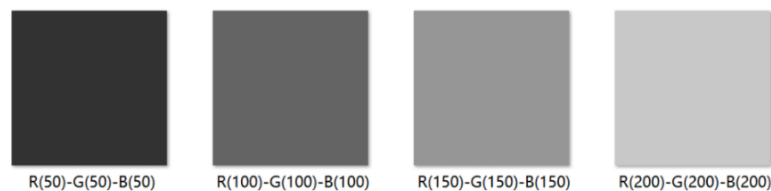
### Comparison Example



### Preparation

Before adjusting the white balance, please complete the following preparation:

1. Make sure that the 2D image is not over- or under-exposed. If the 2D image is over- or under-exposed, please adjust the [parameters for the 2D image](#).
2. Prepare a neutral-gray color board. Refer to the following image for examples of neutral-gray colors. Then, place the color board close to the camera and acquire data to ensure, as much as possible, that only the color board is captured.



### Instructions

Please follow these steps to adjust the white balance of a color 2D camera:

1. Select the 2D camera whose white balance needs to be adjusted, and click [ **ViewOn** ]. The camera will acquire data continuously.
2. In **2D Camera Configuration**, set **AutoWhiteBalance** to **Once** or **Continuous**, and the camera will start to adjust the white balance.
  - If the lighting conditions remain relatively unchanged, it is recommended to use **Once**.
  - If the lighting conditions vary, it is recommended to use **Continuous**.
3. Check the color of the gray color board in the image.
  - If the color still appears distorted, move the board until the color appears consistent to the actual color board.
  - If the color appears consistent to the actual color board, set **AutoWhiteBalance** to **Off**, and click [ **ViewOff** ] to finish adjusting the white balance.

4. Click [ **Apply Config** ] to save the configuration to the camera.

## 6. Mech-Eye API

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You can connect to a camera and obtain the 2D image, depth map, and point cloud using Mech-Eye API.

The C++ and C# Mech-Eye API interfaces are included in the Mech-Eye SDK installation package. The Python Mech-Eye API interfaces need to be downloaded and installed separately. The ROS Mech-Eye API interfaces are available on GitHub.

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Instructions on **installing Mech-Eye SDK**:

[Mech-Eye SDK Installation Guide \(Windows\)](#)

[Mech-Eye SDK Installation Guide \(Ubuntu\)](#)

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A tutorial on how to use **Mech-Eye API**:

[Capture Tutorial](#)

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Instructions on **installing, configuring, building, and running Mech-Eye API samples**:

[Sample Usage Guide](#)

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Instructions on **using Mech-Eye API tools**:

[Firmware Upgrade Tool](#)

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The Mech-Eye API reference guide:

[Mech-Eye API Reference](#)

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List of the **methods and parameters renamed in version 2.0.0**:

[cpp-name-change.pdf](#)

[csharp-name-change.pdf](#)



Not applicable to Mech-Eye API below 2.0.0.



## 6.1. Mech-Eye SDK Installation Guide (Ubuntu)

This topic guides you through the downloading, installation, upgrade, and uninstallation of Mech-Eye SDK on Ubuntu.



If you are using the Windows operating system, please refer to [Mech-Eye SDK Installation Guide](#).

### Download Mech-Eye SDK

Mech-Eye SDK installation packages for the AMD64 and ARM64 architectures are provided:

- AMD64: **Mech-Eye\_API\_2.1.0\_AMD64\_Debian&Ubuntu.deb**
- ARM64: **Mech-Eye\_API\_2.1.0\_ARM64\_Nvidia\_Jetson\_Tx2&Xavier.deb**

Please download the corresponding [Mech-Eye SDK installation package](#) according to your needs.



Use the `arch` command to check the system architecture.

### Install Mech-Eye SDK



If you have installed Mech-Eye SDK already, please [upgrade Mech-Eye SDK](#) instead.

Follow these steps to install Mech-Eye SDK on Ubuntu:

1. Enter the directory where the installation package is stored and execute the following command to install Mech-Eye SDK:
  - If the system architecture is AMD64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.1.0_AMD64_Debian&Ubuntu.deb'
```

- If the system architecture is ARM64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.1.0_ARM64_Nvidia_Jetson_Tx2&Xavier.deb'
```

2. Execute the following command to check if the installation succeeded. If the Mech-Eye SDK version is printed, the installation succeeded.

```
dpkg -l | grep mecheyeapi
```

### Upgrade Mech-Eye SDK

If you have installed Mech-Eye SDK already, follow these steps to upgrade Mech-Eye SDK:

1. Execute the following command to check if Mech-Eye SDK has been installed:

```
dpkg -l | grep mecheyeapi
```

- Execute the following command to uninstall Mech-Eye SDK:

```
sudo dpkg -P MechEyeApi
```

- Enter the directory where the installation package is stored and execute the following command to install Mech-Eye SDK:
  - If the system architecture is AMD64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.1.0_AMD64_Debian&Ubuntu.deb'
```

- If the system architecture is ARM64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.1.0_ARM64_Nvidia_Jetson_Tx2&Xavier.deb'
```

- Execute the following command to check if the installation succeeded. If the Mech-Eye SDK version is printed, the installation succeeded.

```
dpkg -l | grep mecheyeapi
```

## Uninstall Mech-Eye SDK

Follow these steps to uninstall Mech-Eye SDK:

- Execute the following command to uninstall Mech-Eye SDK:

```
sudo dpkg -P MechEyeApi
```

- Execute the following command to check if the uninstallation succeeded. If no messages are printed, the uninstallation succeeded.

```
dpkg -l | grep mecheyeapi
```

## 6.2. Capture Tutorial

This topic describes how to use Mech-Eye API to connect to a camera, set camera parameters, obtain and save the data.



Mech-Eye API 2.0.0 updated the method and parameter names of C++ and C#. If you have installed Mech-Eye SDK 2.0.0 but still use programs written before, please modify the parameter names in your programs according to the following table.

- [cpp-name-change.pdf](#)
- [csharp-name-change.pdf](#)

## Requirements

For C++, C# and Python, please install [Mech-Eye SDK](#) first.

Also for Python, please [complete the relevant configurations](#).

## Detect Cameras

Once the requirements are satisfied, you can detect the connectable cameras using the following commands.

### Detect Cameras (C++)

```
std::vector<mmind::api::MechEyeDeviceInfo> deviceInfoList =  
mmind::api::MechEyeDevice::enumerateMechEyeDeviceList();
```

### Detect Cameras (C#)

```
List<MechEyeDeviceInfo> deviceInfoList =  
MechEyeDevice.EnumerateMechEyeDeviceList();
```

### Detect Cameras (Python)

```
self.device_list = self.device.get_device_list()
```

## Connect to a Camera

After finding the connectable cameras, you can connect to a camera using the following commands (Example codes connect to the first camera in the list).

### Connect to a Camera (C++)

```
mmind::api::MechEyeDevice device;  
device.connect(deviceInfoList[0]);
```

### Connect to a Camera (C#)

```
MechEyeDevice device = new MechEyeDevice();  
device.Connect(deviceInfoList[0]);
```

### Connect to a Camera (Python)

```
self.device.connect(self.device_list[int(0)])
```

## Set the Camera Parameters

After connecting to the camera, you can set the camera parameters using the following commands.

### Set Parameters for 2D Image

Before capturing the 2D image, you need to set the **2D Parameters**, including **Exposure Mode** and **Exposure Time**.

#### Set Parameters for 2D Image (C++)

```
device.setScan2DExposureMode(mmind::api::Scanning2DSettings::Scan2DExposureMode::Timed);  
device.setScan2DExposureTime(100);
```

#### Set Parameters for 2D Image (C#)

```
device.SetScan2DExposureMode(Scan2DExposureMode.Timed);  
device.SetScan2DExposureTime(100);
```

#### Set Parameters for 2D Image (Python)

```
self.device.set_scan_2d_exposure_mode("Timed")  
self.device.set_scan_2d_exposure_time(100.0)
```

## Set Parameters for Depth Map and Point Cloud

Before capturing images used for calculating depth data, you need to set the parameters that affect the quality of the depth map and point cloud, including **Exposure Time**, **Depth Range**, **ROI**, and **Point Cloud Processing**.

#### Set Parameters for Depth Map and Point Cloud (C++)

```
device.setScan3DExposure(std::vector<double>{5, 10});  
device.setDepthRange(mmind::api::DepthRange(100, 1000));  
device.setScan3DROI(mmind::api::ROI(0, 0, 500, 500));  
device.setCloudSmoothMode(  
    mmind::api::PointCloudProcessingSettings::CloudSmoothMode::Normal);  
device.setCloudOutlierFilterMode(  
    mmind::api::PointCloudProcessingSettings::CloudOutlierFilterMode::Normal);
```

#### Set Parameters for Depth Map and Point Cloud (C#)

```
device.SetScan3DExposure(new List<double> {5, 10});
```

```
device.SetDepthRange(new DepthRange(100, 1000));  
device.SetScan3DROI(new ROI(0, 0, 500, 500));  
device.SetCloudSmoothMode(CloudSmoothMode.Normal);  
device.SetCloudOutlierFilterMode(CloudOutlierFilterMode.Normal);
```

### Set Parameters for Depth Map and Point Cloud (Python)

```
self.device.set_scan_3d_exposure([5.0, 10.0])  
self.device.set_depth_range(100, 1000)  
self.device.set_scan_3d_roi(0, 0, 500, 500)  
self.device.set_cloud_smooth_mode("Normal")  
self.device.set_cloud_outlier_filter_mode("Normal")
```

## Obtain Data

After setting the parameters, you can trigger the camera to capture images and return the 2D image and point cloud data.

### Obtain 2D Image Data

#### Obtain 2D Image Data (C++)

```
mmind::api::ColorMap color;  
device.captureColorMap(color);
```

#### Obtain 2D Image Data (C#)

```
ColorMap color = new ColorMap();  
device.CaptureColorMap(ref color);
```

#### Obtain 2D Image Data (Python)

```
color_map = device.capture_color()
```

## Obtain Point Cloud Data

#### Obtain Point Cloud Data (C++)

```
mmind::api::PointXYZMap pointXYZMap;  
device.capturePointXYZMap(pointXYZMap);
```

#### Obtain Point Cloud Data (C#)

```
PointXYZMap pointXYZMap = new PointXYZMap();  
device.CapturePointXYZMap(ref pointXYZMap);
```

### Obtain Point Cloud Data (Python)

```
point_xyz = device.capture_point_xyz()
```

## Save Data

### Save 2D Image

You can convert the obtained 2D image data to OpenCV format and save the 2D image as a PNG file.

### Save 2D Image (C++)

```
const std::string colorFile = "ColorMap.png";  
cv::Mat color8UC3 = cv::Mat(colorMap.height(), colorMap.width(), CV_8UC3,  
colorMap.data());  
cv::imwrite(colorFile, color8UC3);
```

### Save 2D Image (C#)

```
string colorFile = "colorMap.png";  
Mat color8UC3 = new Mat(unchecked((int)colorMap.height()),  
unchecked((int)colorMap.width()), DepthType.Cv8U, 3, colorMap.data(),  
unchecked((int)colorMap.width()) * 3);  
CvInvoke.Imwrite(colorFile, color8UC3);
```

### Save 2D Image (Python)

```
color_file = "ColorMap.png"  
cv2.imwrite(color_file, color_map.data())
```

## Save Point Cloud

You can save the point cloud data as a PLY file.

### Save Point Cloud (C++)

```
std::string pointCloudPath = "PointCloudXYZ.ply";  
savePLY(pointXYZMap, pointCloudPath);
```

### Save Point Cloud (C#)

```
Mat depth32FC3 = new Mat(unchecked((int)pointXYZMap.height()),
    unchecked((int)pointXYZMap.width()), DepthType.Cv32F, 3, pointXYZMap.data(),
    unchecked((int)pointXYZMap.width()) * 12);
string pointCloudPath = "pointCloudXYZ.ply";
CvInvoke.WriteCloud(pointCloudPath, depth32FC3);
```

### Save Point Cloud (Python)

```
point_cloud_xyz = o3d.geometry.PointCloud()
points_xyz = np.zeros(
    (point_xyz.width() * point_xyz.height(), 3), dtype=np.float64)

pos = 0
for dd in np.nditer(point_xyz_data):
    points_xyz[int(pos / 3)][int(pos % 3)] = 0.001 * dd
    pos = pos + 1

point_cloud_xyz.points = o3d.utility.Vector3dVector(points_xyz)
o3d.io.write_point_cloud("PointCloudXYZ.ply", point_cloud_xyz)
```

## 6.3. Sample Usage Guide

This topic provides the instructions on using the samples for different platforms and languages.

- [C++ \(Windows\)](#)
- [C++ \(Ubuntu\)](#)
- [C#](#)
- [Python \(Windows\)](#)
- [Python \(Ubuntu\)](#)
- [ROS](#)

### 6.3.1. C++ (Windows)

This topic introduces how to configure the Mech-Eye API C++ samples with CMake and then build the samples with Visual Studio on Windows.

#### Sample List

Samples are divided into 7 categories, **Basic**, **Advanced**, **Util**, **Laser**, **UHP**, **Calibration**, and **Halcon**.

- **Basic**: camera connection and basic capturing functions.
- **Advanced**: advanced capturing functions.
- **Util**: obtain information from a camera and set camera parameters.



- **Laser**: for the Laser, DEEP and LSR series cameras only.
- **UHP**: for the UHP series cameras only.
- **Calibration**: perform hand-eye calibration through Mech-Eye API.
- **Halcon**: obtain HALCON-readable point clouds through Mech-Eye API.

The samples in each category and their descriptions are provided below.

#### ▼ Basic

- **ConnectToCamera**: Connects to a camera.
- **ConnectAndCaptureImage**: Connects to a camera and obtains the 2D image, depth map and point cloud data.
- **CaptureColorMap**: Obtains and saves the 2D image from a camera.
- **CaptureDepthMap**: Obtains and saves the depth map from a camera.
- **CapturePointCloud**: Obtains and save untextured and textured point clouds generated from images captured with a single exposure time.
- **CaptureHDRPointCloud**: Obtains and save untextured and textured point clouds generated from images captured with multiple exposure times.
- **CapturePointCloudROI**: Obtains and save untextured and textured point clouds of the objects in the ROI from a camera.
- **CapturePointCloudFromTextureMask**: Constructs and saves untextured and textured point clouds generated from a depth map and masked 2D image.

#### ▼ Advanced

- **CaptureCloudFromDepth**: Constructs and saves point clouds from the depth map and 2D image obtained from a camera.
- **CaptureSequentiallyMultiCamera**: Obtains and saves 2D images, depth maps and point clouds sequentially from multiple cameras.
- **CaptureSimultaneouslyMultiCamera**: Obtains and saves 2D images, depth maps and point clouds simultaneously from multiple cameras.
- **CaptureTimedAndPeriodically**: Obtains and saves 2D images, depth maps and point clouds periodically for the specified duration from a camera.

#### ▼ Util

- **GetCameraIntri**: Gets and prints a camera's intrinsic parameters.
- **PrintDeviceInfo**: Gets and prints a camera's information such as model, serial number, firmware version and temperatures.
- **SetDepthRange**: Sets the range of depth values to be retained by a camera.
- **SetParameters**: Sets specified parameters to a camera.
- **SetUserSets**: Performs functions related to parameter groups, such as obtaining the names of all available parameter groups, selecting a parameter group, and saving the parameter values to the current parameter group. The parameter group feature allows user to save and quickly apply a set of parameter values.

#### ▼ Laser

- **SetLaserFramePartitionCount**: Divides the projector FOV into partitions and project structured light in one partition at a time. The output of the entire FOV is composed from

images of all partitions.

- [SetLaserFrameRange](#): Sets the projection range of the structured light. The entire projector FOV is from 0 to 100.
- [SetLaserFringeCodingMode](#): Sets the coding mode of the structured light pattern.
- [SetLaserPowerLevel](#): Sets the output power of the laser projector in percentage of max power. This affects the intensity of the laser light.

#### ▼ UHP

- [SetUHPCaptureMode](#): Sets the capture mode (capture images with 2D camera 1, with 2D camera 2, or with both 2D cameras and compose the outputs).
- [SetUHPFringeCodingMode](#): Sets the coding mode of the structured light pattern.

#### ▼ Calibration

- [HandEyeCalibration](#): Performs hand-eye calibration.

#### ▼ Halcon

- [CaptureHalconPointCloud](#): Obtains point cloud data from a camera, and then transforms and saves the point clouds using HALCON C++ interface.

## Prerequisites

In order to use the C++ samples of Mech-Eye API, the following prerequisites must be satisfied:

- [Connect the camera and computer correctly](#).
- Obtain the samples.
- Install the required software.
- Install the optional software on which samples depend and add relevant environment variables.

## Obtain the Samples

C++ samples are included in the installation directory of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation directory are the version at the time of Mech-Eye SDK release. The version on GitHub may contain later changes.

- The samples in the installation directory are located in `xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source`.
- The samples cloned from GitHub are located in `xxx/mecheye_cpp_samples/source`.

## Install Required Software

In order to use the C++ samples of Mech-Eye API, Mech-Eye SDK, CMake and Visual Studio must be installed.

## Install the latest version of Mech-Eye SDK

Please install or upgrade [according to](#) Mech-Eye SDK Installation Guide.

## Install CMake (version 3.2 or above)

1. Download [CMake](#): download the installer to the right of **Windows x64 Installer**.

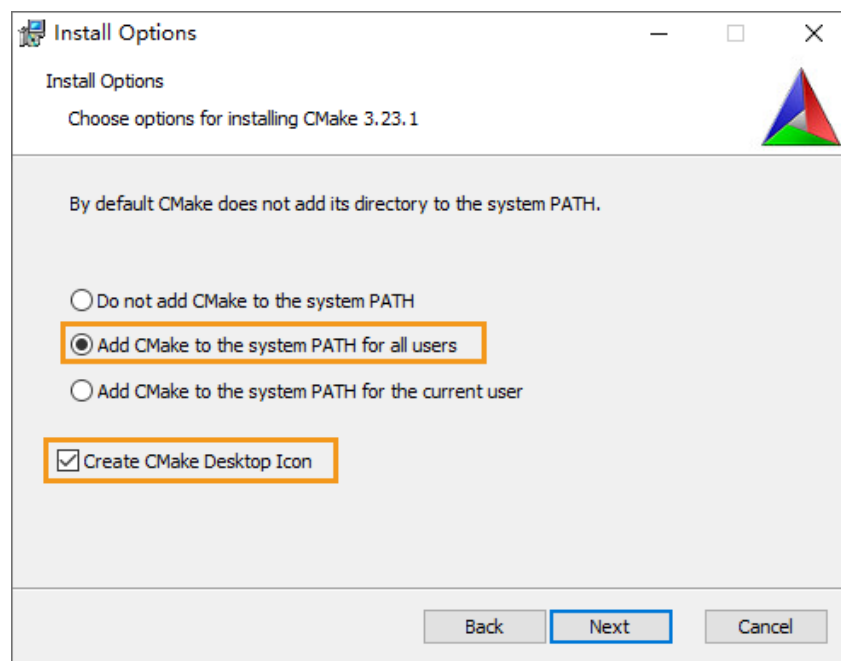
Source distributions:

Platform	Files
Unix/Linux Source (has \n line feeds)	cmake-3.23.1.tar.gz
Windows Source (has \r\n line feeds)	cmake-3.23.1.zip

Binary distributions:

Platform	Files
Windows x64 Installer	cmake-3.23.1-windows-x86_64.msi
Windows x64 ZIP	cmake-3.23.1-windows-x86_64.zip
Windows I386 Installer	cmake-3.23.1-windows-i386.msi
Windows I386 ZIP	cmake-3.23.1-windows-i386.zip

2. When installing, select the following two options to add CMake to environment variables and create a desktop shortcut for CMake.
  - o Add CMake to the system PATH for all users
  - o Create Cmake Desktop Icon



## Install Visual Studio (version 2017 or above)

1. Download the [Visual Studio installer](#).
2. When installing, select the following two workloads in the **Desktop & Mobile** category, and then click [ **Install** ].
  - o Desktop development with C++
  - o Universal Windows Platform development



Please restart your computer after installing Visual Studio. If you still need to install the optional software, you can restart your computer after [adding environment variables](#).

## Install Optional Software

Some samples contain functions that depend on the following third-party software libraries. If you

need to use the samples listed in the table below, you must install the software on which the samples depend.

- OpenCV: version 3.4.5 or above
- PCL: version 1.8.1 or above
- HALCON: version 20.11 or above



HALCON versions below 20.11 are not fully tested.



If any of the optional software is not installed, then you must complete the steps in [Disable Unneeded Samples \(Optional\)](#) before configuring the samples.

Refer to the following table for the samples that depend on third-party software libraries.

Sample	OpenCV	PCL	Halcon
CaptureColorMap	√		
CaptureDepthMap	√		
CapturePointCloud		√	
CaptureHDRPointCloud		√	
CapturePointCloudROI		√	
CapturePointCloudFromTextureMask		√	
CaptureCloudFromDepth		√	
CaptureTimedAndPeriodically	√	√	
CaptureSimultaneouslyMultiCamera	√	√	
CaptureSequentiallyMultiCamera	√	√	
CaptureHalconPointCloud			√

### Install OpenCV

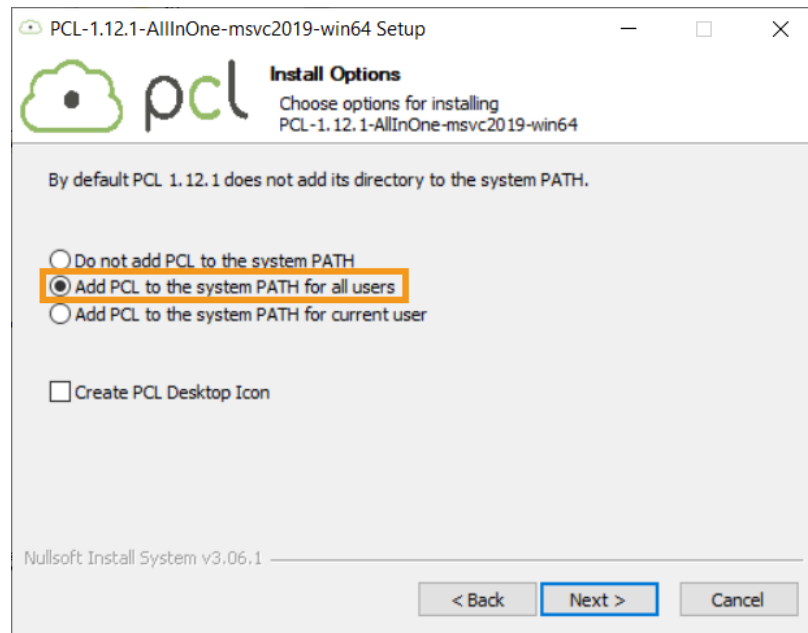
1. Download and install [OpenCV](#). Note down the installation directory of OpenCV.
2. Add OpenCV to environment variables. Refer to [Add Environment Variables](#) for instructions.

### Install PCL

1. Refer to the following table and determine the version of PCL to install based on the version of Visual Studio.

Visual Studio version	Supported PCL versions
2017	1.8.1–1.9.1
2019	1.8.1–1.12.1
2022	1.8.1 and above

2. Open the [PCL download page](#), click on **Assets** under the corresponding version, and download the EXE installer.
3. Run the installer to install PCL. When installing, select **Add PCL to the system PATH** for all users to add PCL to environment variables.



The following error message might pop up during installation:



**Warning! PATH too long installer unable to modify PATH!**

In this case, you need to add PCL to environment variables manually. Refer to [Add Environment Variables](#) for instructions.

4. Add OpenNI2 on which PCL depends to environment variables. Refer to [Add Environment Variables](#) for instructions.

## Install HALCON

Install [HALCON](#) 20.11 or above. Please confirm that your HALCON license is still valid.

## Add Environment Variables

If you need to use samples that depend on OpenCV or PCL, please add the relevant environment variables according to the following steps.

1. Right-click **This PC** on the desktop and select **Properties**.
2. Click **Advanced system settings**, and in the pop-up **System Properties** window, click **[ Environment Variables ]** to open the **Environment Variables** window.
3. Double-click **Path** in the user variables to enter the **Edit environment variable** page. Click **[ New ]** in the upper-right and add the following directories one by one. Then, click **[ OK ]** to exit the window.
  - For PCL: *C:/Program Files/OpenNI2/Tools*
  - For OpenCV:
    - *xxx/OpenCV/build/x64/vc14/bin*
    - *xxx/OpenCV/build/x64/vc14/lib*
  - If you encountered the error message while installing PCL, please add the following directories as well:
    - *xxx/PCL 1.12.1/bin*

- `xxx/PCL 1.12.1/3rdParty/VTK/bin`



Please restart your computer after adding the environment variables. If not restarted, the environmental variables added to PATH may not be effective.

## Build and Run Samples

You can build all samples at once or build a single sample individually.



The paths provided in this section correspond to the samples included in the installation directory. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

## Disable Unneeded Samples (Optional)



If you did not install some of the optional software and still want to build all samples at once, then you must complete the steps in this section. Otherwise, an error will occur during the configuration of samples using CMake.

If you do not need the samples that depend on OpenCV, PCL or HALCON, please edit the CMakeLists file to disable these samples before building all samples at once.

1. Open `CMakeLists.txt` in `xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source`.
2. Edit lines containing `options`: find the lines starting with `options`, change `ON` at the end of the line to `OFF` to disable the samples that depend on the software mentioned in that line.

Example: If you do not need to build the sample that depends on HALCON, change `ON` at the end of the line starting with `option(USE_HALCON` to `OFF`.

3. Save the changes and close `CMakeLists.txt`.

## Configure Samples in CMake

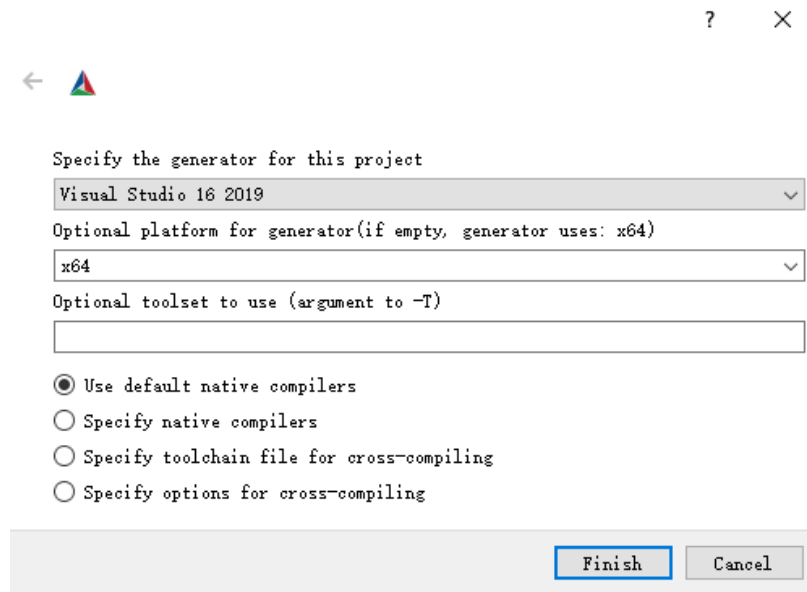
1. Right-click CMake and select **Run as administrator**.
2. Enter the directories of source code and binaries.
  - To build all samples at once, enter the following directories.

Where is the source code	<code>xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source</code>
Where to build the binaries	<code>xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source/build</code>

- To build one sample individually, enter the following directories. Replace **Category** with the category name of the sample and **SampleName** with the name of the sample.

Where is the source code	<code>xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source/Category/SampleName</code>
Where to build the binaries	<code>xxx/Mech-Eye SDK-x.x.x/API/samples/c++/source/Category/SampleName/build</code>

3. Click [ **Configure** ] in the bottom to open the configuration page. Select Visual Studio version, and set the platform to **x64**. Then, click [ **Finish** ]. When the configuration completes, the log will display **Configuring done**.



4. Click [ **Generate** ] to generate Visual Studio solution. When the generation completes, the log will display **Generating done**. Then, click [ **Open Project** ] to open the solution in Visual Studio.

### Build Samples in Visual Studio

1. In Visual Studio toolbar, change the solution configuration from **Debug** to **Release**.
2. In the **Solution Explorer** panel, right-click **Solution 'xxx'** at the top, and select **Build Solution**. An EXE format executable file is generated for each sample. The executable files are saved to the **Release** folder, located in the **Where to build the binaries directory** that you entered in CMake.

### Run Samples

You can run the samples in Visual Studio after building them, or run the samples by double-clicking the executable files.

#### Run a sample in Visual Studio

1. In the **Solution Explorer** panel, right-click a sample, and select **Set as Startup Project**.
2. Click [ **Local Windows Debugger** ] in the toolbar to run the sample.

While the sample is running, input the device index of the camera to which you want to connect according to the instruction, and press **Enter** to connect.

3. If image and/or point cloud files are saved by the sample, you can find the files in the **build** folder (the **Where to build the binaries** directory that you entered in CMake).

#### Run the executable file of a sample

1. Navigate to the **Where to build the binaries** directory that you entered in CMake, and open the **Release** folder.
2. Run the EXE file with the same name as the sample.

While the sample is running, input the device index of the camera to which you want to connect according to the instruction, and press **Enter** to connect.



3. If image and/or point cloud files are saved by the sample, you can find the files in the **Release** folder.

### 6.3.2. C++ (Ubuntu)

This topic introduces how to configure the Mech-Eye API C++ samples with CMake and then build the samples with the make command on Ubuntu.

#### Sample List

Samples are divided into 7 categories, **Basic**, **Advanced**, **Util**, **Laser**, **UHP**, **Calibration**, and **Halcon**.

- **Basic**: camera connection and basic capturing functions.
- **Advanced**: advanced capturing functions.
- **Util**: obtain information from a camera and set camera parameters.
- **Laser**: for the Laser, DEEP and LSR series cameras only.
- **UHP**: for the UHP series cameras only.
- **Calibration**: perform hand-eye calibration through Mech-Eye API.
- **Halcon**: obtain HALCON-readable point clouds through Mech-Eye API.

The samples in each category and their descriptions are provided below.

#### ▼ Basic

- [ConnectToCamera](#): Connects to a camera.
- [ConnectAndCaptureImage](#): Connects to a camera and obtains the 2D image, depth map and point cloud data.
- [CaptureColorMap](#): Obtains and saves the 2D image from a camera.
- [CaptureDepthMap](#): Obtains and saves the depth map from a camera.
- [CapturePointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with a single exposure time.
- [CaptureHDRPointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with multiple exposure times.
- [CapturePointCloudROI](#): Obtains and save untextured and textured point clouds of the objects in the ROI from a camera.
- [CapturePointCloudFromTextureMask](#): Constructs and saves untextured and textured point clouds generated from a depth map and masked 2D image.

#### ▼ Advanced

- [CaptureCloudFromDepth](#): Constructs and saves point clouds from the depth map and 2D image obtained from a camera.
- [CaptureSequentiallyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds sequentially from multiple cameras.
- [CaptureSimultaneouslyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds simultaneously from multiple cameras.
- [CaptureTimedAndPeriodically](#): Obtains and saves 2D images, depth maps and point clouds periodically for the specified duration from a camera.

### ▼ Util

- [GetCameraIntri](#): Gets and prints a camera's intrinsic parameters.
- [PrintDeviceInfo](#): Gets and prints a camera's information such as model, serial number, firmware version and temperatures.
- [SetDepthRange](#): Sets the range of depth values to be retained by a camera.
- [SetParameters](#): Sets specified parameters to a camera.
- [SetUserSets](#): Performs functions related to parameter groups, such as obtaining the names of all available parameter groups, selecting a parameter group, and saving the parameter values to the current parameter group. The parameter group feature allows user to save and quickly apply a set of parameter values.

### ▼ Laser

- [SetLaserFramePartitionCount](#): Divides the projector FOV into partitions and project structured light in one partition at a time. The output of the entire FOV is composed from images of all partitions.
- [SetLaserFrameRange](#): Sets the projection range of the structured light. The entire projector FOV is from 0 to 100.
- [SetLaserFringeCodingMode](#): Sets the coding mode of the structured light pattern.
- [SetLaserPowerLevel](#): Sets the output power of the laser projector in percentage of max power. This affects the intensity of the laser light.

### ▼ UHP

- [SetUHPCaptureMode](#): Sets the capture mode (capture images with 2D camera 1, with 2D camera 2, or with both 2D cameras and compose the outputs).
- [SetUHPFringeCodingMode](#): Sets the coding mode of the structured light pattern.

### ▼ Calibration

- [HandEyeCalibration](#): Performs hand-eye calibration.

### ▼ Halcon

- [CaptureHalconPointCloud](#): Obtains point cloud data from a camera, and then transforms and saves the point clouds using HALCON C++ interface.

## Prerequisites

In order to use the C++ samples of Mech-Eye API, the following prerequisites must be satisfied:

- [Connect the camera and computer correctly](#).
- The version of the Ubuntu operating system is 18 or above.
- Obtain the samples.
- Install the required software.
- Install the optional software on which samples depend.



If using a Ubuntu virtual machine, please ensure that the available disk space is greater than 20 GB. Otherwise, installation of the software may fail.

## Obtain the Samples

C++ samples are included in the installation directory of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation directory are the version at the time of Mech-Eye SDK release. The version on GitHub may contain later changes.

- The samples in the installation directory are located in `/opt/mech-mind/mech-eye-sdk/samples/c++/source`.
- The samples cloned from GitHub are located in `xxx/mecheye_cpp_samples/source`.

## Install Required Software

In order to use the C++ samples of Mech-Eye API, the software source list must be updated, and Mech-Eye SDK and dependencies must be installed.

1. Update software source list:

```
sudo apt-get update
```

2. Install dependencies:

```
sudo apt-get install -y build-essential pkg-config cmake
```

3. Install Mech-Eye SDK: Please refer to [Mech-Eye SDK Installation Guide \(Ubuntu\)](#).

## Install Optional Software

Some samples contain functions that depend on the following third-party software libraries. If you need to use the samples listed in the table below, you must install the software on which the samples depend.

- OpenCV: latest version
- PCL: latest version
- HALCON: version 20.11 or above



HALCON versions below 20.11 are not fully tested.



If any of the optional software is not installed, then you must complete the steps in [Disable Unneeded Samples \(Optional\)](#) before configuring the samples.

Refer to the following table for the samples that depend on third-party software libraries.

Sample	OpenCV	PCL	Halcon
CaptureColorMap	√		
CaptureDepthMap	√		
CapturePointCloud		√	
CaptureHDRPointCloud		√	
CapturePointCloudROI		√	

Sample	OpenCV	PCL	Halcon
CapturePointCloudFromTextureMask		✓	
CaptureCloudFromDepth		✓	
CaptureTimedAndPeriodically	✓	✓	
CaptureSimultaneouslyMultiCamera	✓	✓	
CaptureSequentiallyMultiCamera	✓	✓	
CaptureHalconPointCloud		✓	✓

- Install OpenCV:

```
sudo apt update && sudo apt install -y unzip
wget -O opencv.zip https://github.com/opencv/opencv/archive/4.x.zip
unzip opencv.zip
mkdir build && cd build
cmake ../opencv-4.x
cmake --build .
sudo make install
```

- Install PCL:

```
sudo apt-get install libpcl-dev
```



On different versions of Ubuntu, this command installs different versions of PCL. On Ubuntu 18.04, PCL 1.8.1 is installed; on Ubuntu 20.04, PCL 1.10.0 is installed.

- Install HALCON and add environmental variables:

- After downloading HALCON installer, use the following command to install HALCON (taking version 20.11 as an example):

```
tar zxvfHALCON-20.11.3.0-linux.tar.gz
sudo sh install-linux.sh #Note down the installation directory ofHALCON.
```

- Add HALCON-relevant environment variables: open `/etc/profile` in an editor (such as vi) and paste the following lines to the end of the file. Replace `/opt/halcon` with the actual installation directory of HALCON.

```
HALCONARCH=x64-linux; exportHALCONARCH
HALCONROOT="/opt/halcon"; exportHALCONROOT
HALCONEXAMPLES=${HALCONROOT}/examples; exportHALCONEXAMPLES
HALCONIMAGES=${HALCONROOT}/examples/images; exportHALCONIMAGES
PATH=${HALCONROOT}/bin/${HALCONARCH}:${PATH}; export PATH
if [ ${LD_LIBRARY_PATH} ]; then
    LD_LIBRARY_PATH=${HALCONROOT}/lib/${HALCONARCH}:${LD_LIBRARY_PATH};
```

```
export LD_LIBRARY_PATH
else
    LD_LIBRARY_PATH=${HALCONROOT}/lib/${HALCONARCH}; export
LD_LIBRARY_PATH
fi
```



- The changes are applied when you log in again. Or, you can run the `source /etc/profile/` command before you configure and build the samples.
- For more information, please refer to HALCON's installation guide.

## Build and Run Samples

You can build all samples at once or build a single sample individually.



The paths provided in this section correspond to the samples included in the installation directory. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

## Disable Unneeded Samples (Optional)



If you did not install some of the optional software and still want to build all samples at once, then you must complete the steps in this section. Otherwise, an error will occur during the configuration of samples using CMake.

If you do not need the samples that depend on OpenCV, PCL or HALCON, please edit the CMakeLists file to disable these samples before building all samples at once.

1. Open `/opt/mech-mind/eye-sdk/samples/c++/source/CMakeLists.txt` in an editor (such as vi).
2. Edit lines containing `options`: find the lines starting with `options`, change `ON` at the end of the line to `OFF` to disable the samples that depend on the software mentioned in that line.  
Example: If you do not need to build the sample that depends on HALCON, change `ON` at the end of the line starting with `option(USE_HALCON` to `OFF`.
3. Save the changes in the editor and close the CMakeLists file.

## Build Samples

Please follow these steps to run the sample:

1. Enter the directory of the sample(s):
  - If building all samples at once, please use the following command.

```
cd /opt/mech-mind/eye-sdk/samples/c++/source/
```

- If building a single sample individually, please use the following command. Replace **Category** with the category name of the sample and **SampleName** with the name of the sample.

```
cd /opt/mech-mind/eye-sdk/samples/c++/source/Category/SampleName/
```

2. Create a **build** folder in the directory for saving the built samples and so on.

```
mkdir build && cd build
```

3. Configure and build the sample(s):

```
cmake ..  
make
```



If the source code files in the sample folder are altered, please delete the **build** folder and repeat steps 2 and 3 to rebuild the samples.

## Run Samples

After building the samples, follow these steps to run the sample:

1. Enter the **build** folder in the directory of the sample(s) (Skip this step if you are running the sample(s) directly after building the sample(s):
  - If building all samples at once, please use the following command.

```
cd /opt/mech-mind/eye-sdk/samples/c++/source/build/
```

- If building a single sample individually, please use the following command. Replace **Category** with the category name of the sample and **SampleName** with the name of the sample.

```
cd /opt/mech-mind/eye-sdk/samples/c++/source/Category/SampleName/build/
```

2. Run the sample: replace **SampleName** with the name of the sample. While the sample is running, input the device index of the camera to which you want to connect according to the instruction, and press **Enter** to connect.

```
./SampleName
```

3. If image and/or point cloud files are saved by the sample, you can find the files in the **build** folder.

### 6.3.3. C#

This topic introduces how to run the C# samples on Windows.

#### Sample List

Samples are divided into 5 categories, **Basic**, **Advanced**, **Util**, **Laser** and **UHP**.

- **Basic:** camera connection and basic capturing functions.
- **Advanced:** advanced capturing functions.
- **Util:** obtain information from a camera and set camera parameters.
- **Laser:** for the Laser, DEEP and LSR series cameras only.
- **UHP:** for the UHP series cameras only.

The samples in each category and their descriptions are provided below.

#### ▼ Basic

- [ConnectToCamera](#): Connects to a camera.
- [ConnectAndCaptureImage](#): Connects to a camera and obtains the 2D image, depth map and point cloud data.
- [CaptureColorMap](#): Obtains and saves the 2D image from a camera.
- [CaptureDepthMap](#): Obtains and saves the depth map from a camera.
- [CapturePointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with a single exposure time.
- [CaptureHDRPointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with multiple exposure times.
- [CapturePointCloudROI](#): Obtains and save untextured and textured point clouds of the objects in the ROI from a camera.
- [CapturePointCloudFromTextureMask](#): Constructs and saves untextured and textured point clouds generated from a depth map and masked 2D image.

#### ▼ Advanced

- [CaptureCloudFromDepth](#): Constructs and saves point clouds from the depth map and 2D image obtained from a camera.
- [CaptureSequentiallyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds sequentially from multiple cameras.
- [CaptureSimultaneouslyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds simultaneously from multiple cameras.
- [CaptureTimedAndPeriodically](#): Obtains and saves 2D images, depth maps and point clouds periodically for the specified duration from a camera.

#### ▼ Util

- [GetCameraIntri](#): Gets and prints a camera's intrinsic parameters.
- [PrintDeviceInfo](#): Gets and prints a camera's information such as model, serial number, firmware version and temperatures.
- [SetDepthRange](#): Sets the range of depth values to be retained by a camera.
- [SetParameters](#): Sets specified parameters to a camera.
- [SetUserSets](#): Performs functions related to parameter groups, such as obtaining the names of all available parameter groups, selecting a parameter group, and saving the parameter values to the current parameter group. The parameter group feature allows user to save and quickly apply a set of parameter values.

#### ▼ Laser



- **SetLaserFramePartitionCount**: Divides the projector FOV into partitions and project structured light in one partition at a time. The output of the entire FOV is composed from images of all partitions.
- **SetLaserFrameRange**: Sets the projection range of the structured light. The entire projector FOV is from 0 to 100.
- **SetLaserFringeCodingMode**: Sets the coding mode of the structured light pattern.
- **SetLaserPowerLevel**: Sets the output power of the laser projector in percentage of max power. This affects the intensity of the laser light.

#### ▼ UHP

- **SetUHPCaptureMode**: Sets the capture mode (capture images with 2D camera 1, with 2D camera 2, or with both 2D cameras and compose the outputs).
- **SetUHPFringeCodingMode**: Sets the coding mode of the structured light pattern.

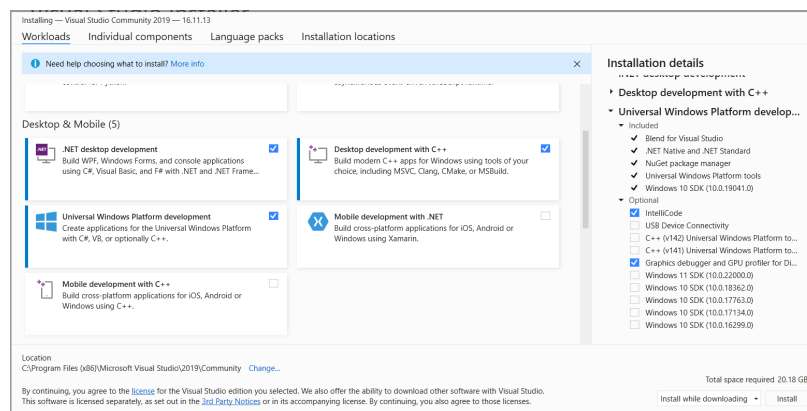
## Requirements

### 1. Download Visual Studio 2019.

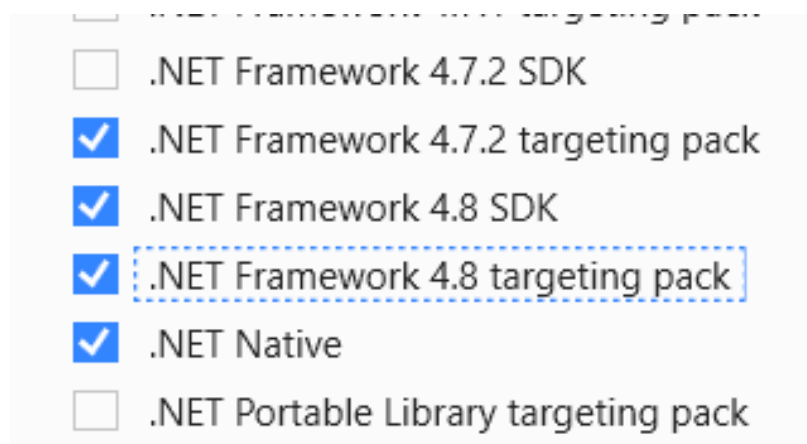
It is recommended to use Visual Studio 2019 or Visual Studio 2015.

### 2. Choose and install workloads and individual components in Visual Studio:

Workloads: .NET desktop development, Desktop development with C++, Universal Windows Platform development



Individual components: .NET Framework 4.8 targeting pack

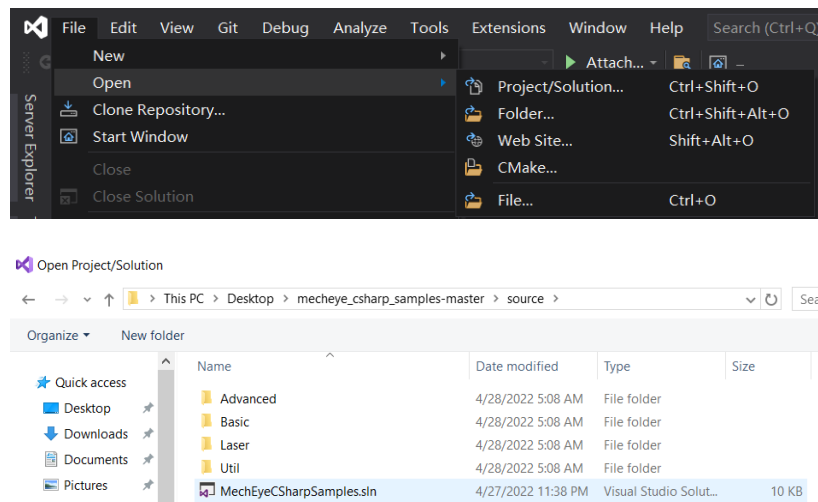


3. Download and install the latest version of Mech-Eye SDK.
1. Connect the camera and computer correctly.
  2. To use the following samples, [Emgu.CV.runtime.windows](#) must be installed in Visual Studio using the NuGet Package Manager. Please refer to [Install and manage packages in Visual Studio using the NuGet Package Manager](#) for detailed instructions.
    - CaptureColorMap
    - CaptureDepthMap
    - CapturePointCloud
    - CaptureHDRPointCloud
    - CapturePointCloudROI
    - CapturePointCloudFromTextureMask
    - CaptureCloudFromDepth
    - CaptureSequentiallyMultiCamera
    - CaptureSimultaneouslyMultiCamera
    - CaptureTimedAndPeriodically

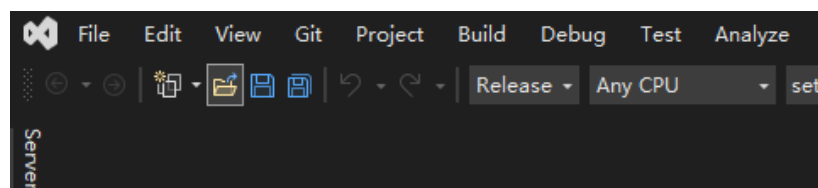
## Instructions

### Build Solution in Visual Studio

1. Open MechEyeCSharpSamples.sln in Visual Studio. This file is located in `xxx/Mech-Eye SDK-x.x.x/API/samples/csharp/source`.

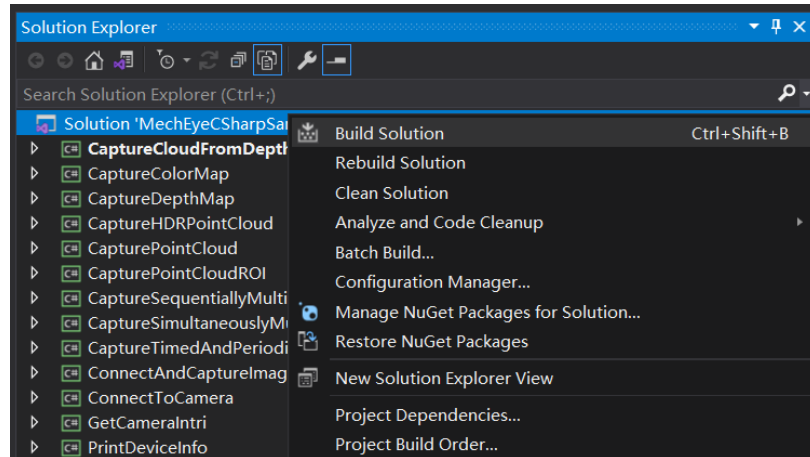


2. Change the Solution Configuration from Debug to Release.



3. Build solution.

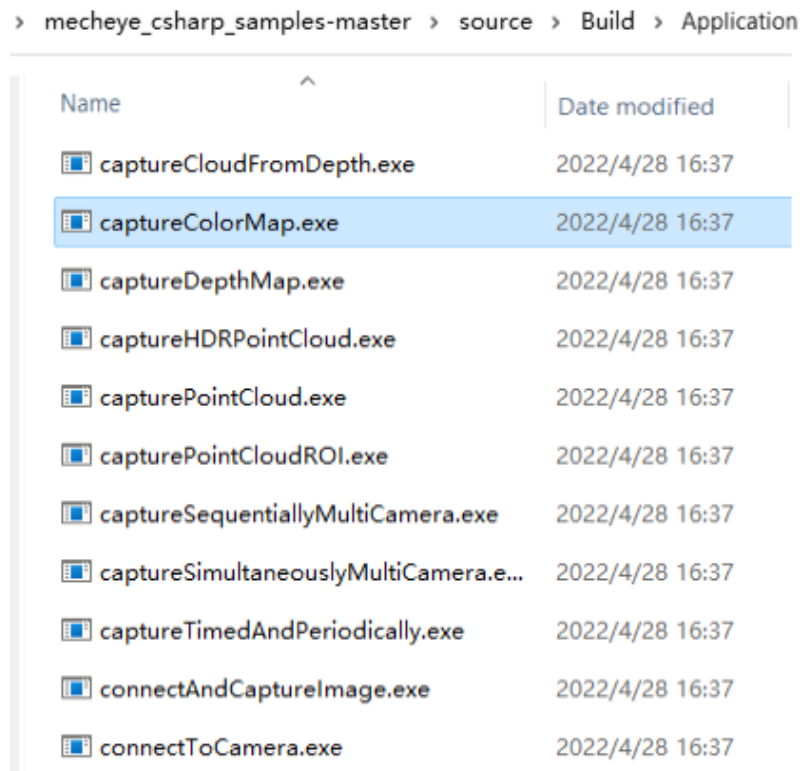
Right-click Solution 'MechEyeCSharpSamples' in the Solution Explorer panel, and click **Build Solution** in the context menu.



## Run Samples

The example below shows how to run CaptureColorMap.exe:

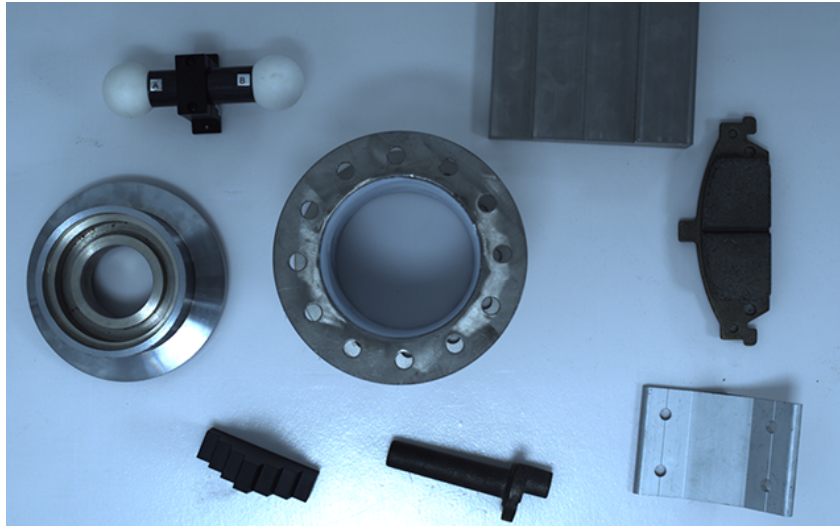
1. Go to `mecheye_csharp_samples-master > source > Build`.



2. Double-click CaptureColorMap.exe.

While the program is running, please follow the instructions to input the camera index, and then wait for the program to finish.

3. After running the program, you will get the 2D image (named ColorMap) in Build directory.



### 6.3.4. Python (Windows)

This topic introduces how to run the Python samples on Windows.

#### Sample List

Samples are divided into 5 categories, **Basic**, **Advanced**, **Util**, **Laser** and **UHP**.

- **Basic**: camera connection and basic capturing functions.
- **Advanced**: advanced capturing functions.
- **Util**: obtain information from a camera and set camera parameters.
- **Laser**: for the Laser, DEEP and LSR series cameras only.
- **UHP**: for the UHP series cameras only.

The samples in each category and their descriptions are provided below.

#### ▼ Basic

- [ConnectToCamera](#): Connects to a camera.
- [ConnectAndCaptureImage](#): Connects to a camera and obtains the 2D image, depth map and point cloud data.
- [CaptureColorMap](#): Obtains and saves the 2D image from a camera.
- [CaptureDepthMap](#): Obtains and saves the depth map from a camera.
- [CapturePointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with a single exposure time.
- [CaptureHDRPointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with multiple exposure times.
- [CapturePointCloudROI](#): Obtains and save untextured and textured point clouds of the objects in the ROI from a camera.
- [CapturePointCloudFromTextureMask](#): Constructs and saves untextured and textured point clouds generated from a depth map and masked 2D image.

#### ▼ Advanced

- [CaptureCloudFromDepth](#): Constructs and saves point clouds from the depth map and 2D image obtained from a camera.
- [CaptureSequentiallyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds sequentially from multiple cameras.
- [CaptureSimultaneouslyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds simultaneously from multiple cameras.
- [CaptureTimedAndPeriodically](#): Obtains and saves 2D images, depth maps and point clouds periodically for the specified duration from a camera.

#### ▼ Util

- [GetCameraIntri](#): Gets and prints a camera's intrinsic parameters.
- [PrintDeviceInfo](#): Gets and prints a camera's information such as model, serial number, firmware version and temperatures.
- [SetDepthRange](#): Sets the range of depth values to be retained by a camera.
- [SetParameters](#): Sets specified parameters to a camera.
- [SetUserSets](#): Performs functions related to parameter groups, such as obtaining the names of all available parameter groups, selecting a parameter group, and saving the parameter values to the current parameter group. The parameter group feature allows user to save and quickly apply a set of parameter values.

#### ▼ Laser

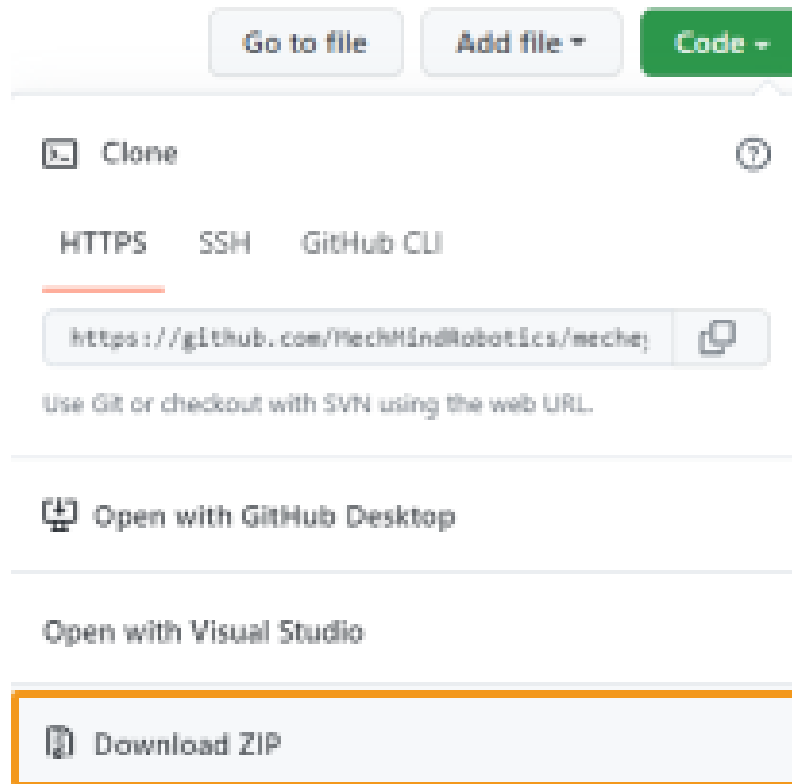
- [SetLaserFramePartitionCount](#): Divides the projector FOV into partitions and project structured light in one partition at a time. The output of the entire FOV is composed from images of all partitions.
- [SetLaserFrameRange](#): Sets the projection range of the structured light. The entire projector FOV is from 0 to 100.
- [SetLaserFringeCodingMode](#): Sets the coding mode of the structured light pattern.
- [SetLaserPowerLevel](#): Sets the output power of the laser projector in percentage of max power. This affects the intensity of the laser light.

#### ▼ UHP

- [SetUHPCaptureMode](#): Sets the capture mode (capture images with 2D camera 1, with 2D camera 2, or with both 2D cameras and compose the outputs).
- [SetUHPFringeCodingMode](#): Sets the coding mode of the structured light pattern.

## Requirements

1. [Download and install the latest version of Mech-Eye SDK](#).
2. Download [samples from GitHub](#). select Code › Download as ZIP.



3. Make sure that the version of Python installed is between 3.6.5 and 3.10.



If **Add Python to PATH** was not selected during installation, please add the following two directories to the **Path** environment variable:

- xxx/AppData/LocalProgramsPython/Python36/
- xxx/AppData/LocalProgramsPython/Python36/Scripts/

4. [Connect the camera and computer correctly.](#)

## Instructions

### Setting up Python

Press Win + R on the keyboard to open Run box. Type "PowerShell" and then press Ctrl+Shift+Enter to run PowerShell as Administrator.

- Required: Mech-Eye API.

```
pip install MechEyeAPI
```

If an error occurs, please enter the command as below:

```
pip install MechEyeAPI -i http://pypi.douban.com/simple/ --trusted-host
pypi.douban.com
```

- Optional: Open3D and OpenCV.

Sample	Open3D	OpenCV
CaptureColorMap		✓
CaptureDepthMap		✓
CapturePointCloud	✓	
CaptureHDRPointCloud	✓	
CapturePointCloudROI	✓	
CaptureCloudFromDepth	✓	

Installation command:

```
pip install opencv-python
```

### Run Samples

The example below shows how to run CaptureColorMap.exe:

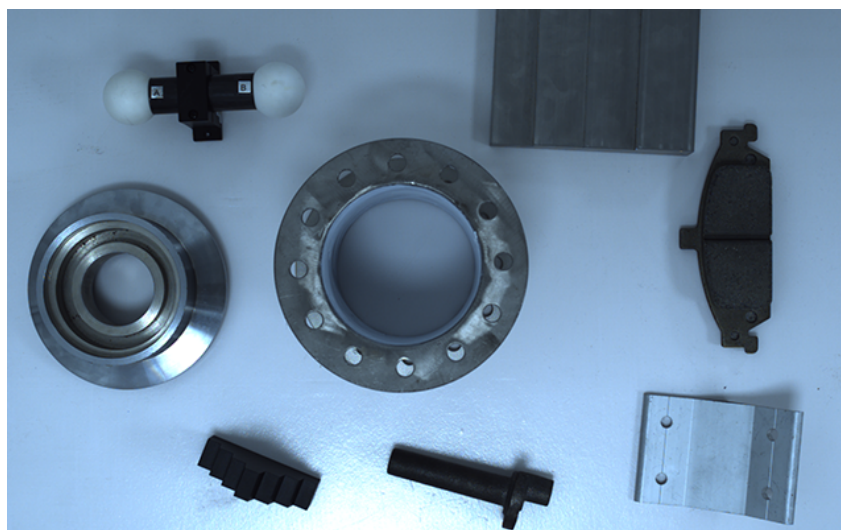
1. Navigate to the directory where CaptureColorMap.py is located.

```
cd xxx/mecheye_python_samples/source/Basic
```

2. Run the sample.

```
python CaptureColorMap.py
```

3. After running the program, you will get the 2D image (named **ColorMap**) in the Build directory.





### 6.3.5. Python (Ubuntu)

This topic introduces how to run the Python samples on Ubuntu.

#### Sample List

Samples are divided into 5 categories, **Basic**, **Advanced**, **Util**, **Laser** and **UHP**.

- **Basic**: camera connection and basic capturing functions.
- **Advanced**: advanced capturing functions.
- **Util**: obtain information from a camera and set camera parameters.
- **Laser**: for the Laser, DEEP and LSR series cameras only.
- **UHP**: for the UHP series cameras only.

The samples in each category and their descriptions are provided below.

#### ▼ Basic

- [ConnectToCamera](#): Connects to a camera.
- [ConnectAndCaptureImage](#): Connects to a camera and obtains the 2D image, depth map and point cloud data.
- [CaptureColorMap](#): Obtains and saves the 2D image from a camera.
- [CaptureDepthMap](#): Obtains and saves the depth map from a camera.
- [CapturePointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with a single exposure time.
- [CaptureHDRPointCloud](#): Obtains and save untextured and textured point clouds generated from images captured with multiple exposure times.
- [CapturePointCloudROI](#): Obtains and save untextured and textured point clouds of the objects in the ROI from a camera.
- [CapturePointCloudFromTextureMask](#): Constructs and saves untextured and textured point clouds generated from a depth map and masked 2D image.

#### ▼ Advanced

- [CaptureCloudFromDepth](#): Constructs and saves point clouds from the depth map and 2D image obtained from a camera.
- [CaptureSequentiallyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds sequentially from multiple cameras.
- [CaptureSimultaneouslyMultiCamera](#): Obtains and saves 2D images, depth maps and point clouds simultaneously from multiple cameras.
- [CaptureTimedAndPeriodically](#): Obtains and saves 2D images, depth maps and point clouds periodically for the specified duration from a camera.

#### ▼ Util

- [GetCameraIntri](#): Gets and prints a camera's intrinsic parameters.
- [PrintDeviceInfo](#): Gets and prints a camera's information such as model, serial number, firmware version and temperatures.
- [SetDepthRange](#): Sets the range of depth values to be retained by a camera.

- [SetParameters](#): Sets specified parameters to a camera.
- [SetUserSets](#): Performs functions related to parameter groups, such as obtaining the names of all available parameter groups, selecting a parameter group, and saving the parameter values to the current parameter group. The parameter group feature allows user to save and quickly apply a set of parameter values.

#### ▼ Laser

- [SetLaserFramePartitionCount](#): Divides the projector FOV into partitions and project structured light in one partition at a time. The output of the entire FOV is composed from images of all partitions.
- [SetLaserFrameRange](#): Sets the projection range of the structured light. The entire projector FOV is from 0 to 100.
- [SetLaserFringeCodingMode](#): Sets the coding mode of the structured light pattern.
- [SetLaserPowerLevel](#): Sets the output power of the laser projector in percentage of max power. This affects the intensity of the laser light.

#### ▼ UHP

- [SetUHPCaptureMode](#): Sets the capture mode (capture images with 2D camera 1, with 2D camera 2, or with both 2D cameras and compose the outputs).
- [SetUHPFringeCodingMode](#): Sets the coding mode of the structured light pattern.

The following samples require third-party libraries to be installed (instructions provided below):

Samples	open3d	opencv-python
CaptureColorMap		✓
CaptureDepthMap		✓
CapturePointCloud	✓	
CaptureHDRPointCloud	✓	
CapturePointCloudROI	✓	
CapturePointCloudFromTextureMask	✓	
CaptureCloudFromDepth	✓	

## Requirements

1. [Connect the camera and computer correctly.](#)
2. Make sure that the version of Python installed is between 3.6.5 and 3.10.
3. [Download and install the latest version of Mech-Eye SDK.](#)
4. (Optional) Install OpenCV.

```
sudo apt-get install libopencv-dev
sudo apt-get install python3-opencv
```

5. (Optional) Install Open3D.

```
sudo pip install open3d
```

## Instructions

### Install Required Software

1. Install pip.

```
sudo apt install python3-pip
```

If you have already installed pip, please make sure that the version of pip is 20.3 or above. Use the following command to upgrade pip:

```
python3 -m pip install --upgrade pip
```

2. Install Mech-Eye API.

```
sudo pip3 install MechEyeApi
```

### Run Samples

1. Download the samples.

```
cd ~  
git clone https://github.com/MechMindRobotics/mecheye_python_samples.git
```

2. Open a sample folder and run the sample (taking **ConnectToCamera.py** as an example).

```
cd ~/mecheye_python_samples/source/Basic  
sudo python3 ConnectToCamera.py
```

You will be prompted to enter the index of the camera that you want to connect:

```
Find Mech-Eye device...  
Mech-Eye device index : 0  
Camera Model Name: Mech-Eye Pro M Enhanced  
Camera ID:          NEC15221A3000001  
Camera IP Address: 192.168.xx.xx  
Hardware Version:  Vx.x.x  
Firmware Version:  Vx.x.x  
.....
```

```
Please enter the device index you want to connect: 0
```

Please enter the index and press Enter to confirm. Below is an example of the full output of ConnectToCamera.py (0 is entered for the index):

```
Connected to the Mech-Eye device successfully.
Disconnected from the Mech-Eye device successfully.
```



- For samples that involve point cloud acquisition, a regular user is unable to write point cloud files, so please use the sudo command to run the sample as the admin.
- For samples that involve image and point cloud acquisition, when the sample execution is complete, the image and point cloud data is by default saved to the folder of the sample.

When writing your own program, use the import command to import Mech-Eye API first, and import Mech-Eye API before importing Open3D:



```
python3
import MechEye
import open3d
```

### 6.3.6. ROS

This topic introduces how to use Mech-Eye SDK on the ROS platform on Ubuntu.

#### Requirements

1. Operating system: [Ubuntu](#).
2. ROS installed according to instructions on [Documentation of ROS](#).



- In the example below, the Ubuntu system's version is **18.04**, but the installation of ROS will be different for different versions of Ubuntu systems.
- If using a virtual machine to install the software, please reserve more than **20 GB** of disk space; otherwise, the installation may fail.
- If after following the instructions below, you can run turtlesim normally, you have successfully installed ROS:

1. Open a terminal in any directory and enter the command:

```
roscore
```

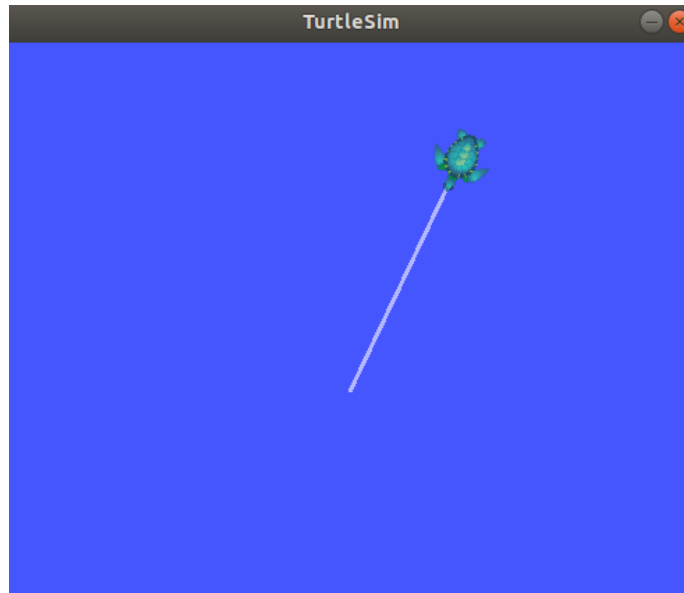
2. Open a second terminal and enter the command:

```
roslaunch turtlesim turtlesim_node
```

3. Open a third terminal and enter the command:

```
roslaunch turtlesim turtlesim
```

After executing the above command, in the third terminal window, you will be able to control the little turtle by pressing the up, down, left, and right keys on the keyboard, as shown in the figure below.



## Requirements

### Install Mech-Eye SDK for Ubuntu

Please refer to [Install Mech-Eye SDK on Ubuntu](#) for instructions.

### Install ROS API

1. Install libzmq5 and libzmq3-dev.

```
sudo apt install libzmq5 libzmq3-dev
```

2. Create directory `~/ros_ws/src` and open it.

```
mkdir -p ~/ros_ws/src && cd ~/ros_ws/src
```

3. Clone repository `mecheye_ros_interface` to directory `~/ros_ws/src`.

```
git clone https://github.com/MechMindRobotics/mecheye_ros_interface
```

4. Open directory `~/ros_ws` and build.

```
cd ~/ros_ws && catkin_make
```

## 5. Modify the files.

- If you need to save the data, please change `false` to `true` in the line `<arg name="save_file" default="true" />` in the file `~/ros_ws/src/mecheye_ros_interface/launch/start_camera.launch`.
- The path for saving the data can be modified in the file `~/ros_ws/src/mecheye_ros_interface/src/main.cpp`.

## Run the Service

1. Open a new terminal and run the following command to start the service.

```
source ~/ros_ws/devel/setup.bash
roslaunch mecheye_ros_interface start_camera.launch
```

The output is as follows:

```
... logging to /home/mechmind/.ros/log/69ffe3a2-d290-11ec-828a-
000c29351753/roslaunch-ubuntu-4349.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://ubuntu:38711/

SUMMARY
=====

PARAMETERS
* /mechmind_camera_start/camera_ip: 192.168.0.123
* /mechmind_camera_start/fx: 1727.46410256
* /mechmind_camera_start/fy: 1727.45869267
* /mechmind_camera_start/save_file: False
* /mechmind_camera_start/u: 655.818082573
* /mechmind_camera_start/use_external_intri: False
* /mechmind_camera_start/v: 516.630650061
* /rostdistro: melodic
* /rosversion: 1.14.13

NODES
 /
   mechmind_camera_start (mecheye_ros_interface/start)

auto-starting new master
```

```

process[master]: started with pid [4359]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to 69ffe3a2-d290-11ec-828a-000c29351753
process[rosout-1]: started with pid [4370]
started core service [/rosout]
process[mechmind_camera_start-2]: started with pid [4377]
Find Mech-Eye devices...
Mech-Eye device index : 0
.....
Camera Model Name: Mech-Eye Pro M Enhanced
Camera ID:          Sample
Camera IP Address: 192.168.xx.xx
Hardware Version:  Vx.x.x
Firmware Version:  Vx.x.x
.....
Please enter the device index you want to connect: 0
Connected to the Mech-Eye device successfully.
.....
Camera Model Name: Mech-Eye Nano
Camera ID:          TAM06218A3020706
Camera IP Address: 192.168.xx.xx
Hardware Version:  Vx.x.x
Firmware Version:  Vx.x.x
.....
    
```

- Open another new terminal and run the following command to acquire data.

```

source ~/ros_ws/devel/setup.bash
rosservice call /run_mechmind_camera
    
```

The output is as follows:

```

success: True
message: ''
    
```

At this point, the camera has been connected. Data such as 2D images and depth maps are saved in the folder `/tmp` by default.



Every time you modify a file under `~/ros_ws/src/mecheye_ros_interface/src`, please do `cd ~/ros_ws && catkin_make` to update the executable.

## 6.4. Tools



### 6.4.1. Firmware Upgrade Tool

With this tool, you can upgrade the camera firmware on Ubuntu directly, simplifying the processing of camera firmware upgrade.

The camera firmware upgrade tool consists of two parts: the executable file `firmware_update_tool` and the firmware upgrade package `mmind_eye_vx.x.x.zip`.

Follow these steps to upgrade the camera firmware:

1. [Download and install the latest version of Mech-Eye SDK.](#)
2. Execute the following command to give execute permission to `firmware_update_tool`.

```
chmod 777 /opt/mech-mind/mech-eye-sdk/bin
```

3. Execute the following command to upgrade the firmware. Make sure to replace `x.x.x` with the actual installed version of Mech-Eye SDK.

```
sudo /opt/mech-mind/mech-eye-sdk/bin/firmware_update_tool /opt/mech-mind/mech-eye-sdk/resource/mmind_eye_vx.x.x.zip
```



- The two paths must be separated by a space. If not separated, the paths cannot be recognized, and the camera firmware upgrade tool cannot be executed. Write the path of `firmware_update_tool` first and the path of `mmind_eye_vx.x.x.zip` second. If the order is incorrect, the camera firmware upgrade tool cannot be executed.

4. Input the device index of the camera whose firmware needs to be upgraded according to the instruction, and press **Enter** to connect. If the following content is displayed, the firmware has been successfully upgraded.

```
Firmware version: VX.X.X install completed.
Upgrade Completed
The camera will restart after this upgrade.
Sending file update_reboot.sh ...
Execute shell: sh /home/ubuntu/Downloads/update_reboot.sh.
```



If the firmware upgrade failed, please retry or contact Technical Support.

## 6.5. Mech-Eye API Reference

Thank you for using Mech-Eye API! Please refer to [Mech-Eye API Reference](#) for detailed information.

## 7. GenICam Interface

---

Mech-Eye Industrial 3D Camera (“camera”) supports the GenICam standard, which allows GenICam-compliant third-party machine vision software (“GenICam clients”) to control them.

After upgrading the camera firmware to 2.0.0 or above, you can directly control the camera with GenICam clients, such as HALCON (MVTec) and VisionPro (Cognex), without any extra procedures.

---

Basic knowledge on **GenICam**:

### [GenICam Basics](#)

---

Instructions on **using HALCON to control the camera**:

- [HALCON: Connect to Camera, Perform Image Capturing, and Adjust Parameters](#)
- [HALCON: Hand-Eye Calibration](#)
- [HALCON: Obtain Textured Point Cloud](#)
- [HALCON: Obtain Depth Values Only](#)
- [HALCON: Set IP Address](#)
- \*\*

Useful reference information for using GenICam:

- [Camera Parameters Supported for GenICam](#)
- [Use Mech-Eye Viewer to Adjust Camera Parameters for GenICam Client](#)
- [Obtain HALCON-Readable Point Cloud through Mech-Eye API](#)

### 7.1. GenICam Basics

This topic covers the following contents: **Introduction**, **Mechanism** and **Supporting GenICam**.

#### Introduction

GenICam is a common machine vision industry standard developed by the European Machine Vision Association (EMVA), which allows the use of a unified programming interface to control machine vision cameras.

GenICam provides a widely-applicable programming interface that provides an end-to-end configuration interface for standard interfaces including GigE Vision, USB 3.0 Vision, Camera Link, and IEEE 1394.

For cameras compliant with GenICam, GenICam-compliant machine vision software such as HALCON (MVTec), VisionPro (Cognex) can be used to conveniently connect and control cameras without camera-specific configuration.

## Mechanism

1. A GenICam-compliant camera provides an XML descriptor file, which describes the camera parameters and indicates the features and functions provided by the camera. A GenICam-compatible machine vision software converts the XML file into the GenAPI application programming interfaces or graphical user interface elements.
2. A GenICam-compatible machine vision software converts the XML file into the GenAPI application programming interfaces or graphical user interface elements.
3. By using the application programming interfaces or graphical user interface on the machine vision software, you can easily access and use the features and functions provided by the camera.

For more information about GenICam, please visit: [GenICam](#).

## Supporting GenICam

After upgrading the camera firmware to 2.0.0 or above, you can control cameras with third-party machine vision software such as HALCON (MVTec) and VisionPro (Cognex).

For camera parameters provided for GenICam by the camera and their description, refer to [Camera Parameters Supported for GenICam](#).

If you want to connect and manage the camera with the HALCON software, refer to [HALCON: Connect to Camera, Perform Image Capturing, and Adjust Parameters](#).

## 7.2. HALCON

### 7.2.1. HALCON: Connect to Camera, Perform Image Capturing, and Adjust Parameters

This topic provides instructions on connecting to a Mech-Eye Industrial 3D Camera, perform image capturing, and adjust camera parameters of the camera with HALCON image acquisition assistant and the HALCON sample program provided by Mech-Mind.

#### Prerequisites

- [The camera and computer are properly connected.](#)



For Nano (V3) and Pro XS (V3), it is recommended to connect the camera directly to the computer without using a network switch.

- [HALCON 20.11 or above has been installed on computer.](#)



HALCON versions below 20.11 are not fully tested.

- Mech-Eye SDK 2.0.0 or above has been installed on computer.



The version of the camera firmware must be consistent with that of Mech-Eye SDK. If not, please [upgrade the camera firmware](#).

- The IP addresses of the camera and computer are in the same subnet.



It is recommended to use static IP addresses. For instructions on setting the camera IP address, please refer to [Set Camera IP Address with Mech-Eye Viewer](#).

In HDevelop, you can connect to the camera with the image acquisition assistant or the sample

program provided by Mech-Mind.

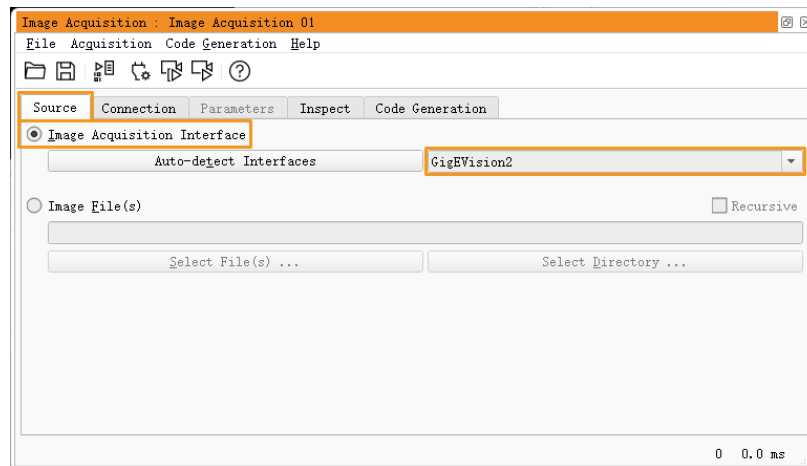
## Use Image Acquisition Assistant

Using the image acquisition assistant provided by HDevelop, you can quickly connect to the camera, perform image capturing and adjust camera parameters.

To open the image acquisition assistant: open HDevelop, and in the menu bar, select Assistants > Open New Image Acquisition.

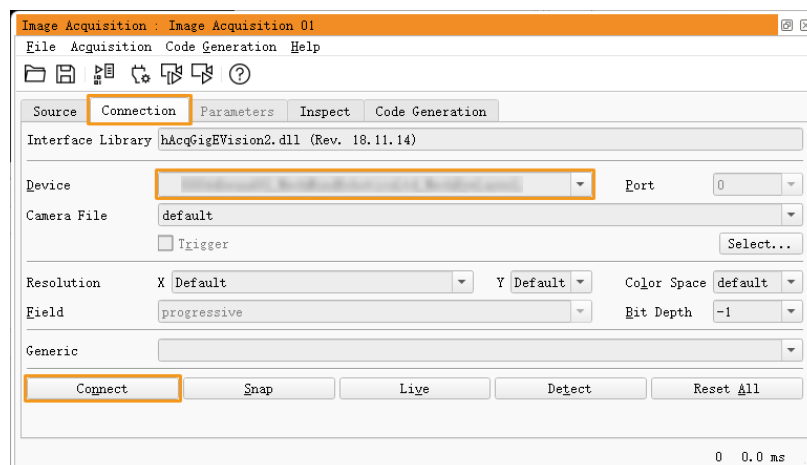
### Connect to the Camera

1. In the Image Acquisition window, under the **Source** tab, select **Image Acquisition Interface**, and select **GigEVision2** from the drop-down menu.



If the **GigEVision2** option is unavailable, the GigEVision2 image acquisition interface is not installed. Please refer to HALCON's Installation Guide and install the interface through MVTec Software Manager (SOM).

2. Under the **Connection** tab, from the drop-down menu of **Device**, select the device you would like to connect. Then, click **[ Connect ]** in the lower left.



- If the camera is successfully connected, the **[ Connect ]** button changes to **[ Disconnect ]**. If this change does not occur, the camera connection failed. To disconnect from the camera in HDevelop, click **[ Disconnect ]**.
- If the camera is already connected by another client, it cannot be connected by

HDevelop. Please disconnect the camera from the other client first.

- The camera name displayed in **Device** can be customized in Mech-Eye Viewer for easier distinction. Connect to the camera in Mech-Eye Viewer, and then [customize the camera name](#). Avoid using special characters such as letters with accent marks, as these characters cannot be displayed in HDevelop.

## Perform Image Capturing

To perform image capturing once: under the **Connection** tab, click **[ Snap ]**.



If the image capturing process takes too long, you can increase the MTU size of the camera, and [enable jumbo frames](#) on your computer.

You can also perform image capturing multiple times or continuously. To do this, you need to adjust the **AcquisitionMode** parameter first.

- To perform image capturing multiple times:
  - Switch to the **Parameters** tab, set the value of the **AcquisitionMode** parameter to **MultiFrame**.
  - Click **[ Refresh ]** in the upper right, and then set the number of times for image capturing in the **AcquisitionFrameCount** parameter.
  - Switch to the **Connection** tab and click **[ Live ]** to perform image capturing.
  - After the set times of image capturing are completed, the **[ Live ]** button becomes **[ Stop ]**. Click **[ Stop ]** to stop image capturing.
- To perform image capturing continuously:
  - Switch to the **Parameters** tab, set the value of the **AcquisitionMode** parameter to **Continuous**.
  - Switch to the **Connection** tab and click **[ Live ]** to perform image capturing.
  - The **[ Live ]** button becomes **[ Stop ]**. Click **[ Stop ]** to stop image capturing.



- You can still use **[ Snap ]** to perform single-time image capturing when **AcquisitionMode** is set to **MultiFrame** or **Continuous**.
- When **AcquisitionMode** is set to **SingleFrame**, you can only perform single-time image capturing.

## Select Data Type

After the camera is connected, the 2D image is obtained by default. You can select whether to obtain 2D image or depth map by adjusting the **DeviceScanType** parameter.

1. Click the **Parameters** tab and find the **DeviceScanType** parameter. Set its value according to your needs. The parameter values are explained below:

Value	Data type
Areascan	2D image
Areascan3D	Depth map (an image containing depth information)

2. Perform image capturing to obtain the data type that you selected.



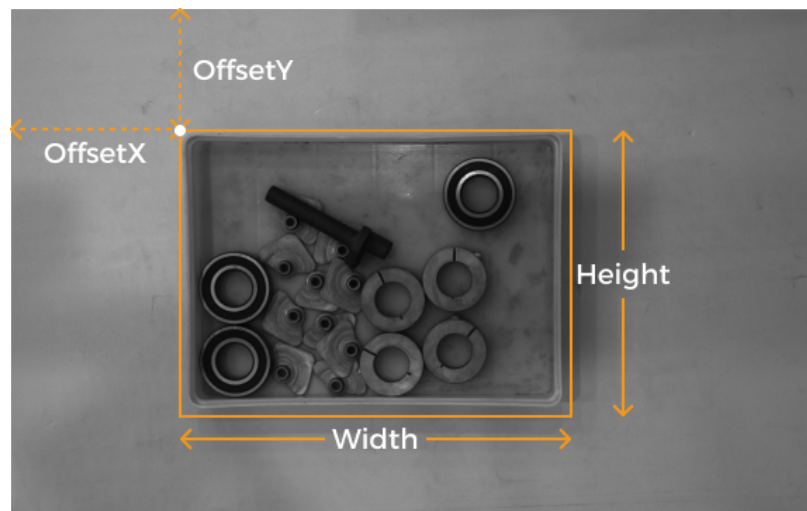
If **Update Image** in the upper right of the **Parameters** tab is checked, the image in the **Canvas** window is automatically updated as you adjust the parameters.

## Set Capture Region

After the camera is connected, if you need to trim the obtained image, you can set a capture region by adjusting the **Height**, **Width**, **OffsetX** and **OffsetY** parameters.

To set a capture region, follow these steps:

1. Select the data type for setting a capture region.
2. Perform image capturing once with [ **Snap** ] to check the current image.
3. Switch to the **Parameters** tab and adjust the **Height**, **Width**, **OffsetX** and **OffsetY** parameters. The following figure shows the four parameters and the capture region defined (orange box) relative to the original image.



- **Width**: the width of the capture region
- **Height**: the height of the capture region
- **OffsetX**: the x-coordinate of the upper-left corner of the capture region (the upper-left corner of the original image being (0, 0))
- **OffsetY**: the y-coordinate of the upper-left corner of the capture region



The above four parameters must satisfy the following requirements:

- $(\text{Width} + \text{OffsetX})$  not greater than the width of the original image
- $(\text{Height} + \text{OffsetY})$  not greater than the height of the original image

The width and height of the original image are displayed in the **WidthMax** and **HeightMax** parameters under **Read-only parameters** (**Visibility** level must be set to **Expert** or higher).

4. Perform image capturing again to see the trimming result.



If **Update Image** in the upper right of the **Parameters** tab is checked, the image in the **Canvas** window is automatically updated as you adjust the parameters.

1. Switch to the **Code Generation** tab, click [ **Insert Code** ] to generate the corresponding code.
2. If you need to set a capture region for the other data type:
  - a. Disconnect from the camera in the current image acquisition assistant.

- b. Open a new image acquisition assistant, and connect to the camera.
- c. Select the other data type and repeat the above steps.



- The values of the four capture region parameters are not saved to parameter groups. If the camera is powered off, their values are reset. Please generate the corresponding code and save the code for future reference.
- The values of these parameters are also reset if the values of the **DeviceScanType** and **Scan3DBininingEnable** parameters are changed.

### Comparison of Capture Region and Scan3DROI

Mech-Eye Industrial 3D Camera provides another set of parameters for setting an ROI: **Scan3DROILeft**, **Scan3DROIHeight**, and **Scan3DROIWidth** (collectively referred to as "Scan3DROI").

The differences between the capture region parameters and Scan3DROI parameters are summarized below. Please select the set of parameters that suit your needs.

Capture region	Scan3DROI
Not saved to parameter groups, reset if camera powered off	Can be saved to parameter groups
Applicable to 2D image and depth map	Not applicable to 2D image
Image is trimmed	Image not trimmed
Can only be set in HDevelop	Can be set with <a href="#">visualized tool in Mech-Eye Viewer</a>

### Adjust Parameters

If the quality of the obtained data is unsatisfactory, you can adjust the camera parameters under the **Parameters** tab.

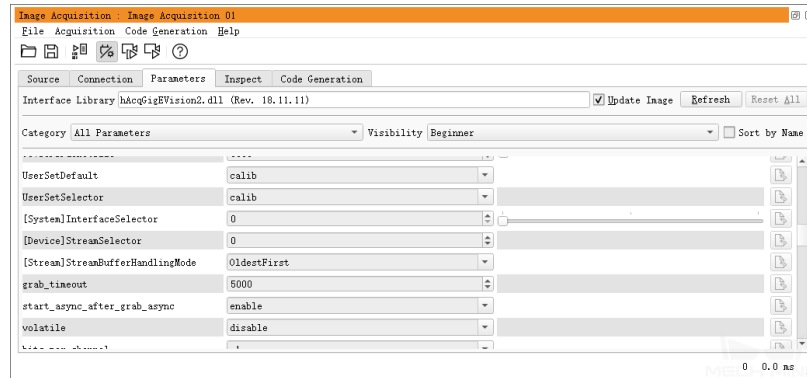


- The camera supports the [parameter group](#) function. By selecting a different parameter group, you can quickly change the parameter configuration for the camera. When adjusting parameters, please select a parameter group for saving the parameter values first.
- You can add or delete a parameter group in Mech-Eye Viewer. After configuring the parameter group in Mech-Eye Viewer, click the **[ Refresh ]** button in the upper-right corner of the **Parameters** tab in the image acquisition assistant to obtain the latest camera configuration.

To adjust the camera parameters, follow these steps:

1. After the camera is connected, click the **Parameters** tab, set the **UserSetSelector** parameter to the parameter group that you want to modify.





2. Find the **UserSetLoad** parameter, and click **[ Apply ]** to the right to read in the configuration.

 If parameter values are not updated after you click **[ Apply ]**, please click it again.

3. Find the parameter that you want to adjust and change its value.

4. Find the **UserSetSave** parameter, and click **[ Apply ]** to the right to save the configuration.

5. Switch to the **Code Generation** tab, click **[ Insert Code ]** to generate the corresponding code.

## References

- Camera parameters supported for GenICam generally correspond with those provided in Mech-Eye Viewer. For the parameter correspondence, descriptions and explanations of camera parameters supported for GenICam, please refer to [Camera Parameters Supported for GenICam](#).
- Setting camera parameters such as **Auto-Exposure ROI**, **Depth Range** and **ROI** usually requires the assistance of visualized tools for several rounds of fine tuning. Since HALCON does not provide visualized tools, you can set these parameters using the visualized tools provided by Mech-Eye Viewer. For detailed information, refer to [Use Mech-Eye Viewer to Adjust Camera Parameters for GenICam Client](#).



You must disconnect from the camera in HDevelop before you can connect to it in Mech-Eye Viewer and adjust parameters. If you fail to connect the camera in Mech-Eye Viewer, close HDevelop and try again.

## Use HALCON Sample Program

A series of [HALCON sample programs](#) are provided on GitHub. This section introduces how to use the `connect_to_camera_and_capture_images` sample program to connect to a camera, perform image capturing, adjust camera parameters, and save the data. You can run the program as is or modify it to better suit your needs.




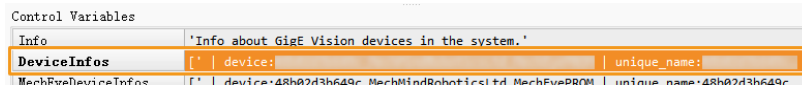
The HALCON sample program is written in C++ and can be executed in the HDevelop integrated development environment directly.

## Run the Sample Program

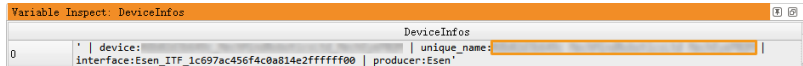
Please follow these steps to run the sample program:

1. [Download the connect\\_to\\_camera\\_and\\_capture\\_images sample program](#): select Code > Download ZIP.
2. Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.

3. Select the line containing the `info_framegrabber` operator in **Program Windows**, and click  in the toolbar or press the **F6** key to run this line.
4. In the **Control Variables** area, double-click **DeviceInfos** to display a list of all the available cameras.




5. In the list, double-click the camera that you want to connect, and copy the camera name after `unique_name:` or `user_name:`.




`user_name` is the custom camera name. You can [customize the camera name in Mech-Eye Viewer](#).

6. Locate the following line, and replace **MechEye** with the copied `unique_name` or `user_name`.

```
DeviceInfo := 'MechEye'
```

7. Run the sample program by clicking  in the toolbar or pressing the **F5** key.
8. If the program is successfully executed, you can find the saved 2D image and point cloud in the folder where the sample program is located. The default file names are **image2d.bmp** and **PointCloud.ply**.



- After executing the entire sample program, please click  in the toolbar to reset program execution. Otherwise, the camera cannot be connected by Mech-Eye Viewer.
- When the point cloud is displayed in the **Canvas** window, please click the orange **[Continue]** button in this window to continue the program execution. Otherwise, the program is stuck in the `visualize_object_model_3d` operator and will not proceed.
- If the image capturing process takes too long, you can increase the MTU size of the camera, and [enable jumbo frames](#) on your computer.
- If the network connection is poor, you can reduce data loss by increasing the maximum number of allowed packet gaps with the following operator. Replace **ParameterValues** with the number of allowed packet gaps.

```
set_framegrabber_param (AcqHandle,
    '[Stream]GevStreamMaxPacketGaps', ParameterValues)
```

## Adjust Parameters

If the quality of the obtained data is unsatisfactory, you can adjust the camera parameters under the Parameters tab.



- The camera supports the parameter group function; by selecting a different parameter group, you can quickly change the parameter configuration for the camera. Camera parameters must be set and saved under a parameter group.
- You can add or delete a parameter group in Mech-Eye Viewer.

To adjust the camera parameters, follow these steps:

1. Use the following operator to obtain a list of available parameter groups.

```
get_framegrabber_param (AcqHandle, 'UserSetSelector_values',  
ParameterValues)
```

2. View the list of parameter groups in the **ParameterValues** variable in the **Control Variables** area.
3. Use the following operator to select the parameter group to modify. **UserSetSelector** and **UserSetLoad** are the camera parameters used to select and load a parameter group, respectively. Replace **ParameterGroupName** with the actual parameter group name.

```
set_framegrabber_param (AcqHandle, 'UserSetSelector', 'ParameterGroupName')  
set_framegrabber_param (AcqHandle, 'UserSetLoad', 'ParameterGroupName')
```

4. Use the following operator to obtain the value of the specified parameter. Replace **ParameterName** with the actual camera parameter name. **ParameterValues** is the variable used to save the parameter value, and you can change it according to actual needs. Note that this variable does not need to be included in parentheses.

```
get_framegrabber_param (AcqHandle, 'ParameterName', ParameterValues)
```

5. View the parameter value in the **ParameterValues** variable in the **Control Variables** area.
6. Use the following operator to adjust the setting of the specified parameter. Replace **ParameterName** with the actual camera parameter name and **NewParameterValue** with the new parameter value.

```
set_framegrabber_param (AcqHandle, 'ParameterName', 'NewParameterValue')
```

7. Use the following operator to save the parameter value modification into the parameter group. **UserSetSave** is the camera parameter used to save the parameter group. Replace **ParameterGroupName** with the actual parameter group name.

```
set_framegrabber_param (AcqHandle, 'UserSetSave', 'ParameterGroupName')
```

## References

- Camera parameters supported for GenICam generally correspond with those provided in Mech-Eye Viewer. For the parameter correspondence, descriptions and explanations of camera parameters supported for GenICam, please refer to [Camera Parameters Supported for GenICam](#).
- Setting camera parameters such as **Auto-Exposure ROI**, **Depth Range** and **ROI** usually requires the assistance of visualized tools for several rounds of fine tuning. Since HALCON does not provide visualized tools, you can set these parameters using the visualized tools provided by Mech-Eye Viewer. For detailed information, refer to [Use Mech-Eye Viewer to Adjust Camera](#)

### Parameters for GenICam Client.



You must disconnect from the camera in HDevelop before you can connect to it in Mech-Eye Viewer and adjust parameters. If you fail to connect the camera in Mech-Eye Viewer, close HDevelop and try again.

## 7.2.2. HALCON: Hand-Eye Calibration

This topic introduces how to perform hand-eye calibration in Windows using the HALCON sample programs provided by Mech-Mind. Mech-Mind provides the following two sample programs:

- **determine\_calibration\_poses**: used to determine the calibration poses used during the hand-eye calibration.
- **perform\_hand\_eye\_calibration**: used to perform hand-eye calibration.



- Currently, the sample programs only support hand-eye calibration of 6-axis robots.
- For UHP series, to perform the hand-eye calibration, the **Capture Mode** parameter must be set to **Camera1**.

### Prerequisites

Before performing the hand-eye calibration, please make sure that the following requirements are satisfied:

1. The accuracy of the robot is good enough, and the robot can operate properly.
2. Prepare the calibration board that came with the camera, and [mount the calibration board](#).
3. [Download and install the latest version of Mech-Eye SDK](#).
4. Make sure that the quality of the 2D image and depth map [meet the requirements](#).
5. Make sure that the [camera intrinsic parameters are accurate](#).
6. Download the [hand\\_eye\\_calibration sample programs](#): select Code > Download ZIP.

### Edit the Sample Programs

After determining the calibration poses with the **determine\_calibration\_poses** sample program, you will use the **perform\_hand\_eye\_calibration** sample program to perform the hand-eye calibration.

The following information must be identical in the two sample programs:


- The camera to be connected
- Calibration board model

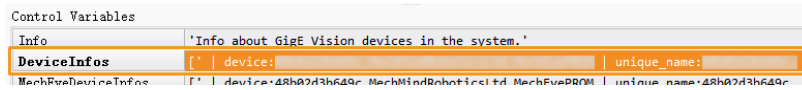
Besides, the Euler angle convention in the **robot\_pose** JSON file should be set before determining the calibration poses.

### Select the Camera

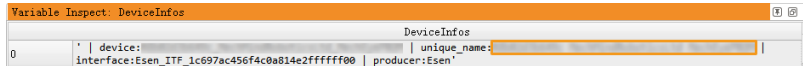
Before running the sample programs, you need to set the camera to be connected in the sample program to make sure the two programs connect to the same camera. Please follow these steps:

1. Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.

2. Select the line containing the `info_framegrabber` operator in **Program Windows**, and click  in the toolbar or press the **F6** key to run this line.
3. In the **Control Variables** area, double-click **DeviceInfos** to display a list of all the available cameras.



4. In the list, double-click the camera that you want to connect, and copy the camera name after `unique_name:` or `user_name:`.



`user_name` is the custom camera name. You can [customize the camera name in Mech-Eye Viewer](#).

5. Locate the following line, and replace **MechEye** with the copied `unique_name` or `user_name`.

```
DeviceInfo := 'MechEye'
```

## Set Calibration Board Model

Please follow these steps to set the calibration board model:

1. Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.
2. Set the calibration board model: The default model is BDB-5. If you are using another model, locate the following operator, and change **BDB-5** to the [calibration board model](#) in use.

```
set_framegrabber_param (AcqHandle, 'BoardType', 'BDB-5')
```

## Set Euler Angle Convention and Unit

The calibration poses determined using the `determine_calibration_poses` sample program need to be entered into the `robot_pose` JSON file. The default Euler angle convention in this file is **sxyz**, and the default unit is degree. Please follow these steps to set the Euler angle convention:

1. Open the `robot_pose` JSON file.
2. Set the Euler angle convention: locate the following line, and replace **sxyz** with the Euler angle convention of the robot in use. For the Euler angle conventions already supported in the sample program, please refer to [Supported Euler Angle Conventions](#).

```
"EulerType": "sxyz"
```

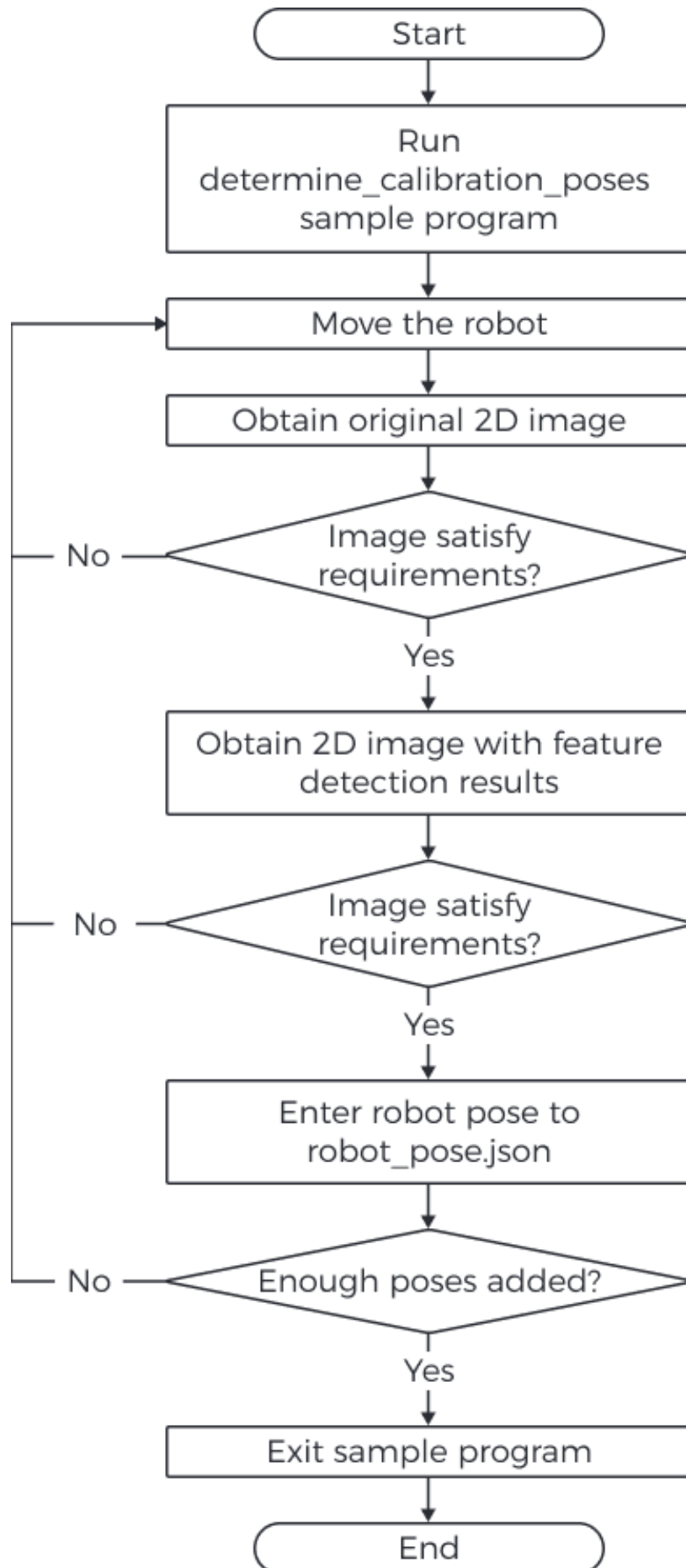
3. Set the Euler angle unit: if you need to enter Euler angles in radians, locate the following line, and replace **true** with **false**.

```
"FromDegree":true
```

4. Save the `robot_pose` JSON file.

## Determine Calibration Poses


### Workflow





## Instructions

Before performing the hand-eye calibration, you need to determine at least 15 calibration poses. Please follow these steps to determine the calibration poses:

1. Run the sample program by clicking  in the toolbar or pressing the **F5** key. When the program runs to the line `read_char (WindowHandle, Char, ReCode)`, the program will pause and wait for command input in the following steps.



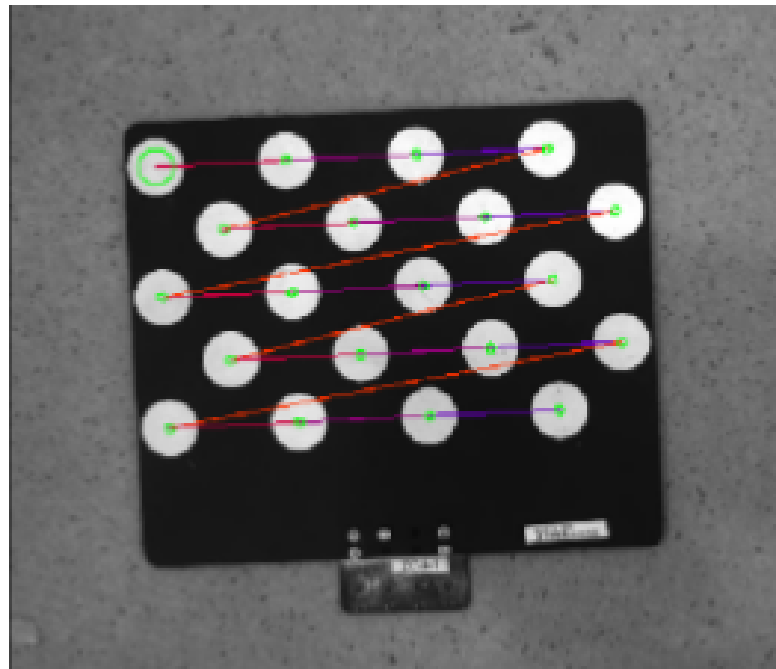
If the camera cannot be connected, please check if it is already connected by Mech-Eye Viewer or another GenICam client.

2. Move the robot to a candidate calibration pose with the teach pendant.



Calibration poses need to satisfy certain requirements. The HALCON Reference provides some guidance: click Help > HALCON Reference in HDevelop and check the **Calibration** chapter.

3. Press **P** to obtain the 2D image from the camera.
  - If the calibration board is not entirely captured, please move the robot and obtain the 2D image again.
  - If the entire calibration board is captured, proceed to the next step.
4. Press **T** to obtain the 2D image containing the feature detection results.
  - If the camera did not detect the circles on the calibration board, no image will be displayed in HDevelop. In this case, please move the robot and obtain the original 2D image and the 2D image containing the feature detection results again.
  - If the camera can detect the circles on the calibration board, a 2D image containing the feature detection results (as shown below) will be displayed in HDevelop. Please proceed to the next step.



5. Check the robot teach pendant, and enter the current robot pose to the `robot_pose` JSON file. The translational component of the pose should be in mm, and the unit of the rotational component (Euler angles) should match the setting in the `robot_pose` JSON file.



It is recommended to save the pose on the teach pendant. When performing the hand-eye calibration, you can use the saved poses to move the robot.

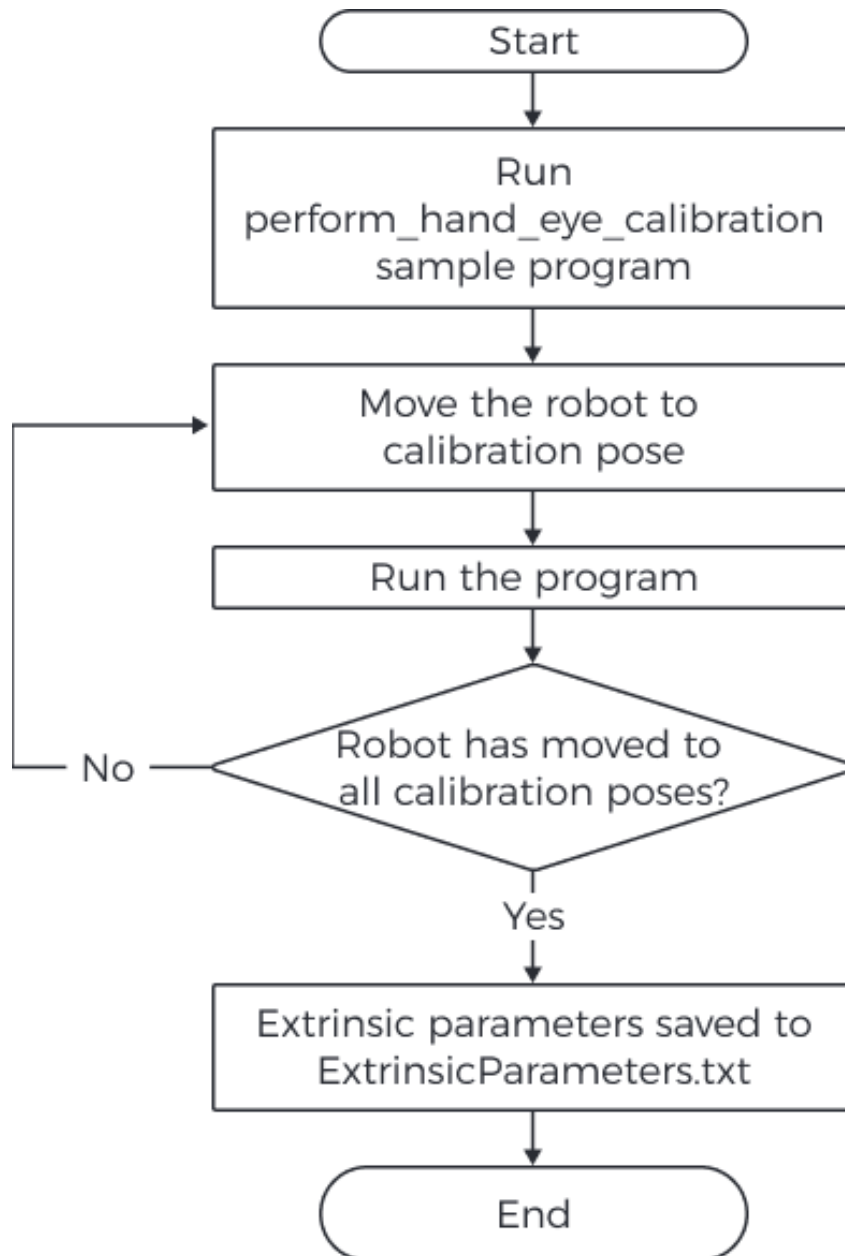
6. Repeat steps 2 to 5 to determine more calibration poses.
7. After determining at least 15 calibration poses, press **Q** to exit the program.
8. Set the number of calibration poses in the **robot\_pose** JSON file: Open the **robot\_pose** JSON file, and locate the following line. Replace **15** with the actual number of calibration poses determined.

```
"pose_count" : 15
```

## Perform Hand-Eye Calibration

After determining the robot calibration poses, you can perform the hand-eye calibration by running the **perform\_hand\_eye\_calibration** sample program.

## Workflow



### Set Camera Mounting Method

Before performing the hand-eye calibration, please set the camera mounting method in the sample program.

The default mounting method is Eye in Hand. If your camera is mounted in the Eye to Hand mode, please locate the following operator, and replace **EyeInHand** with **EyeToHand**.

```
set_framegrabber_param (AcqHandle, 'CalibrationType', 'EyeInHand')
```

### Switch Reference Frame


The sample program contains an operator that can switch the reference frame in which the point cloud is output from the camera.

The default setting is not to switch the reference frame. If you would like to switch to the robot reference frame, please locate the following operator in the `captureTranformedPointCloud` procedure, and replace `false` with `true`.

```
set_framegrabber_param (AcqHandle, 'Scan3dCoordinateTransformEnable', false)
```


## Instructions

Please follow these steps to perform the hand-eye calibration:

1. Run the sample program by clicking  in the toolbar or pressing the **F5** key. The sample program will stop when it runs to the stop operator.
2. Move the robot to the calibration pose in the `robot_pose` JSON file.



Please move the robot to the calibration poses in the exact order as they are written in the JSON file. Otherwise, the subsequent calculation of the extrinsic parameters will fail.

3. Run the sample program by clicking  in the toolbar or pressing the **F5** key. The camera will perform image capturing.
4. In the **Control Variables** area, check the value of **CollectResult**.
  - If **SUCCESS** is displayed, please proceed to the next step.
  - If an error is displayed, please troubleshoot according to the displayed [error code](#), and then determine the calibration poses again.
5. A message saying **Move the robot to the next calibration pose** will be displayed on the image. Please repeat steps 2 to 3.



After the robot has moved to all the calibration poses in the `robot_pose` JSON file, when you run the sample program again, the extrinsic parameters will be calculated.

6. In the **Control Variables** area, check the value of **CalibResult**.
  - If **SUCCESS** is displayed, then the hand-eye calibration has succeeded. In the folder where the sample program is stored, you can find the **ExtrinsicParameters** TXT file that contains the extrinsic parameters and the obtained point cloud.
  - If an error is displayed, please troubleshoot according to the displayed [error code](#), and then determine the calibration poses again.

## Supported Euler Angle Conventions

The conversion from the following Euler angle conventions to quaternions is already supported in the sample program.

Common representation	Euler angle convention	Robot brand
Z-Y'-Z''/OAT	rzyz	Kawasaki
Z-Y'-X''/yaw, pitch, roll	rzyx	ABB
		KUKA

Common representation	Euler angle convention	Robot brand
X-Y-Z/WPR	sxyz	FANUC
		YASKAWA
		ROKAE
		UR
X-Y'-Z''	rxyz	/
Z-X'-Z''	rzxz	/



- Even if using the same Euler angle convention, different robot brands might display the Euler angles in different orders. Please input the Euler angles in the order specified in the above table.
- If the Euler angle convention used by your robot is not listed in the above table, you need to add the conversion from this Euler angle convention to quaternions. Please refer to the code of the `euler_to_quad` procedure in the `perform_hand_eye_calibration` sample program and add your own conversion.

## Hand-Eye Calibration Parameters

This section introduces the parameters used during hand-eye calibration.

### BoardType

This parameter is used to set the model of the calibration board in use.

Value list and descriptions:

Value	Description
BDB-5	The recommended distance from the calibration board to the camera is < 0.6 m
BDB-6	The recommended distance from the calibration board to the camera is 0.6–1.5 m
BDB-7	The recommended distance from the calibration board to the camera is > 1.5 m
OCB-005	Only used for Eye-to-Hand projects with high accuracy requirements
OCB-010	
OCB-015	
OCB-020	
CGB-020	The recommended distance from the calibration board to the camera is < 0.6 m
CGB-035	The recommended distance from the calibration board to the camera is 0.6–1.5 m
CGB-050	The recommended distance from the calibration board to the camera is > 1.5 m

## ExtrinErrCode

This read-only parameter is used to check the status codes returned during the hand-eye calibration process.

Status code	Description
SUCCESS	Successfully executed.
POSE_INVALID	The pose format is incorrect. Please input quaternions.
IMAGE2D_EMPTY	The 2D image is invalid.
FIND_CORNERS_FAIL	Feature detection of the 2D image failed. Please adjust the <a href="#">parameters for the 2D image</a> .
DEPTH_EMPTY	The depth map is invalid.
CORNERS_3D_INVALID	Feature detection of the depth map failed. Please adjust the <a href="#">parameters for the depth map</a> .
POSES_INSUFFICIENT	Not enough poses are input. Please input at least 15 calibration poses.

### 7.2.3. HALCON: Obtain Textured Point Cloud

This topic introduces how to obtain the textured point cloud in Windows using the HALCON sample programs provided by Mech-Mind.

#### Data Types

This sample program obtains the data in the Range and Intensity channels. The data in these channels are described below.

- Range: a 2D image containing the X, Y and Z values of points. This channel cannot be disabled.
- Intensity: The color or monochrome 2D image used to texture the point cloud.


The pixels of the images in the two channels are perfectly aligned and can be used to generate textured point cloud directly.

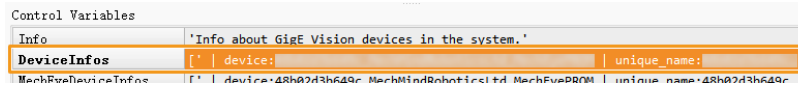


If you need to set capture regions (**Width**, **Height**, **OffsetX** and **OffsetY** parameters) for the images in the two channels, make sure that the parameter values are identical. Otherwise, the pixels of the two images will not be aligned, and the images cannot be used to generate textured point cloud directly.

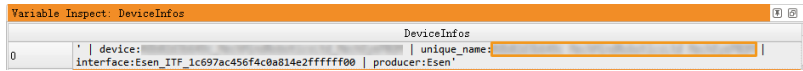
#### Obtain Textured Point Cloud

Please follow these steps to obtain the textured point cloud:

1. [Download the obtain\\_textured\\_point\\_cloud sample program](#): select Code > Download ZIP.
2. Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.
3. Select the line containing the **info\_framegrabber** operator in **Program Windows**, and click  in the toolbar or press the **F6** key to run this line.
4. In the **Control Variables** area, double-click **DeviceInfos** to display a list of all the available cameras.



- In the list, double-click the camera that you want to connect, and copy the camera name after `unique_name:` or `user_name:`.



`user_name` is the custom camera name. You can [customize the camera name in Mech-Eye Viewer](#).

- Locate the following line, and replace **MechEye** with the copied `unique_name` or `user_name`.

```
DeviceInfo := 'MechEye'
```

- When the point cloud is displayed in the **Canvas** window, please click the orange **[ Continue ]** button in this window to continue the program execution.
- The textured point cloud is stored in the **ObjectModel3D** variable.



For DEEP (V4) and LSR (V4) series, the 2D image (texture) is obtained for texturing the point cloud by default. If you want to use the 2D image (depth source) instead, please locate the following line and activate (uncomment) it.


```
set_framegrabber_param (AcqHandle, 'SourceSelector',  
'Monochrome')
```

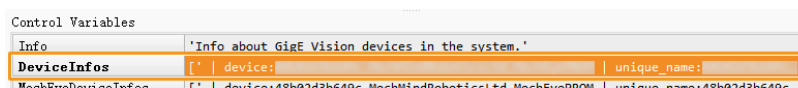
#### 7.2.4. HALCON: Obtain Depth Values Only

This topic introduces how to obtain the depth map that contains only the object depth information in Windows using the HALCON sample programs provided by Mech-Mind. Obtaining only the depth information can speed up the data transmission and improve efficiency.

##### Obtain Depth Map

Please follow these steps to obtain the depth map:

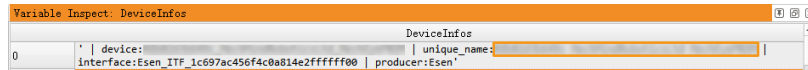
- Download the [obtain\\_depth\\_map](#) sample program: select Code > Download ZIP.
- Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.
- Select the line containing the `info_framegrabber` operator in **Program Windows**, and click  in the toolbar or press the **F6** key to run this line.
- In the **Control Variables** area, double-click **DeviceInfos** to display a list of all the available cameras.



- In the list, double-click the camera that you want to connect, and copy the camera name after



unique\_name: or user\_name:.



**user\_name** is the custom camera name. You can [customize the camera name in Mech-Eye Viewer](#).

- Locate the following line, and replace **MechEye** with the copied **unique\_name** or **user\_name**.

```
DeviceInfo := 'MechEye'
```


- The obtained depth map is stored in the **DepthInM** variable.

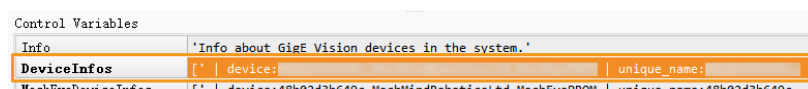
### 7.2.5. HALCON: Set IP Address

This topic introduces how to obtain and modify the camera's current IP address, subnet mask, and gateway in Windows using the HALCON sample programs provided by Mech-Mind.

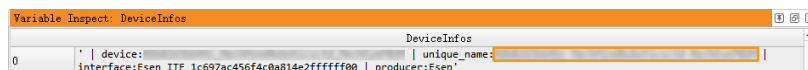
#### Obtain Sample Program and Select Camera

Before obtaining or modifying the IP address, you need to download the sample program and set the camera to be connected in the program.

- Download the [configure\\_camera\\_ip\\_address](#) sample program: select Code > Download ZIP.
- Open the sample program in HDevelop: Open HDevelop, and drag the sample program into HDevelop.
- Select the line containing the **info\_framegrabber** operator in **Program Windows**, and click  in the toolbar or press the **F6** key to run this line.
- In the **Control Variables** area, double-click **DeviceInfos** to display a list of all the available cameras.



- In the list, double-click the camera that you want to connect, and copy the camera name after **unique\_name:** or **user\_name:**.




**user\_name** is the custom camera name. You can [customize the camera name in Mech-Eye Viewer](#).

- Locate the following line, and replace **MechEye** with the copied **unique\_name** or **user\_name**.

```
DeviceInfo := 'MechEye'
```

## Obtain Camera IP Address, Subnet Mask and Gateway

Please follow these steps to obtain the current IP address, subnet mask and gateway of the camera:

Run the sample program by clicking  in the toolbar or pressing the **F5** key. In the **Control Variables** area, check the following variables for the current IP address, subnet mask and gateway of the camera.


- CurrentIPAddressString: IP address
- CurrentSubnetMaskString: subnet mask
- CurrentDefaultGatewayString: gateway




If the camera firmware version is 2.0.2 or below, the above information cannot be obtained, and the error message will be recorded in the **Exception** variable.

## Set Static IP address

This sample program sets a static IP address by default. Please follow these steps to modify the IP address, subnet mask and gateway of the camera:


1. Click  in the toolbar to reset program execution.
2. Locate the following line, and change the IP address, subnet mask and gateway to the values to be set:

```
IPAddressString := '192.168.1.100'  
SubnetMaskString := '255.255.255.0'  
DefaultGatewayString := '192.168.1.1'
```


3. Run the sample program by clicking  in the toolbar or pressing the **F5** key.
4. Restart the camera to make the new settings take effect.

## Set Dynamic IP Address

Please follow these steps to dynamically assign an IP address to the camera:

1. Click  in the toolbar to reset program execution.
2. Locate the following line, and replace **true** with **false**.

```
set_framegrabber_param (AcqHandle, 'GevCurrentIPConfigurationPersistentIP',  
true)
```

3. Run the sample program by clicking  in the toolbar or pressing the **F5** key.
4. Restart the camera to make the new settings take effect.



When the camera is connected to the computer directly, the IP address of the camera cannot be dynamically assigned.

## 7.3. GenICam Reference

This topic provides reference information helpful for using a GenICam client to control the camera.

Camera parameters supported for GenICam clients and their descriptions:

[Camera Parameters Supported for GenICam](#)

Instructions on using Mech-Eye Viewer to adjust camera parameters for a GenICam client:

[Use Mech-Eye Viewer to Adjust Camera Parameters for GenICam Client](#)

Instructions on Obtaining HALCON-readable point clouds through Mech-Eye API:

[Obtain HALCON-Readable Point Cloud through Mech-Eye API](#)

### 7.3.1. Camera Parameters Supported for GenICam

This topic describes the camera parameters provided by the camera for GenICam, which indicates the features and functions provided by the camera.

#### Supported Camera Parameters

For descriptions and explanations of camera parameters supported for GenICam, please download and read [Parameters in GenICam Client](#).

#### Correspondence Between Camera Parameters in GenICam Client and Mech-Eye Viewer



Camera parameters supported for GenICam generally correspond with those provided in Mech-Eye Viewer. Mech-Eye Viewer provides more detailed information such as parameter descriptions and parameter values, which can be helpful for adjusting parameters in GenICam clients.

The following table provides the correspondence between camera parameters in GenICam clients and Mech-Eye Viewer:

Parameter in GenICam Client	Parameter in Mech-Eye Viewer	Visibility	Notes
Scan2DROIHeight	2D Parameters • Auto-Exposure ROI	Beginner	
Scan2DROILeft			
Scan2DROITop			
Scan2DROIWidth			

Parameter in GenlCam Client	Parameter in Mech-Eye Viewer	Visibility	Notes
Scan2DExposureMode	2D Parameters <ul style="list-style-type: none"> <li>Exposure Mode</li> <li>2D Image (Texture) Exposure Mode</li> </ul>	Beginner	
Scan2DExposureTime	2D Parameters <ul style="list-style-type: none"> <li>Exposure Time</li> </ul>	Beginner	
Scan2DExpectedGrayValue	2D Parameters <ul style="list-style-type: none"> <li>Gray Value</li> </ul>	Beginner	
Scan2DHDRExposureSequence	2D Parameters <ul style="list-style-type: none"> <li>Exposure Sequence</li> </ul>	Beginner	
Scan2DToneMappingEnable	2D Parameters <ul style="list-style-type: none"> <li>Tone Mapping</li> </ul>	Beginner	
Scan2DSharpenFactor	2D Parameters <ul style="list-style-type: none"> <li>Sharpen Factor</li> </ul>	Guru	
Scan2DPatternRoleExposureMode	2D Parameters <ul style="list-style-type: none"> <li>2D Image (Depth Source) Exposure Mode</li> </ul>	Beginner	LSR L (V4) DEEP (V4)
Scan2DPatternRoleExposureTime	2D Parameters <ul style="list-style-type: none"> <li>2D Image (Depth Source) Exposure Time</li> </ul>	Beginner	
Scan3DROIHeight	ROI	Beginner	
Scan3DROILeft			
Scan3DROITop			
Scan3DROIWidth			
ProjectorLightColor	3D Parameters <ul style="list-style-type: none"> <li>Projector               <ul style="list-style-type: none"> <li>Light Color</li> </ul> </li> </ul>	Guru	Pro M Enhanced (V3) Pro S Enhanced (V3) Log M (V3) Log S (V3)
ProjectorPowerLevel	3D Parameters <ul style="list-style-type: none"> <li>Projector               <ul style="list-style-type: none"> <li>Light Brightness</li> </ul> </li> </ul>	Expert	DLP cameras

Parameter in GenlCam Client	Parameter in Mech-Eye Viewer	Visibility	Notes
ProjectorFringeCodingMode	3D Parameters <ul style="list-style-type: none"> <li>• Projector               <ul style="list-style-type: none"> <li>◦ Fringe Coding Mode</li> </ul> </li> </ul>	Expert	Nano (V3) Pro XS (V3) PRO M and PRO S (V4)
AntiFlickerMode	3D Parameters <ul style="list-style-type: none"> <li>• Projector               <ul style="list-style-type: none"> <li>◦ Anti-Flicker Mode</li> </ul> </li> </ul>	Expert	PRO M and PRO S (V4) NANO (V4)
ProjectorSelectionMode	3D Parameters <ul style="list-style-type: none"> <li>• Projector               <ul style="list-style-type: none"> <li>◦ Projector Selection Mode</li> </ul> </li> </ul>	Guru	Deep (V3) Pro L Enhanced (V3)
ProjectorSelector	3D Parameters <ul style="list-style-type: none"> <li>• Projector               <ul style="list-style-type: none"> <li>◦ Projector Selector</li> </ul> </li> </ul>	Guru	
LaserFringeCodingMode	3D Parameters <ul style="list-style-type: none"> <li>• Laser               <ul style="list-style-type: none"> <li>◦ Fringe Coding Mode</li> </ul> </li> </ul>	Expert	Laser L (V3) Laser L Enhanced (V3) LSR L (V4) DEEP (V4)
LaserPowerLevel	3D Parameters <ul style="list-style-type: none"> <li>• Laser               <ul style="list-style-type: none"> <li>◦ Laser Power</li> </ul> </li> </ul>	Expert	
LaserFrameAmplitude	3D Parameters <ul style="list-style-type: none"> <li>• Laser Projection Frame Control               <ul style="list-style-type: none"> <li>◦ Laser Frame Amplitude</li> </ul> </li> </ul>	Guru	
LaserFrameOffset	3D Parameters <ul style="list-style-type: none"> <li>• Laser Projection Frame Control               <ul style="list-style-type: none"> <li>◦ Laser Frame Offset</li> </ul> </li> </ul>	Guru	
LaserFramePartitionCount	3D Parameters <ul style="list-style-type: none"> <li>• Laser Projection Frame Control               <ul style="list-style-type: none"> <li>◦ Laser Frame Partition Count</li> </ul> </li> </ul>	Guru	

Parameter in GenICam Client	Parameter in Mech-Eye Viewer	Visibility	Notes
Scan3DBinningEnable	3D Parameters • 3D Binning	Guru	Pro L Enhanced (V3) Laser L Enhanced (V3)
Scan3DExposureCount	3D Parameters • Exposure Multiplier	Beginner	
Scan3DExposureTime	3D Parameters • Exposure Time	Beginner	
Scan3DExposureTime2	3D Parameters • Exposure Time 2	Beginner	
Scan3DExposureTime3	3D Parameters • Exposure Time 3	Beginner	
Scan3DGain	3D Parameters • Gain	Expert	
FringeCodingMode	3D Parameters • UHP ◦ Fringe Coding Mode	Guru	UHP-140
UhpCaptureMode	3D Parameters • UHP ◦ Capture Mode	Beginner	UHP-140
AcquisitionMode	 and 	-	
DepthLowerLimit	Depth Range	Beginner	
DepthUpperLimit			
DeviceScanType	-	-	
PointCloudSurfaceSmoothing	Point Cloud Processing • Surface Smoothing	Beginner	Available for camera firmware 2.1.0 and above
PointCloudOutlierRemoval	Point Cloud Processing • Outlier Removal	Beginner	
PointCloudNoiseRemoval	Point Cloud Processing • Noise Removal	Expert	
PointCloudEdgePreservation	Point Cloud Processing • Edge Preservation	Guru	

Parameter in GenICam Client	Parameter in Mech-Eye Viewer	Visibility	Notes
CloudOutlierFilterMode	Point Cloud Processing • Noise Removal	Beginner	Available for camera firmware 2.0.2 and below
CloudSmoothMode	Point Cloud Processing • Point Cloud Smoothing	Beginner	
FringeContrastThreshold	Point Cloud Processing • Stripe Contrast Threshold	Beginner	
FringeMinThreshold	Point Cloud Processing • Minimum Fringe Intensity Threshold	Guru	
UserSetDefault	-	-	
UserSetSelector	<b>Parameter Group</b> drop-down menu	-	

### 7.3.2. Use Mech-Eye Viewer to Adjust Camera Parameters for GenICam Client

Setting camera parameters such as **Auto-Exposure ROI**, **Depth Range** and **ROI** usually requires the assistance of visualized tools for several rounds of fine tuning. Since GenICam-compliant third-party machine vision software (GenICam clients) does not provide visualized tools, you can set these parameters by using the visualized tools provided in Mech-Eye Viewer.

After setting these parameters using Mech-Eye Viewer, you can read the latest camera configuration in a GenICam client directly.

#### Preparation

Before you adjust parameters in Mech-Eye Viewer, complete the following steps:

1. Save the changes that you made in the GenICam client.
2. Disconnect from the camera in the GenICam client.
3. [Connect to the camera in Mech-Eye Viewer.](#)
4. In the parameter panel on the right of Mech-Eye Viewer, select the parameter group to which you want to save the parameter values.



A GenICam client can read parameter groups but not add or delete parameter groups. For instructions on adding/deleting a parameter group, please refer to [Configure Parameter Group in Mech-Eye Viewer.](#)

#### Adjust Parameters with Visualized Tools

Below you can find instructions on setting **Auto-Exposure ROI**, **Depth Range** and **ROI**, respectively.



## Set Auto-Exposure ROI

To set **Auto-Exposure ROI**, follow these steps:

1. In the parameter panel on the right of Mech-Eye Viewer, locate the **2D Parameters** category.
2. From the drop-down menu of **Exposure Mode**, select **Auto**.
3. Double-click [ **Edit** ] to the right of **Auto-Exposure ROI** to open the **Set ROI** window.
4. Set **Auto-Exposure ROI** in the pop-up window. For detailed instructions, please refer to [Set Auto-Exposure ROI](#). The correspondence between **Auto-Exposure ROI** parameters in a GenICam client and those in Mech-Eye Viewer is as follows:

Parameter in GenICam Client	Parameter in Mech-Eye Viewer
Scan2DROILeft	Upper-left coordinates: x
Scan2DROITop	Upper-left coordinates: y
Scan2DROIHeight	Dimensions: Height
Scan2DROIWidth	Dimensions: Width

## Set Depth Range

To set **Depth Range**, follow these steps:

1. In the parameter panel on the right of Mech-Eye Viewer, locate the **Depth Range** category.
2. Double-click [ **Edit** ] to the right of **Depth Range** to open the **Set Depth Range** window.
3. Set **Depth Range** in the pop-up window. For detailed instructions, please refer to [Set Depth Range](#).

The correspondence between **Depth Range** parameters in a GenICam client and those in Mech-Eye Viewer is as follows:

Parameter in GenICam Client	Parameter in Mech-Eye Viewer
DepthLowerLimit	Depth Range: Depth Lower Limit
DepthUpperLimit	Depth Range: Depth Upper Limit

## Set ROI

To set **ROI**, follow these steps:

1. In the parameter panel on the right of Mech-Eye Viewer, locate the **ROI** category.
2. Double-click [ **Edit** ] to the right of **ROI** to open the **Set ROI** window.
3. Set **ROI** in the pop-up window. For detailed instructions, please refer to [Set ROI](#).

The correspondence between **ROI** parameters in a GenICam client and those in Mech-Eye Viewer is as follows:

Parameter in GenICam Client	Parameter in Mech-Eye Viewer
Scan3DROILeft	Upper-left coordinates: x
Scan3DROITop	Upper-left coordinates: y

Parameter in GenICam Client	Parameter in Mech-Eye Viewer
Scan3DROIHeight	Dimensions: Height
Scan3DROIWidth	Dimensions: Width

### Read Altered Values into GenICam Client

After setting **Auto-Exposure ROI**, **Depth Range** and **ROI** in Mech-Eye Viewer, complete the following steps to ensure that the GenICam client can read the modified parameter values.

1. In the parameter panel on the right of Mech-Eye Viewer, click **[ Save ]** at the top or press **Ctrl + S** on the keyboard to save the parameter values into the parameter group.
2. Disconnect from the camera in Mech-Eye Viewer.
3. Connect to the camera in the GenICam client.
4. In the GenICam client, select and load the parameter group with the **UserSetSelector** and **UserSetLoad** parameters.

### 7.3.3. Obtain HALCON-Readable Point Cloud through Mech-Eye API

Through Mech-Eye API, you can obtain point clouds faster than through HALCON, and it is possible to obtain textured point clouds directly. Mech-Eye API provides a [C++ sample program CaptureHalconPointCloud](#). By running this sample program, you can obtain untextured and textured point clouds through Mech-Eye API and convert the data to HALCON-readable format. Then, you can read the point clouds into HALCON and perform further processing.

This sample program can be used on Windows and Ubuntu operating system.



This sample program depends on the HALCON/C++ interface. Please confirm that your HALCON license is still valid before using.

#### Use Sample Program on Windows

In order to use this sample program on Windows, the following software must be installed:

- Mech-Eye SDK
- Cmake
- Visual Studio
- HALCON

For instructions on installing the above software, as well as instructions on building and running this sample individually, please refer to [Instructions on Using Mech-Eye API C++ Samples \(Windows\)](#).

After running the sample, you can read the obtained point clouds into HALCON with the `read_object_model_3d` operator.

#### Use Sample Program on Ubuntu

In order to use this sample program on Ubuntu, the following software must be installed:

- Mech-Eye SDK

- Cmake
- PCL
- HALCON

For instructions on installing the above software, as well as instructions on building and running this sample individually, please refer to [Instructions on Using Mech-Eye API C++ Samples \(Ubuntu\)](#).

After running the sample, you can read the obtained point clouds into HALCON with the `read_object_model_3d` operator.

## 8. Camera Hardware User Manual

### 8.1. Camera Models

This topic introduces different models of Mech-Eye Industrial 3D Camera, as well as the characteristics and suitable applications of the models.

#### Basic Information

This section provides the basic information of the third (V3) and fourth (V4) generations of Mech-Eye Industrial 3D Camera.

#### V4 Cameras

Model	Projector type	No. of 2D cameras	Resolution	Focal length	Working distance	2D image color
PRO S	DLP	Monocular	1920 × 1200	500 mm	500–600 mm	Monochrome/RGB
				700 mm	600–800 mm	
				1000 mm	800–1000 mm	
PRO M		Monocular	1920 × 1200	1200 mm	1000–1300 mm	Monochrome/RGB
				2000 mm	1300–2000 mm	
NANO		Monocular	1280 × 1024	350 mm	300–450 mm	Monochrome/RGB
				550 mm	450–600 mm	
UHP-140		Dual-monocular <sup>(1)</sup>	2048 × 1536	300 mm	300 ± 20 mm	Monochrome
LSR L		Laser	Trinocular	Depth: 2048 × 1536 RGB: 4000 × 3000 2000 × 1500	1500 mm	1200–1700 mm
	3000 mm				1700–3000 mm	
LSR S	Trinocular		Depth: 2048 × 1536 RGB: 4000 × 3000 2000 × 1500	800 mm	500–900 mm	RGB/monochrome
				1400 mm	900–1500 mm	
DEEP	Trinocular		Depth: 2048 × 1536 1024 × 768 RGB: 2000 × 1500	3000 mm	1200–3500 mm	RGB/monochrome

(1) UHP-140 camera can capture images with either of the two 2D cameras or with both cameras and merge the captured images, the latter reduces blind spots compared to monocular or binocular cameras.



For camera technical specifications, please refer to [Technical Specifications \(V4\)](#).

### V3 Cameras

Model	Projector type	No. of 2D cameras	Resolution	Focal length	Working distance	2D image color
Pro S Enhanced	DLP	Monocular	1920 × 1200	500 mm	500–550 mm	Monochrome/RGB
				700 mm	600–750 mm	
				1000 mm	800–1000 mm	
Pro M Enhanced		Monocular	1920 × 1200	1200 mm	1000–1200 mm	Monochrome/RGB
				2000 mm	1300–2000 mm	
Log S		Monocular	1280 × 1024	700 mm	500–750 mm	RGB
				1000 mm	750–1000 mm	
Log M		Monocular	1280 × 1024	1200 mm	1000–1200 mm	RGB
				2000 mm	1300–2000 mm	
Nano	Monocular	1280 × 1024	350 mm	300–400 mm	Monochrome	
			550 mm	450–650 mm	RGB	
Pro XS	Binocular	1280 × 1024	350 mm	300–400 mm	Monochrome	
			550 mm	450–650 mm		
Deep	Binocular	2048 × 1536	3000	/	RGB	
Pro L Enhanced	Binocular	4096 × 3000	3000	/	RGB	
Laser L	Laser	Binocular	2048 × 1536	3000	/	Monochrome
Laser L Enhanced		Binocular	4096 × 3000	1500 mm	1200–1700 mm	Monochrome
				3000 mm	1700–3000 mm	



For camera technical specifications, please refer to [Technical Specifications \(V3\)](#).

### Characteristics and Suitable Applications

The following table summarizes the characteristics and suitable applications of different camera models.

Camera model	Characteristics	Suitable applications
UHP-140 (V4)	Micron-level accuracy, independently developed image fusion algorithm. High performance for reflective objects.	Inspection/measurement applications of positional error, gap, and flush in industries such as automotive part manufacturing and assembly.
LSR L (V4)	High accuracy, large field of view, high resistance to ambient light.	Manufacturing plants and other environments with ambient light interference.
Laser L (V3)		
Laser L Enhanced (V3)		

Camera model	Characteristics	Suitable applications
NANO (V4)	Small volume, high accuracy, high resistance to ambient light.	On-robot mounting and high-accuracy applications such as locating and assembly and high-precision picking.
Nano (V3)		
Pro XS (V3)		
DEEP (V4)	Large field of view, deep depth of field, fast data acquisition, comprehensive, detailed, precise and color-accurate point cloud.	Logistics applications such as depalletizing and palletizing.
Deep (V3)		
Pro L Enhanced (V3)		
PRO S (V4)	High accuracy, fast data acquisition, high resistance to ambient light, color variant available.	Medium-range applications with high accuracy requirements, such as random picking, positioning, assembly, academic research.
Pro S Enhanced (V3)		
PRO M (V4)		
Pro M Enhanced (V3)		
Log M (V3)	Fast data acquisition, medium to long range.	Designed for logistics applications, suited for piece picking and parcel feeding.
Log S (V3)	Fast data acquisition, short to medium range.	Designed for logistics applications, suited for piece picking and parcel feeding.

### 8.1.1. Technical Specifications (V4)

This topic provide technical specification comparisons across the V4 cameras. For more details, please refer to the Technical Specifications section of the hardware manual for each model/series.

#### Technical Specification Comparisons

Model	NANO	PRO S	PRO M	UHP-140	DEEP	LSR L
Recommended working distance	300–600 mm	500–1000 mm	1000–2000 mm	300 ± 20 mm	1200–3500 mm	1200–3000 mm
FOV (near)	220 × 150 mm @ 0.3 m	370 × 240 mm @ 0.5 m	800 × 450 mm @ 1 m	135 × 90 mm @ 280 mm	1200 × 1000 mm @ 1.2 m	1200 × 1000 mm @ 1.2 m
FOV (far)	440 × 300 mm @ 0.6 m	800 × 450 mm @ 1 m	1500 × 890 mm @ 2 m	150 × 100 mm @ 320 mm	3500 × 2800 mm @ 3.5 m	3000 × 2400 mm @ 3.0 m
Depth map resolution	1280 × 1024	1920 × 1200	1920 × 1200	2048 × 1536	2048 × 1536 1024 × 768	2048 × 1536

RGB resolution	1280 × 1024	1920 × 1200	1920 × 1200	2048 × 1536	2000 × 1500	4000 × 3000
						2000 × 1500
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	0.1 mm @ 0.5 m	0.05 mm @ 1 m	0.2 mm @ 2 m	2.6 $\mu$ m @ 0.3 m	1.0 mm @ 3 m	0.5 mm @ 3 m
Regional Z-value repeatability ( $\sigma$ ) <sup>(2)</sup>	-	-	-	0.09 $\mu$ m @ 0.3 m	-	-
Measurement accuracy (VDI/VDE) <sup>(3)</sup>	0.1 mm @ 0.5 m	0.1 mm @ 1 m	0.2 mm @ 2 m	0.03 mm @ 0.3 m	3.0 mm @ 3 m	1.0 mm @ 3 m
Typical capture time	0.6–1.1 s	0.3–0.6 s	0.3–0.6 s	0.6–0.9 s	0.5–0.9 s	0.5–0.9 s
Weight	About 0.7 kg	About 1.6 kg	About 1.9 kg	About 1.9 kg	About 2.4 kg	About 2.9 kg
Baseline	About 68 mm	About 180 mm	About 270 mm	About 80 mm	About 300 mm	About 380 mm
Dimensions	About 145 × 51 × 85 mm	About 265 × 57 × 100 mm	About 353 × 57 × 100 mm	About 260 × 65 × 142 mm	About 366 × 77 × 92 mm	About 459 × 77 × 86 mm
Light source	Blue LED (459 nm, RG2)				Red laser (638 nm, class 2)	
Operating temperature	0–45°C				-10–45°C	
Communication interface	Gigabit Ethernet					
Input	24 VDC, 1.5 A	24 VDC, 3.75 A				
Safety and EMC	CE/FCC/VCCI/UKCA/KC					
IP rating <sup>(4)</sup>	IP65					
Cooling	Passive					

(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

(2) One standard deviation of 100 measurements of the difference between the Z-value means of two same-sized regions. The measurement target was a ceramic plate.

(3) According to VDI/VDE 2634 Part II.

(4) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.



## 8.1.2. Technical Specifications (V3)

### Specifications of DLP Cameras

Product name	Mech-Eye Industrial 3D Camera				
Model	Pro S Enhanced	Pro M Enhanced	Log S	Log M	Nano
Recommended working distance	500–1000 mm	800–2000 mm	500–1000 mm	800–2000 mm	300–600 mm
FOV (near)	350 × 220 mm @ 0.5 m	500 × 350 mm @ 0.8 m	360 × 250 mm @ 0.5 m	520 × 390 mm @ 0.8 m	220 × 160 mm @ 0.3 m
FOV (far)	690 × 430 mm @ 1.0 m	1360 × 860 mm @ 2.0 m	710 × 490 mm @ 1.0 m	1410 × 960 mm @ 2.0 m	430 × 320 mm @ 0.6 m
Resolution	1920 × 1200	1920 × 1200	1280 × 1024	1280 × 1024	1280 × 1024
Pixels	2.3 MP	2.3 MP	1.3 MP	1.3 MP	1.3 MP
Point Z-value repeatability ( $\sigma$ )	0.05 mm @ 1 m	0.2 mm @ 2 m	0.1 mm @ 1 m	0.3 mm @ 2 m	0.1 mm @ 0.5 m
Measurement accuracy	0.1 mm @ 1 m	0.2 mm @ 2 m	0.2 mm @ 1 m	0.3 mm @ 2 m	0.1 mm @ 0.5 m
Typical capture time	0.5–0.8 s	0.5–0.8 s	0.3–0.5 s	0.3–0.5 s	0.6–1.1 s
Baseline	150 mm	280 mm	150 mm	280 mm	68 mm
Dimensions	About 270 × 72 × 130 mm	About 387 × 72 × 130 mm	About 270 × 72 × 130 mm	About 387 × 72 × 130 mm	About 145 × 51 × 85 mm
Weight	About 2.2 kg	About 2.4 kg	About 2.2 kg	About 2.4 kg	About 0.7 kg
Operating temperature	0–45°C				
Communication interface	Ethernet				
Operating voltage	24 VDC				
Safety and EMC	CE/FCC/VCCI				
IP rating	IP65				
Cooling	Passive				

### Specifications of Laser Cameras

Product name	Mech-Eye Industrial 3D Camera	
Model	Laser L	Laser L Enhanced
Recommended working distance	1500–3000 mm	
FOV (near)	1500 × 1200 mm @ 1.5 m	
FOV (far)	3000 × 2400 mm @ 3.0 m	
Resolution	2048 × 1536	4096 × 3000

Pixels	3.0 MP	12.0 MP
Point Z-value repeatability ( $\sigma$ )	0.5 mm @ 3 m	0.5 mm @ 3 m
Measurement accuracy	1.0 mm @ 3 m	0.5 mm @ 3 m
Typical capture time	0.5–0.9 s	1.4–1.7 s
Weight	About 3.7 kg	About 3.9 kg
Baseline	About 400 mm	
Dimensions	About 459 × 89 × 145 mm	
Operating temperature	-10–45°C	
Communication interface	Ethernet	
Operating voltage	24 VDC	
Max. power	70 W	
Laser class	Class 2	
Safety and EMC	CE/FCC/VCCI	
IP rating	IP65	
Cooling	Passive	

## 8.2. NANO

### Safety Instructions

- To ensure safe use, please do not use the product before reading this manual and becoming familiar with the correct usage. Improper use and maintenance may damage the product or cause other hazards. Mech-Mind shall not be liable for any injury or damage brought upon the user or any third party due to improper use and maintenance.
- Following the instructions and warnings in this manual can lower risks, but can not totally eliminate all risks.
- Every step has been inspected during the drafting of this user manual. Please do not hesitate to contact Mech-Mind if you find any problems or mistakes in the manual.
- This product is to be mounted, connected, used and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used and maintained properly.
- Laser is hazardous; please familiarize yourself with hazard prevention before using the camera.

### Precautions for Mounting and Using the Camera

- It is PROHIBITED to place any explosive or flammable substances near the camera. Do not expose the camera to open fire or high temperature.
- Do not throw, drop, or collide the camera with other objects. The camera may be damaged by strong shock or vibration. It is PROHIBITED to modify the camera in any form. Do not repair or disassemble the camera by yourself. Mech-Mind shall not be liable for any damage caused by repair or disassembly not performed by Mech-Mind.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the camera. Failure to do so may lead to fire, electric shock, malfunction, etc.

- Do not use the camera at extremely high or low temperature. The operating temperature range is -10–45°C for the LSR and DEEP series, and 0–45°C for other series.
- Please use the camera indoors.
- Please use the camera at elevations below 4,000 meters.
- Please install the camera in a well-circulated, open place.

### Check the Camera

- Before using, please check the camera carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the camera is in proper working conditions. If any of the above abnormalities occur, please disconnect the power immediately.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the cable has aged, please contact Mech-Mind to acquire a replacement.

### Usage of Adapter/DIN Rail Power Supply


- DO NOT use if the power port, adapter/DIN rail power supply, or power socket is wet.
- DO NOT heat or put the adapter/DIN rail power supply and power cable in fire.
- For power, please use a 24 V isolated adapter with an output power of at least 90 W or a 24 V isolated DIN rail power supply.
- Please use the specified voltage. Failure to do so may lead to fire, electric shock, malfunction, etc. The adapter/DIN rail power supply and power cable should be properly grounded. It is recommended to use the isolated adapter/DIN rail power supply provided by Mech-Mind.
- Power plugs should be properly grounded. Do not place the adapter/DIN rail power supply in a place that is hard to disconnect the power.
- Please install the DIN rail power supply inside a control cabinet.

### Precautions for Using Laser Cameras

- DO NOT look into the laser beam or the reflected laser beam directly. Do not look into the laser beam with optical instruments. Failure to do so may lead to eye injuries. DO NOT direct the laser at other people.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. If there is a possibility that personnel may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Do not enter the areas that the laser/reflected laser output reaches. Do not place any reflective light object (mirror, glass, metal, etc.) in the path of the laser beam.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS. NOTE: The risk of skin injury is only likely for highly divergent beams for exposure close to the aperture.

### Notice for Disposal

- Please comply with local laws and regulations when disposing of the camera to avoid polluting the environment. Please do not dispose of the camera irresponsibly. Improper disposal may pollute the environment.

 This icon indicates that failure to follow the instruction may lead to injury or death.

## Certifications

Mech-Eye Industrial 3D Camera is compliant with the following standards and assessment requirements. Please note that the registration statuses may be updated. If you need more information, please contact the local agents.

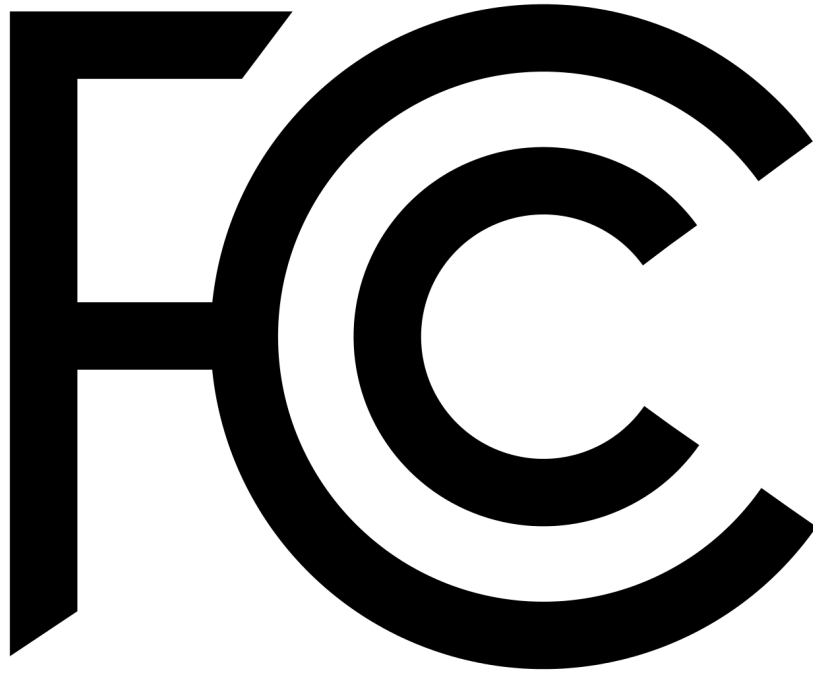
### CE



Compliant with the following European Electromagnetic Compatibility Standards:

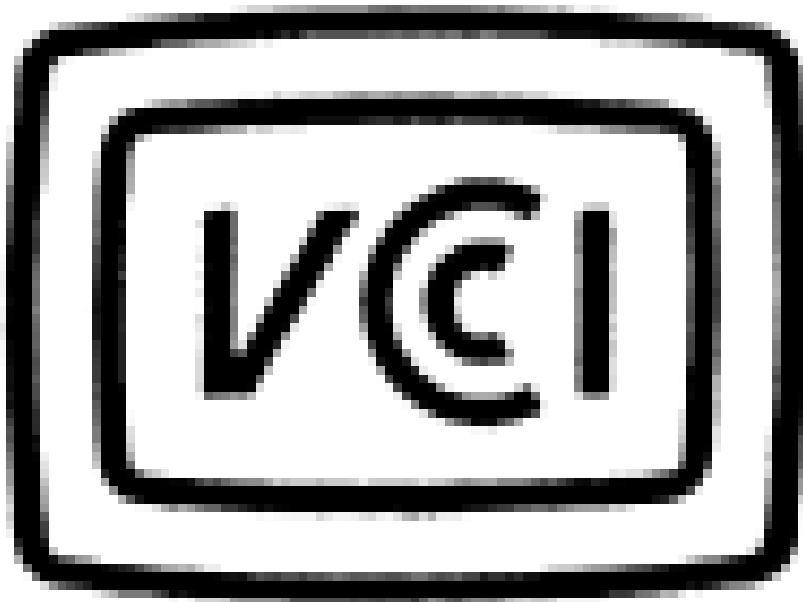
- EN55032: 2015+A11: 2020
- EN IEC 61000-3-2: 2019+A1: 2021
- EN 61000-3-3: 2013+A1: 2019
- EN 55035: 2017+A11: 2020

### FCC



- Compliant with US ANSI C63.4 and 47 CFR PART 15B.
- Compliant with Canada ICES-003.

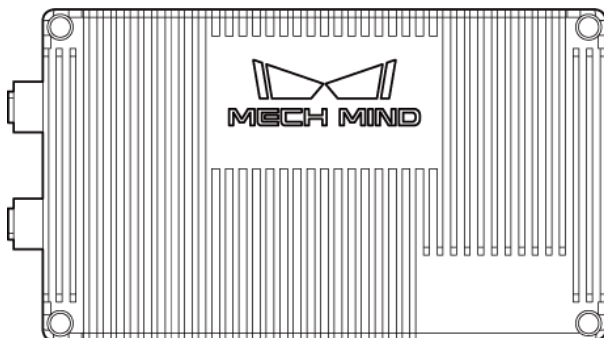
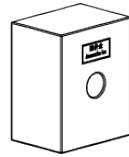

#### VCCI



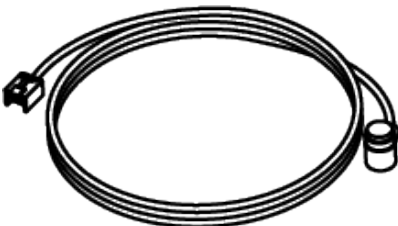
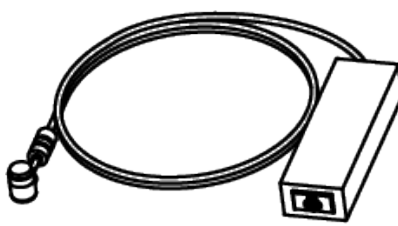

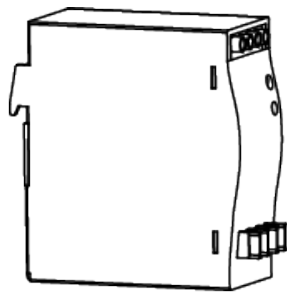

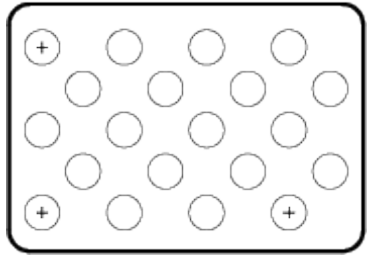
Compliant with Japanese VCCI-CISPR 32: 2016 standard.

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

## Package Contents

Camera	
Accessory box	
User manual	

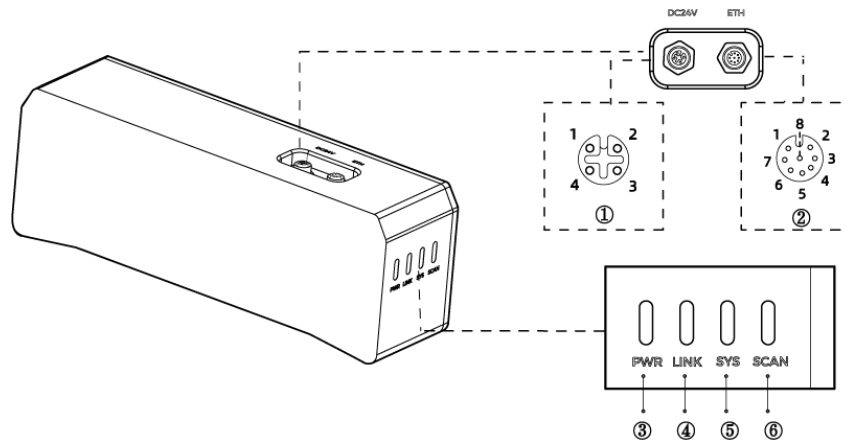
## Cables and Accessories

Ethernet cable	Adapter	AC power cable
		
DIN rail power supply	DC power cable	Calibration board
		



- All the above cables and accessories are optional; please select the type and length based on your actual needs. For detailed usage instructions, please see [Connect the Camera](#).
- Before using, please make sure that the package and the camera are intact, and that no accessories are missing.

## Functional Diagram



The above figure is for reference only. The actual product may differ.

No.	Name	Function	
①	DC 24V port	1: GND	2: GND
		3: 24 VDC	4: 24 VDC
②	ETH port	1: MD3_P	2: MD2_N
		3: MD2_P	4: MD0_P
		5: MD1_P	6: MD0_N
		7: MD3_N	8: MD1_N
③	PWR indicator light	Off: not connected to power	
		Green: normal voltage	
		Yellow: abnormal voltage, but system is still functioning	
		Red: voltage too high or too low, system power is disconnected	
④	LINK indicator light	Off: not connected to network	
		Blinking green: data being transmitted	
		Solid green: no ongoing data transmission	
⑤	SYS indicator light	Off: system not started	
		Solid green: system starting up	
		Blinking green: system operating properly	
		Blinking yellow: system operating with error but still functioning	
⑥	SCAN indicator light	Blinking red: system not operating	
		Solid: capturing and processing in progress	
		Off: not capturing or processing	



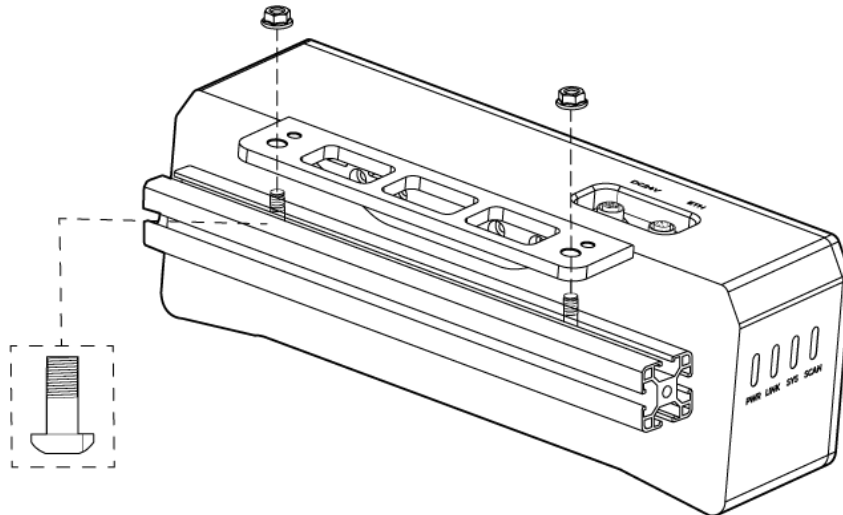
## Mount the Camera



When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the [Dimensions](#) section of Technical Specifications.

### Mount through the Camera Bracket

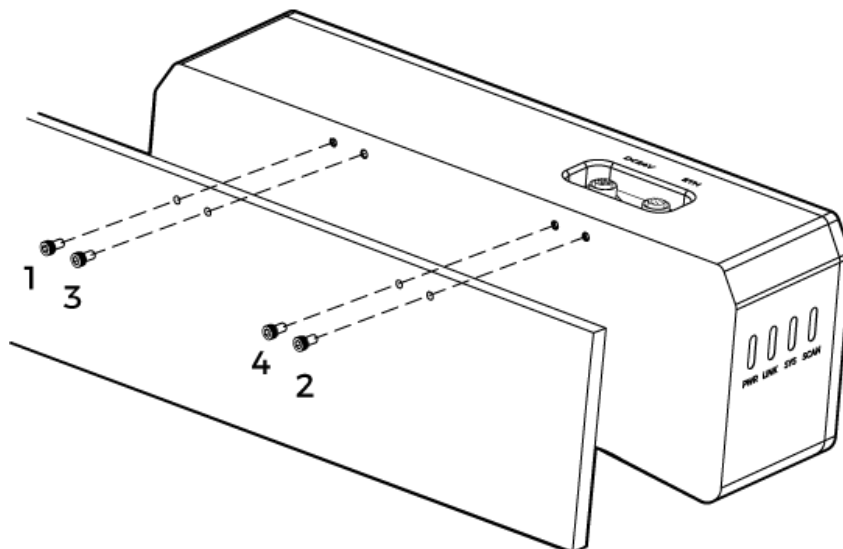
Use the wrench to tighten the two nuts, as shown below.



- The camera bracket is attached to the back of the camera when packaged.

### Mount through Threaded Holes

Use the wrench to loosely screw on the bolts in the order specified below, and then fully tighten all the bolts in the specified order.



- Before mounting the camera, use the wrench to detach the camera bracket from the camera.

## Connect the Camera



- Please connect the power cable last. The PWR indicator light should turn on after the cables are connected. If the light is not on, please contact Technical Support.

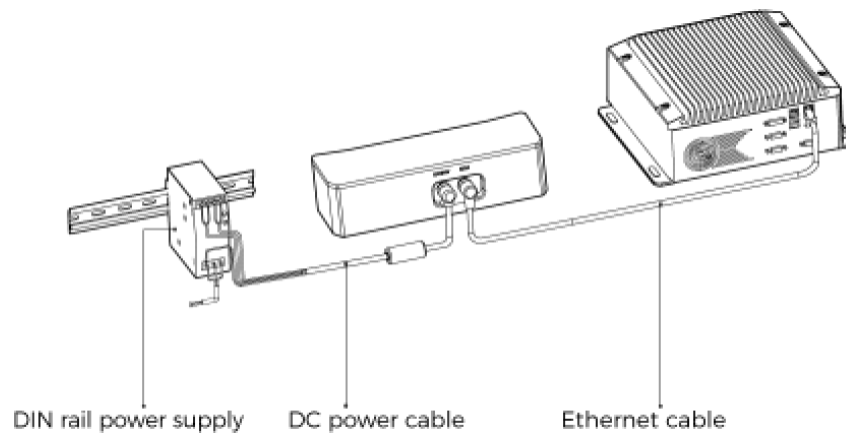
- The recommended tightening torque for the bolts is 16 N·m.
- The DIN rail power supply should be reliably grounded. If using multiple DIN rail power supplies, ensure enough distance in between.
- When mounting the camera onto a robot arm or other mobile equipment, please fasten the DC power and Ethernet cables on the camera end properly to avoid damaging the cables or connectors due to strain.

## Ethernet Cable

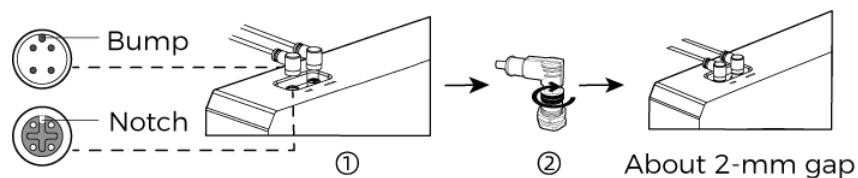
As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

## DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

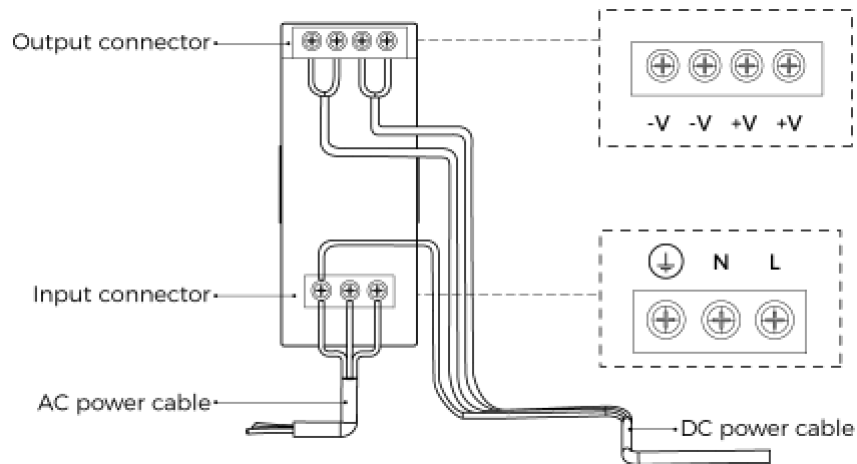


Connect the M12-A connectors of the cables to the corresponding ports:



1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.

## DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊕).
- The 24 V DC power cable has three wires: V+, V- and PE (⊕).

### Warning

The PE wires must be properly grounded! Please install the DIN rail power supply inside a control cabinet.



A network switch can be used to connect multiple cameras or computers.

## Technical Specifications

Product name	Mech-Eye Industrial 3D Camera
Model	NANO
Recommended working distance	300–600 mm
FOV (near)	220 × 150 mm @ 0.3 m
FOV (far)	440 × 300 mm @ 0.6 m
Resolution	1280 × 1024
Pixels	1.3 MP
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	0.1 mm @ 0.5 m
Measurement accuracy (VDI/VDE) <sup>(2)</sup>	0.1 mm @ 0.5 m
Typical capture time	0.6–1.1 s
Weight	About 0.7 kg
Baseline	About 68 mm
Dimensions	About 145 × 51 × 85 mm
Light source	Blue LED (459 nm, RG2)
Operating temperature	0–45°C
Communication interface	Gigabit Ethernet

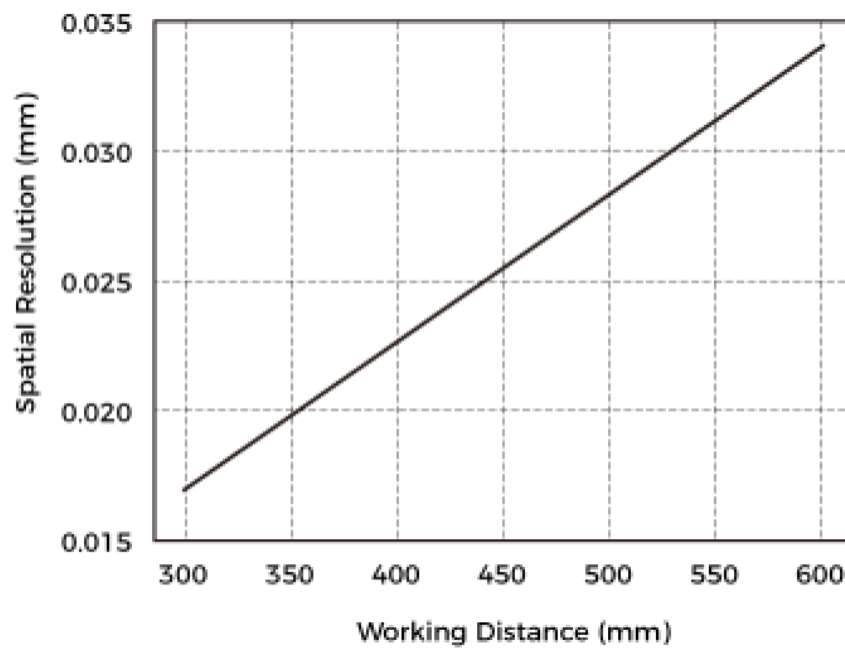
Input	24 VDC, 1.5 A
Safety and EMC	CE/FCC/VCCI/UKCA/KC
IP rating <sup>(3)</sup>	IP65
Cooling	Passive

(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

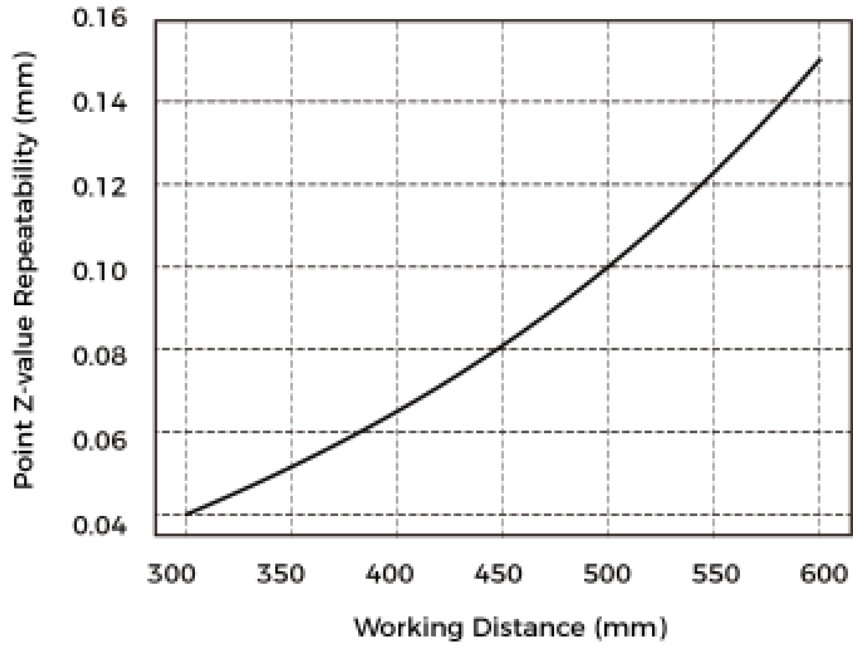
(2) According to VDI/VDE 2634 Part II.

(3) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.

### Spatial Resolution

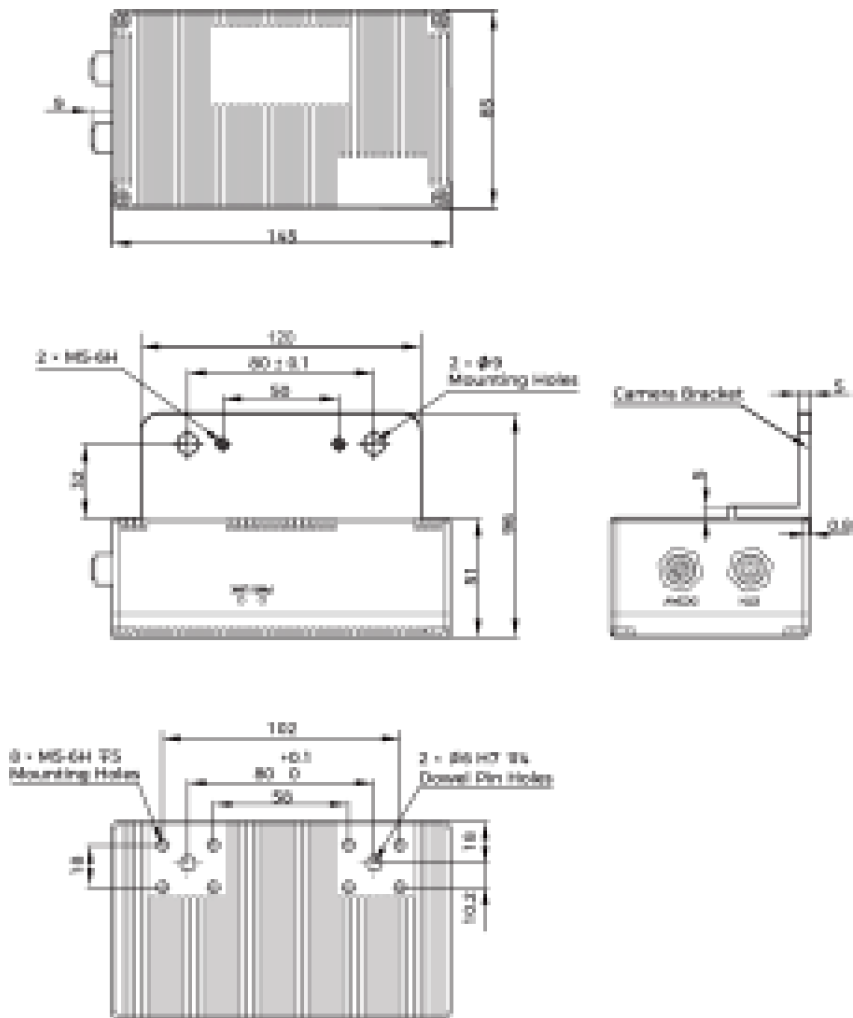


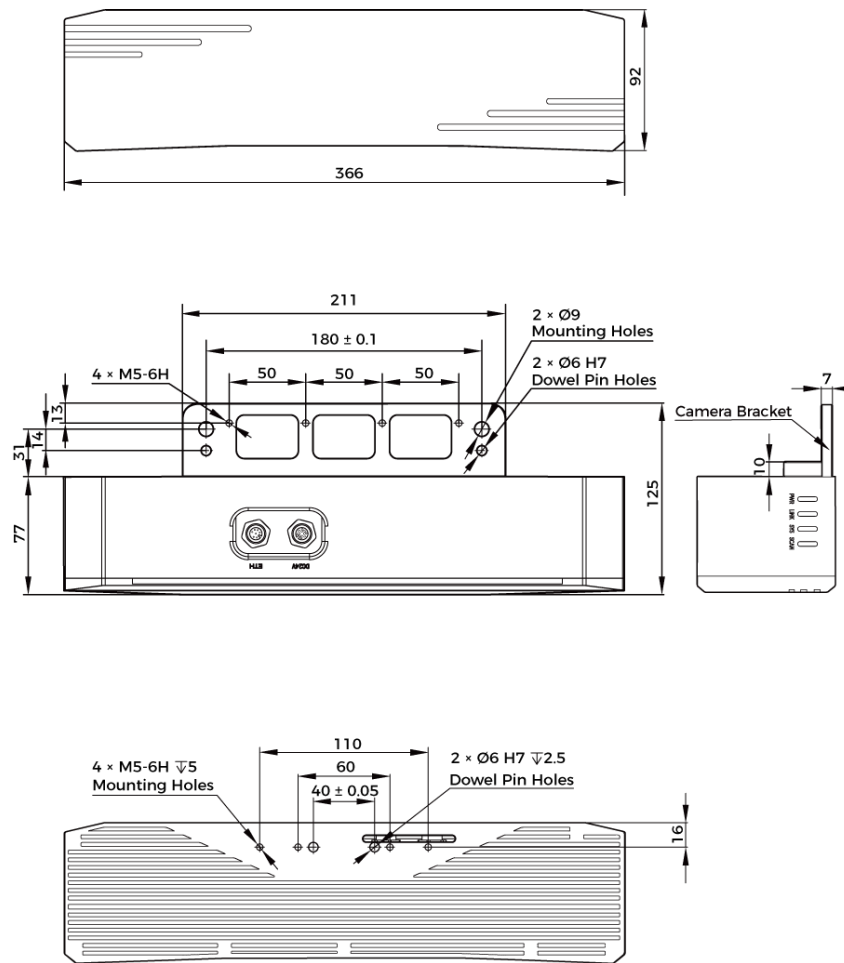
### Point Z-Value Repeatability



Dimensions

Unit: mm





## Maintenance

### Cleaning the Camera

When cleaning the surface of the camera, please blow off the dust gently, and then use a clean soft cloth to gently wipe the surface. When cleaning the camera lenses, a liquid lens cleaner and clean lint-free cloth can be used to carefully wipe the lenses to avoid scratching.

#### Warning

- Do not clean the camera with corrosive or volatile solvents such as alcohol, gasoline and kerosene. These substances may damage the exterior and internal structure of the camera.
- Do not use a pressure washer gun or hose to spray and wash the camera. Water entering the camera may lead to malfunction, fire, or even explosion. Water or other liquid damage to the camera is not covered by the warranty.

### Storing the Camera

This product is rated as IP65. The enclosure of the camera can prevent dust from entering and affecting the functions of the camera. Soaking the camera in water or placing it in a highly humid environment may lead to malfunction. Rusting of the internal unit will lead to irreversible damage. When not using, please store the camera in an indoor, dry, cool and well ventilated place. To avoid damage caused by rain, snow, and other undesirable conditions, please do not place the camera outdoors for an extended period of time.

### Warning

- Disconnect the camera from the power supply when storing to avoid fire.
- Do not leave the lens pointed at the sun or other intense light source for an extended period of time. Intense light may cause the image sensor to deteriorate and produce a white blur effect in images.

 This icon indicates that failure to follow the instruction may lead to injury or death.

## Trademark and Legal Statement

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## 8.3. PRO Series

### Safety Instructions

- To ensure safe use, please do not use the product before reading this manual and becoming familiar with the correct usage. Improper use and maintenance may damage the product or cause other hazards. Mech-Mind shall not be liable for any injury or damage brought upon the user or any third party due to improper use and maintenance.
- Following the instructions and warnings in this manual can lower risks, but can not totally eliminate all risks.
- Every step has been inspected during the drafting of this user manual. Please do not hesitate to contact Mech-Mind if you find any problems or mistakes in the manual.
- This product is to be mounted, connected, used and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used and maintained properly.
- Laser is hazardous; please familiarize yourself with hazard prevention before using the camera.

### Precautions for Mounting and Using the Camera

- It is PROHIBITED to place any explosive or flammable substances near the camera. Do not expose the camera to open fire or high temperature.

- Do not throw, drop, or collide the camera with other objects. The camera may be damaged by strong shock or vibration. It is PROHIBITED to modify the camera in any form. Do not repair or disassemble the camera by yourself. Mech-Mind shall not be liable for any damage caused by repair or disassembly not performed by Mech-Mind.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the camera. Failure to do so may lead to fire, electric shock, malfunction, etc.
- Do not use the camera at extremely high or low temperature. The operating temperature range is -10–45°C for the LSR and DEEP series, and 0–45°C for other series.
- Please use the camera indoors.
- Please use the camera at elevations below 4,000 meters.
- Please install the camera in a well-circulated, open place.

### Check the Camera

- Before using, please check the camera carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the camera is in proper working conditions. If any of the above abnormalities occur, please disconnect the power immediately.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the cable has aged, please contact Mech-Mind to acquire a replacement.

### Usage of Adapter/DIN Rail Power Supply

- DO NOT use if the power port, adapter/DIN rail power supply, or power socket is wet.
- DO NOT heat or put the adapter/DIN rail power supply and power cable in fire.
- For power, please use a 24 V isolated adapter with an output power of at least 90 W or a 24 V isolated DIN rail power supply.
- Please use the specified voltage. Failure to do so may lead to fire, electric shock, malfunction, etc. The adapter/DIN rail power supply and power cable should be properly grounded. It is recommended to use the isolated adapter/DIN rail power supply provided by Mech-Mind.
- Power plugs should be properly grounded. Do not place the adapter/DIN rail power supply in a place that is hard to disconnect the power.
- Please install the DIN rail power supply inside a control cabinet.


### Precautions for Using Laser Cameras

- DO NOT look into the laser beam or the reflected laser beam directly. Do not look into the laser beam with optical instruments. Failure to do so may lead to eye injuries. DO NOT direct the laser at other people.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. If there is a possibility that personnel may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Do not enter the areas that the laser/reflected laser output reaches. Do not place any reflective light object (mirror, glass, metal, etc.) in the path of the laser beam.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS. NOTE: The risk of skin injury is only likely for highly divergent beams for exposure close to the aperture.



### Notice for Disposal

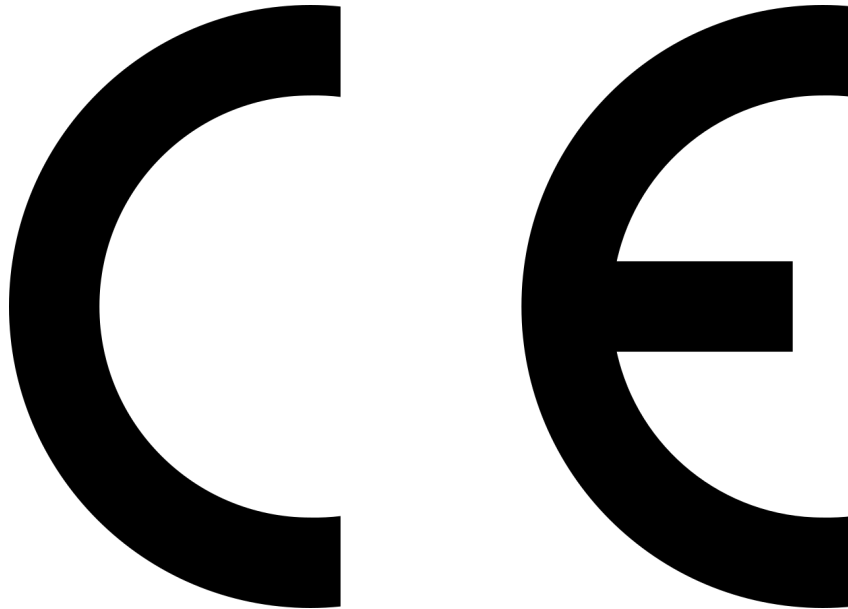
- Please comply with local laws and regulations when disposing of the camera to avoid polluting the environment. Please do not dispose of the camera irresponsibly. Improper disposal may pollute the environment.

 This icon indicates that failure to follow the instruction may lead to injury or death.

### Certifications

Mech-Eye Industrial 3D Camera is compliant with the following standards and assessment requirements. Please note that the registration statuses may be updated. If you need more information, please contact the local agents.

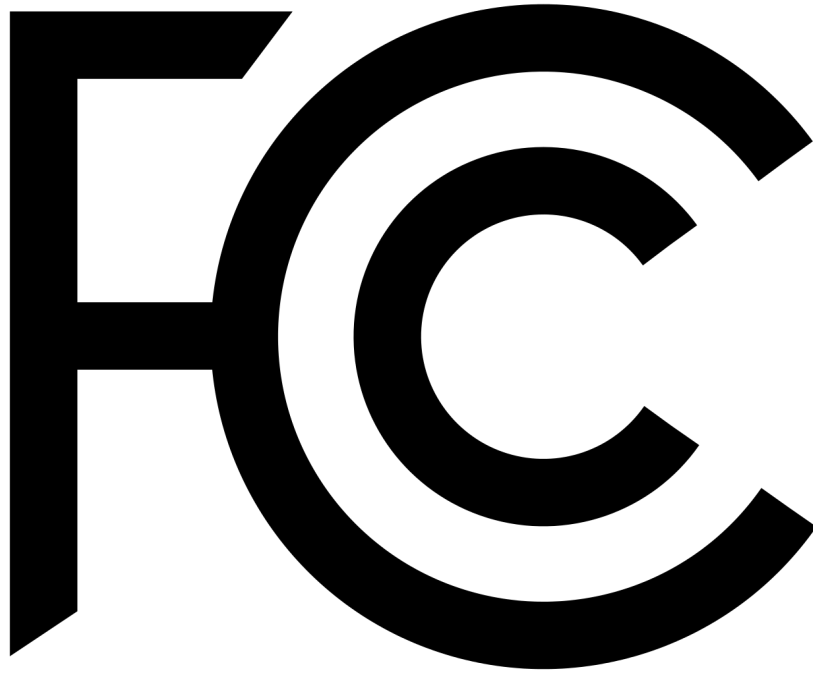
#### CE



Compliant with the following European Electromagnetic Compatibility Standards:

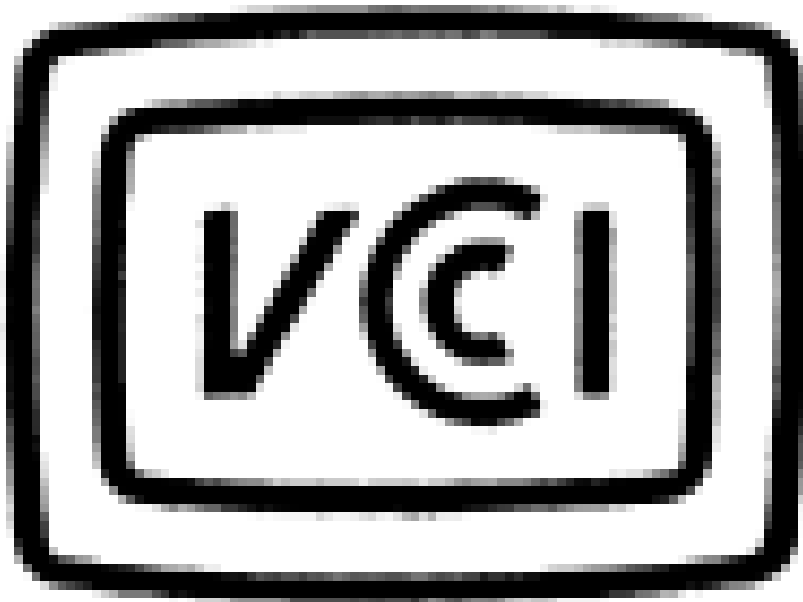
- EN55032: 2015+A11: 2020
- EN IEC 61000-3-2: 2019+A1: 2021
- EN 61000-3-3: 2013+A1: 2019
- EN 55035: 2017+A11: 2020

#### FCC



- Compliant with US ANSI C63.4 and 47 CFR PART 15B.
- Compliant with Canada ICES-003.

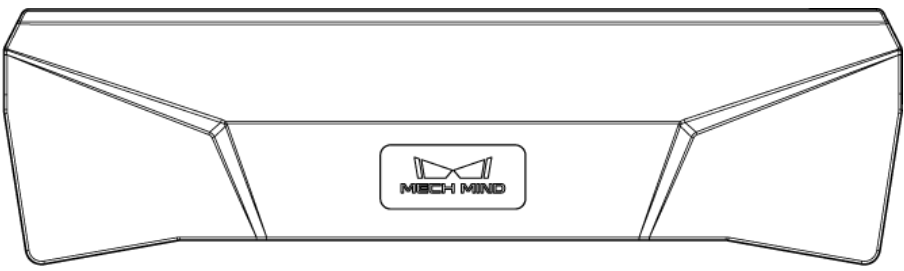
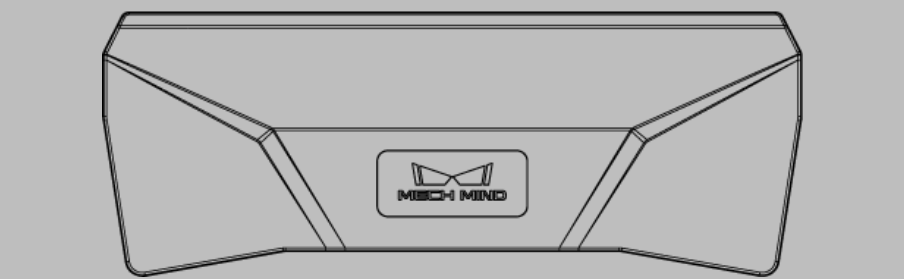
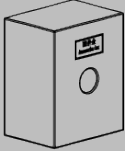

#### VCCI



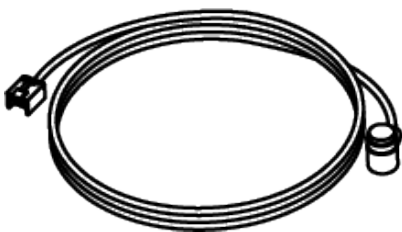
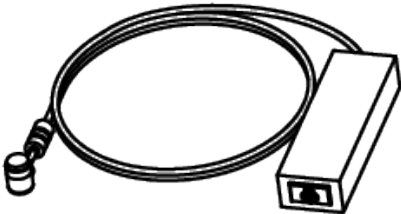
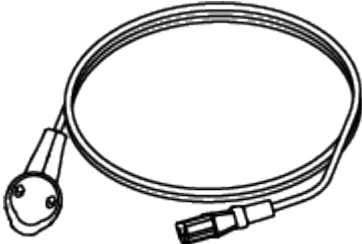
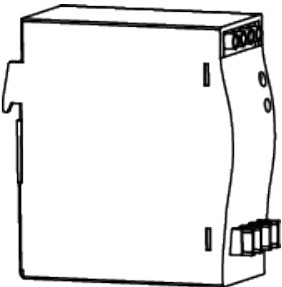
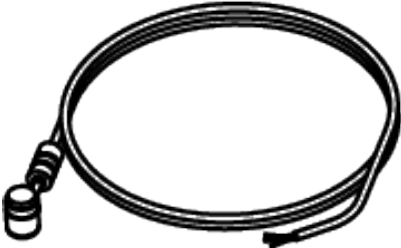
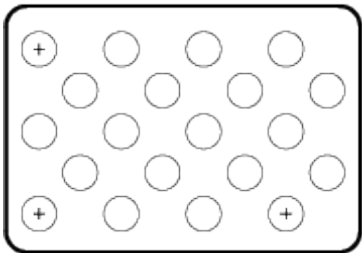
Compliant with Japanese VCCI-CISPR 32: 2016 standard.

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

### Package Contents

Camera	PRO M	
	PRO S	
Accessory box		
User manual		

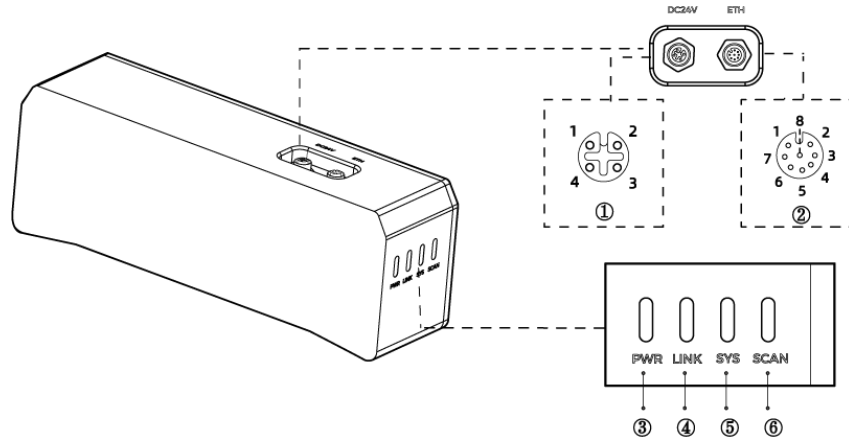
### Cables and Accessories

Ethernet cable	Adapter	AC power cable
		
DIN rail power supply	DC power cable	Calibration board
		



- All the above cables and accessories are optional; please select the type and length based on your actual needs. For detailed usage instructions, please see [Connect the Camera](#).
- Before using, please make sure that the package and the camera are intact, and that no accessories are missing.

## Functional Diagram



The above figure is for reference only. The actual product may differ.

No.	Name	Function
①	DC 24V port	1: GND
		2: GND
②	ETH port	3: 24 VDC
		4: 24 VDC
		1: MD3_P
		2: MD2_N
③	PWR indicator light	3: MD2_P
		4: MD0_P
		5: MD1_P
		6: MD0_N
④	LINK indicator light	7: MD3_N
		8: MD1_N
		Off: not connected to power
		Green: normal voltage
⑤	SYS indicator light	Yellow: abnormal voltage, but system is still functioning
		Red: voltage too high or too low, system power is disconnected
		Off: not connected to network
		Blinking green: data being transmitted
⑥	SCAN indicator light	Solid green: no ongoing data transmission
		Off: system not started
		Solid green: system starting up
		Blinking green: system operating properly
		Blinking yellow: system operating with error but still functioning
		Blinking red: system not operating

⑥	SCAN indicator light	Solid: capturing and processing in progress
		Off: not capturing or processing

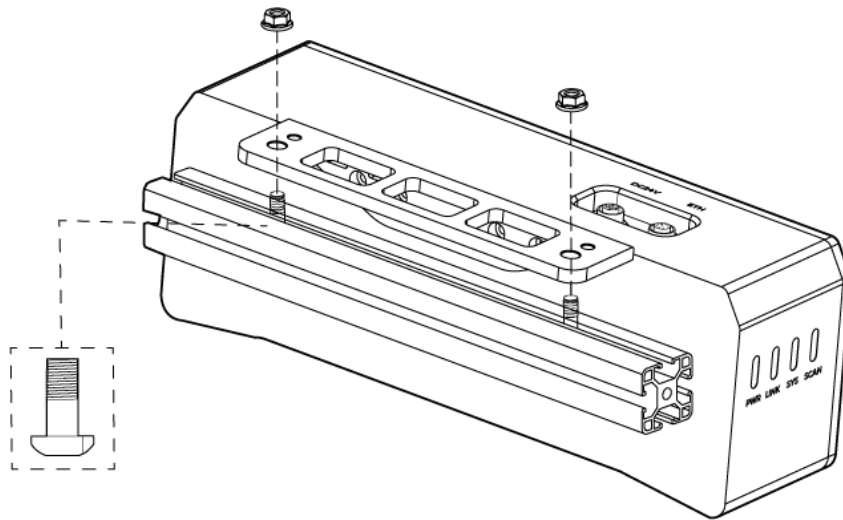
## Mount the Camera



When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the [Dimensions](#) section of Technical Specifications.

### Mount through the Camera Bracket

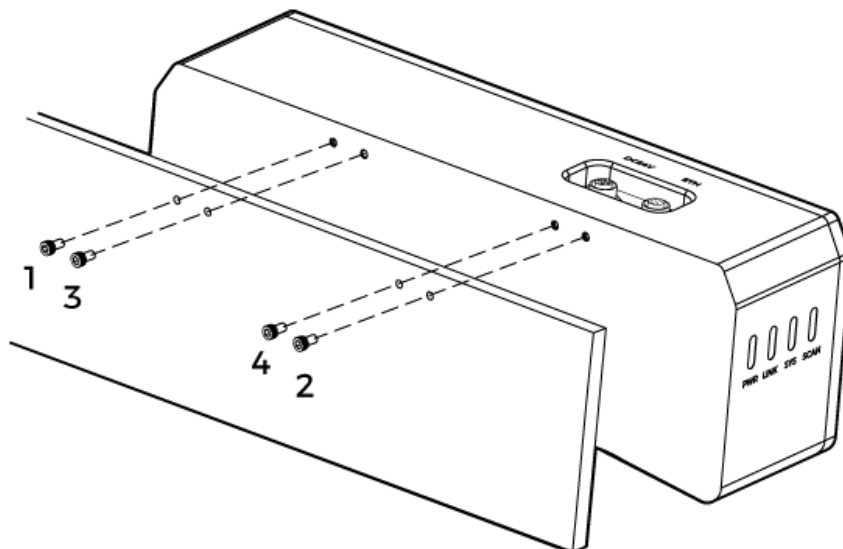
Use the wrench to tighten the two nuts, as shown below.



- The camera bracket is attached to the back of the camera when packaged.

### Mount through Threaded Holes

Use the wrench to loosely screw on the bolts in the order specified below, and then fully tighten all the bolts in the specified order.



- Before mounting the camera, use the wrench to detach the camera bracket from the camera.

## Connect the Camera



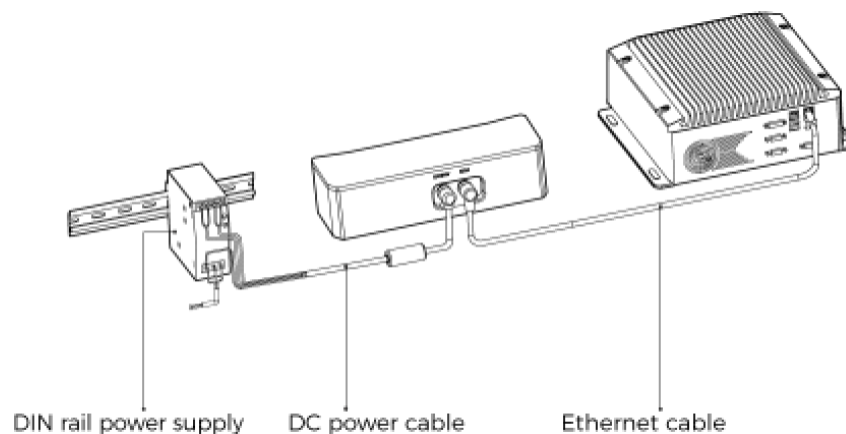
- Please connect the power cable last. The PWR indicator light should turn on after the cables are connected. If the light is not on, please contact Technical Support.
- The recommended tightening torque for the bolts is 16 N·m.
- The DIN rail power supply should be reliably grounded. If using multiple DIN rail power supplies, ensure enough distance in between.
- When mounting the camera onto a robot arm or other mobile equipment, please fasten the DC power and Ethernet cables on the camera end properly to avoid damaging the cables or connectors due to strain.

## Ethernet Cable

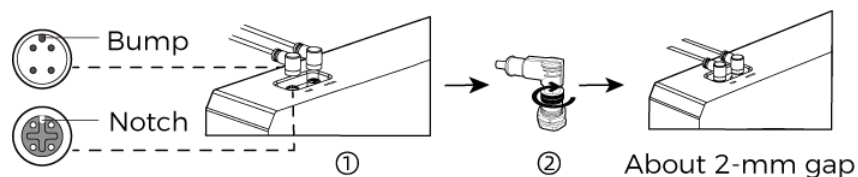
As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

## DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

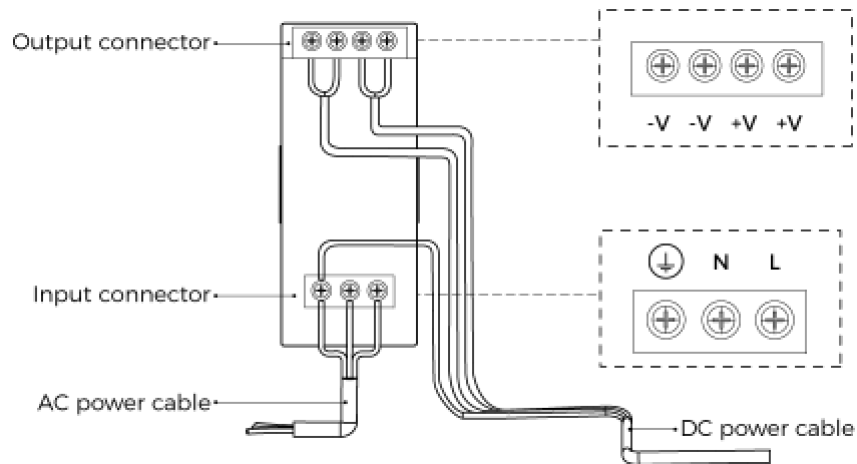


Connect the M12-A connectors of the cables to the corresponding ports:



1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.

## DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊕).
- The 24 V DC power cable has three wires: V+, V- and PE (⊕).

### Warning

The PE wires must be properly grounded! Please install the DIN rail power supply inside a control cabinet.



A network switch can be used to connect multiple cameras or computers.

## Technical Specifications

Product name	Mech-Eye Industrial 3D Camera	
Model	PRO S	PRO M
Recommended working distance	500–1000 mm	1000–2000 mm
FOV (near)	370 × 240 mm @ 0.5 m	800 × 450 mm @ 1 m
FOV (far)	800 × 450 mm @ 1 m	1500 × 890 mm @ 2 m
Resolution	1920 × 1200	
Pixels	2.3 MP	
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	0.05 mm @ 1 m	0.2 mm @ 2 m
Measurement accuracy (VDI/VDE) <sup>(2)</sup>	0.1 mm @ 1 m	0.2 mm @ 2 m
Weight	About 1.6 kg	About 1.9 kg
Baseline	About 180 mm	About 270 mm
Dimensions	About 265 × 57 × 100 mm	About 353 × 57 × 100 mm
Typical capture time	0.3–0.6 s	
Light source	Blue LED (459 nm, RG2)	
Operating temperature	0–45°C	
Communication interface	Gigabit Ethernet	

Input	24 VDC, 3.75 A
Safety and EMC	CE/FCC/VCCI/UKCA/KC
IP rating <sup>(3)</sup>	IP65
Cooling	Passive

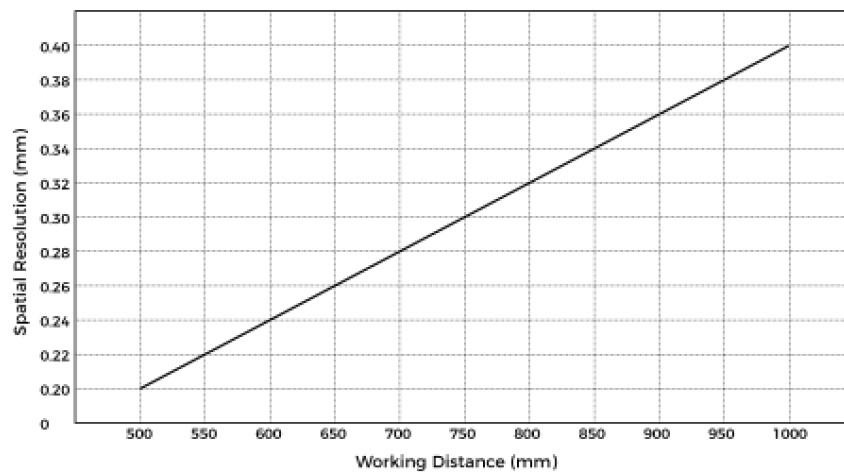
(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

(2) According to VDI/VDE 2634 Part II.

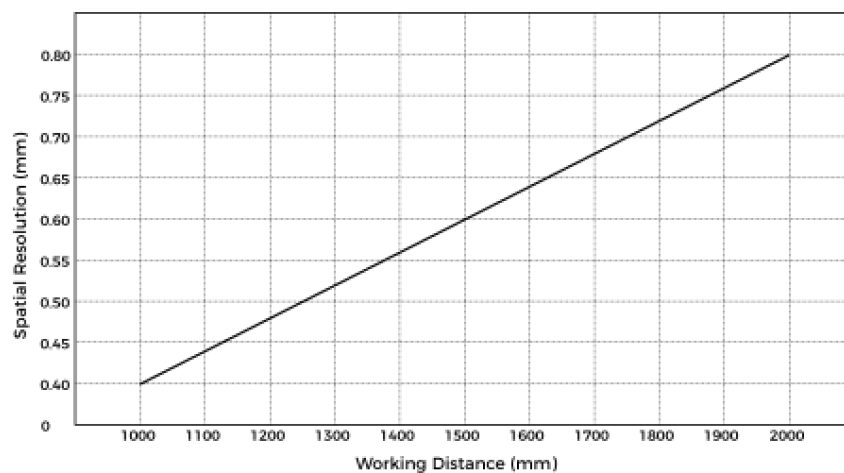
(3) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.

## Spatial Resolution

### PRO S



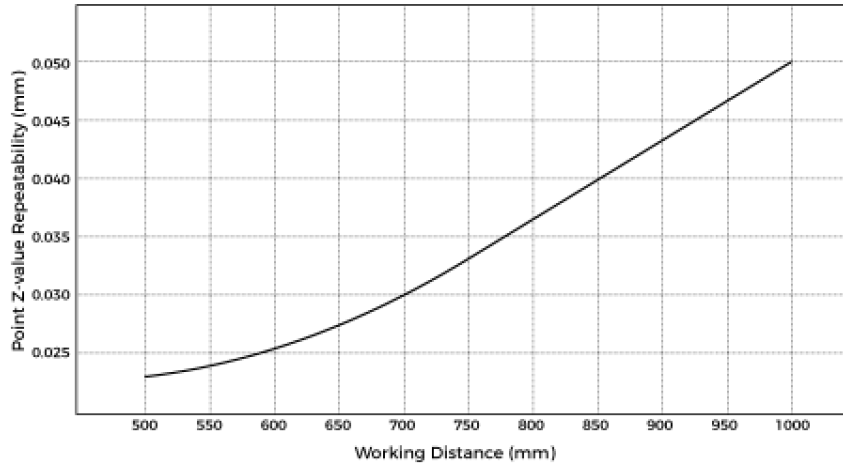
### PRO M



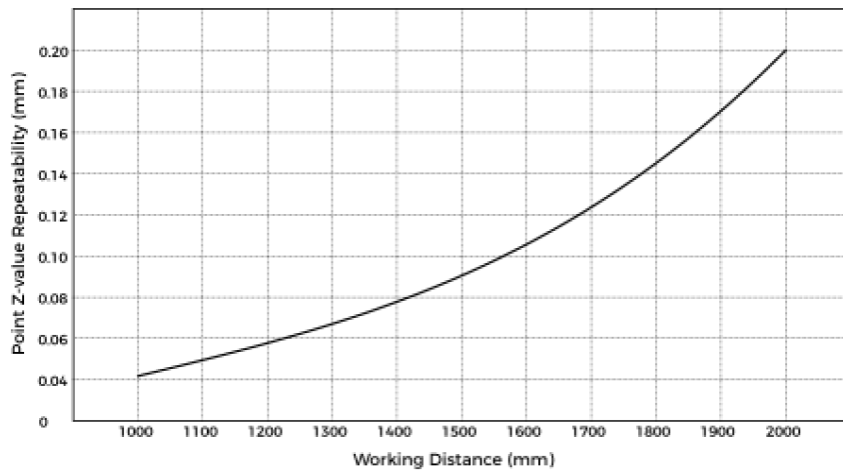
## Point Z-Value Repeatability

### PRO S





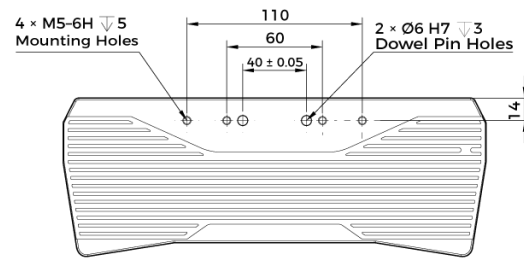
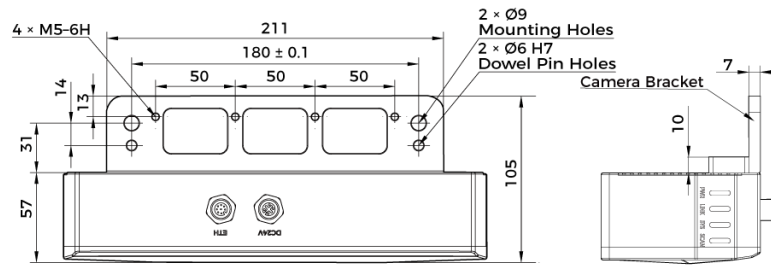
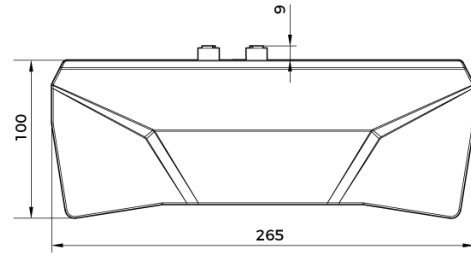
### PRO M



### Dimensions

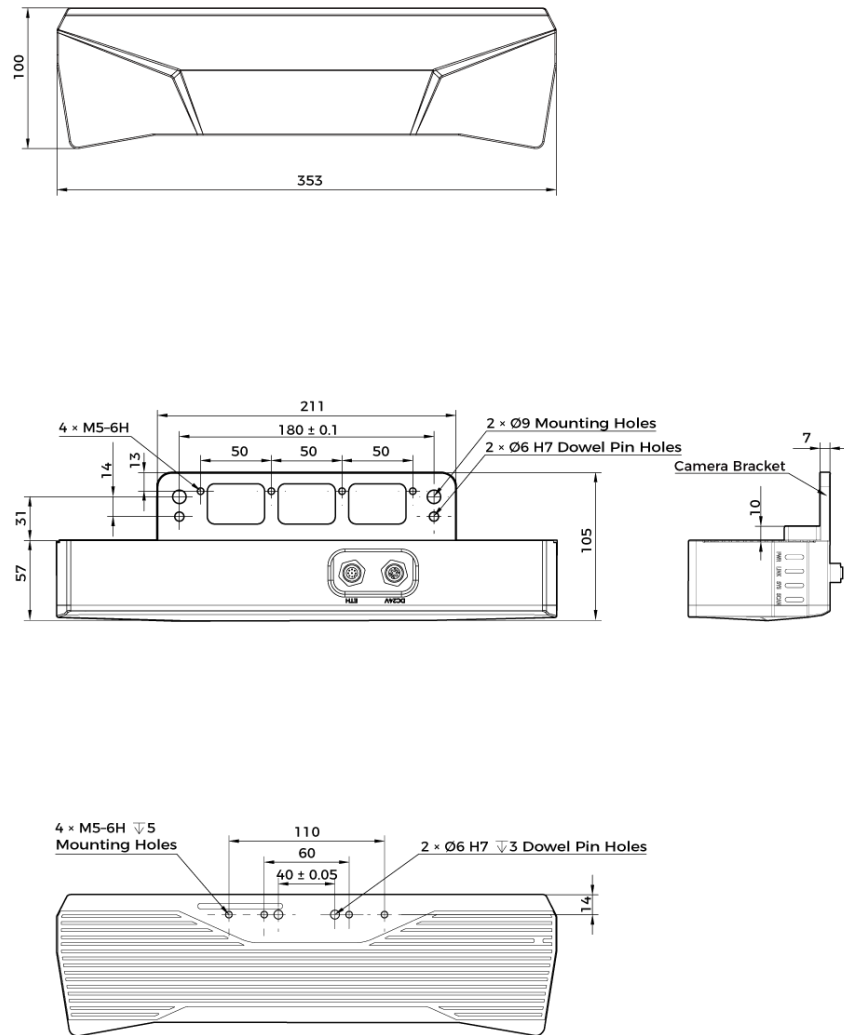
Unit: mm

### PRO S



04

PRO M



## Maintenance

### Cleaning the Camera

When cleaning the surface of the camera, please blow off the dust gently, and then use a clean soft cloth to gently wipe the surface. When cleaning the camera lenses, a liquid lens cleaner and clean lint-free cloth can be used to carefully wipe the lenses to avoid scratching.

#### Warning

- Do not clean the camera with corrosive or volatile solvents such as alcohol, gasoline and kerosene. These substances may damage the exterior and internal structure of the camera.
- Do not use a pressure washer gun or hose to spray and wash the camera. Water entering the camera may lead to malfunction, fire, or even explosion. Water or other liquid damage to the camera is not covered by the warranty.


### Storing the Camera

This product is rated as IP65. The enclosure of the camera can prevent dust from entering and affecting the functions of the camera. Soaking the camera in water or placing it in a highly humid environment may lead to malfunction. Rusting of the internal unit will lead to irreversible damage. When not using, please store the camera in an indoor, dry, cool and well ventilated place. To avoid damage caused by rain, snow, and other undesirable conditions, please do not place the camera

outdoors for an extended period of time.

#### Warning

- Disconnect the camera from the power supply when storing to avoid fire.
- Do not leave the lens pointed at the sun or other intense light source for an extended period of time. Intense light may cause the image sensor to deteriorate and produce a white blur effect in images.

 This icon indicates that failure to follow the instruction may lead to injury or death.

### Trademark and Legal Statement

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## 8.4. UHP-140

### Safety Instructions

- To ensure safe use, please do not use the product before reading this manual and becoming familiar with the correct usage. Improper use and maintenance may damage the product or cause other hazards. Mech-Mind shall not be liable for any injury or damage brought upon the user or any third party due to improper use and maintenance.
- Following the instructions and warnings in this manual can lower risks, but can not totally eliminate all risks.
- Every step has been inspected during the drafting of this user manual. Please do not hesitate to contact Mech-Mind if you find any problems or mistakes in the manual.
- This product is to be mounted, connected, used and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used and maintained properly.
- Laser is hazardous; please familiarize yourself with hazard prevention before using the camera.

### Precautions for Mounting and Using the Camera

- It is PROHIBITED to place any explosive or flammable substances near the camera. Do not expose the camera to open fire or high temperature.
- Do not throw, drop, or collide the camera with other objects. The camera may be damaged by strong shock or vibration. It is PROHIBITED to modify the camera in any form. Do not repair or disassemble the camera by yourself. Mech-Mind shall not be liable for any damage caused by repair or disassembly not performed by Mech-Mind.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the camera. Failure to do so may lead to fire, electric shock, malfunction, etc.
- Do not use the camera at extremely high or low temperature. The operating temperature range is -10–45°C for the LSR and DEEP series, and 0–45°C for other series.
- Please use the camera indoors.
- Please use the camera at elevations below 4,000 meters.
- Please install the camera in a well-circulated, open place.

### Check the Camera

- Before using, please check the camera carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the camera is in proper working conditions. If any of the above abnormalities occur, please disconnect the power immediately.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the cable has aged, please contact Mech-Mind to acquire a replacement.

### Usage of Adapter/DIN Rail Power Supply

- DO NOT use if the power port, adapter/DIN rail power supply, or power socket is wet.
- DO NOT heat or put the adapter/DIN rail power supply and power cable in fire.
- For power, please use a 24 V isolated adapter with an output power of at least 90 W or a 24 V isolated DIN rail power supply.
- Please use the specified voltage. Failure to do so may lead to fire, electric shock, malfunction, etc. The adapter/DIN rail power supply and power cable should be properly grounded. It is recommended to use the isolated adapter/DIN rail power supply provided by Mech-Mind.
- Power plugs should be properly grounded. Do not place the adapter/DIN rail power supply in a place that is hard to disconnect the power.
- Please install the DIN rail power supply inside a control cabinet.

### Precautions for Using Laser Cameras


- DO NOT look into the laser beam or the reflected laser beam directly. Do not look into the laser beam with optical instruments. Failure to do so may lead to eye injuries. DO NOT direct the laser at other people.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. If there is a possibility that personnel may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Do not enter the areas that the laser/reflected laser output reaches. Do not place any reflective light object (mirror, glass, metal, etc.) in the path of the laser beam.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS. NOTE: The risk of skin

injury is only likely for highly divergent beams for exposure close to the aperture.

#### Notice for Disposal

- Please comply with local laws and regulations when disposing of the camera to avoid polluting the environment. Please do not dispose of the camera irresponsibly. Improper disposal may pollute the environment.

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 This icon indicates that failure to follow the instruction may lead to injury or death.

## Certifications

Mech-Eye Industrial 3D Camera is compliant with the following standards and assessment requirements. Please note that the registration statuses may be updated. If you need more information, please contact the local agents.

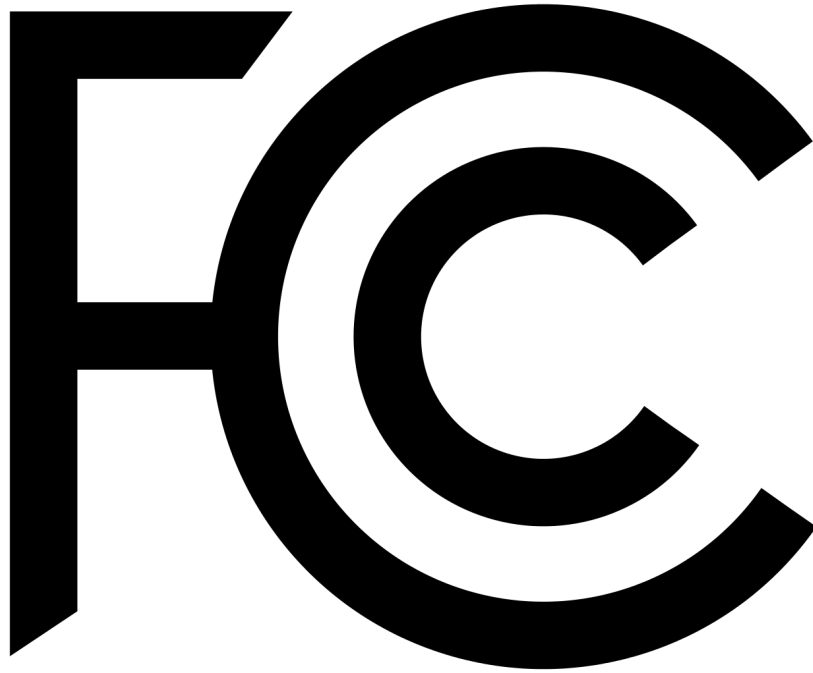
### CE



Compliant with the following European Electromagnetic Compatibility Standards:

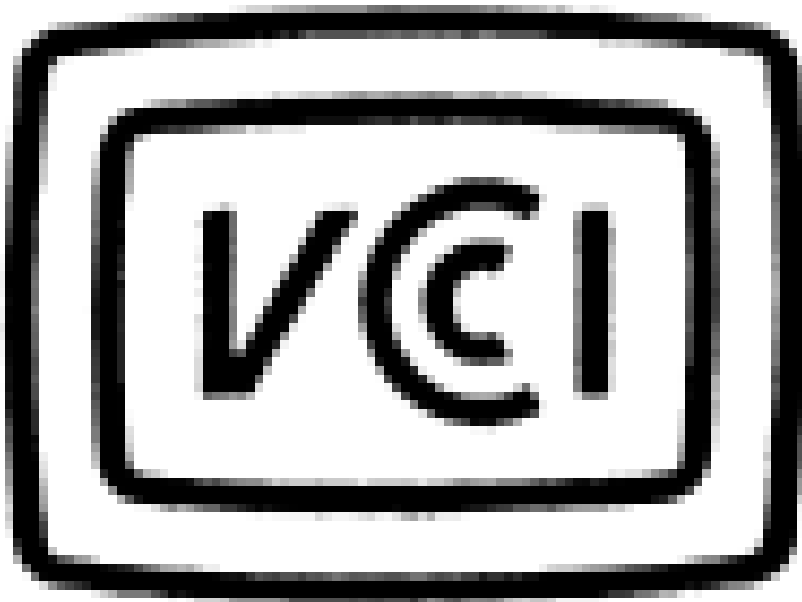
- EN55032: 2015+A11: 2020
- EN IEC 61000-3-2: 2019+A1: 2021
- EN 61000-3-3: 2013+A1: 2019
- EN 55035: 2017+A11: 2020

### FCC



- Compliant with US ANSI C63.4 and 47 CFR PART 15B.
- Compliant with Canada ICES-003.

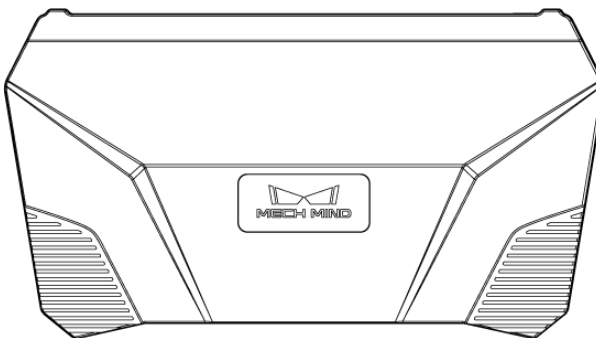
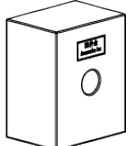
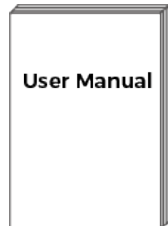
#### VCCI



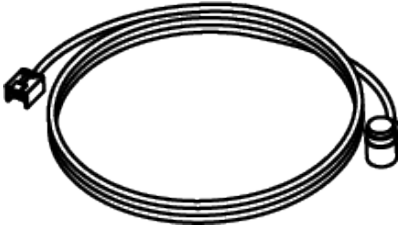
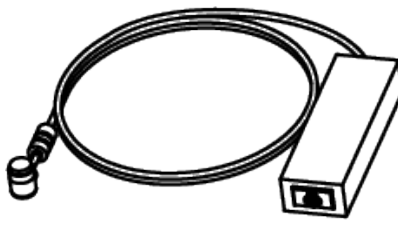

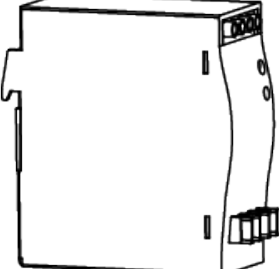
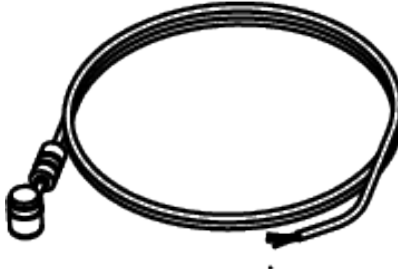
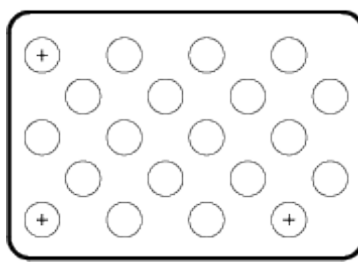
Compliant with Japanese VCCI-CISPR 32: 2016 standard.

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

### Package Contents

Camera	
Accessory box	
User manual	

### Cables and Accessories

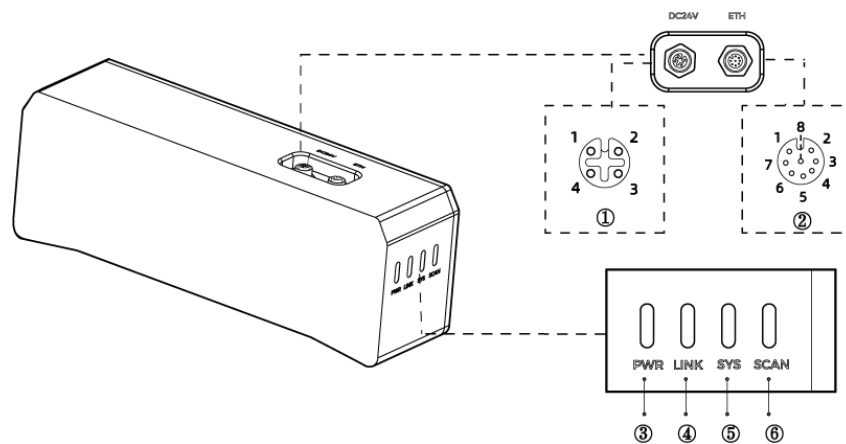
Ethernet cable	Adapter	AC power cable
		
DIN rail power supply	DC power cable	Calibration board
		



- All the above cables and accessories are optional; please select the type and length based on your actual needs. For detailed usage instructions, please see [Connect the Camera](#).
- Before using, please make sure that the package and the camera are intact, and that no accessories are missing.



## Functional Diagram



The above figure is for reference only. The actual product may differ.

No.	Name	Function	
①	DC 24V port	1: GND	2: GND
		3: 24 VDC	4: 24 VDC
②	ETH port	1: MD3_P	2: MD2_N
		3: MD2_P	4: MD0_P
		5: MD1_P	6: MD0_N
		7: MD3_N	8: MD1_N
③	PWR indicator light	Off: not connected to power	
		Green: normal voltage	
		Yellow: abnormal voltage, but system is still functioning	
		Red: voltage too high or too low, system power is disconnected	
④	LINK indicator light	Off: not connected to network	
		Blinking green: data being transmitted	
		Solid green: no ongoing data transmission	
⑤	SYS indicator light	Off: system not started	
		Solid green: system starting up	
		Blinking green: system operating properly	
		Blinking yellow: system operating with error but still functioning	
⑥	SCAN indicator light	Blinking red: system not operating	
		Solid: capturing and processing in progress	
		Off: not capturing or processing	

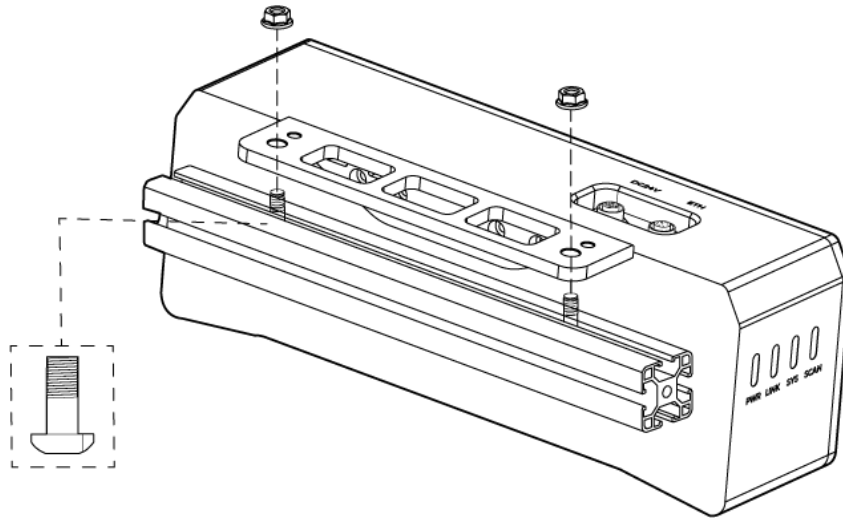
## Mount the Camera



When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the [Dimensions](#) section of Technical Specifications.

### Mount through the Camera Bracket

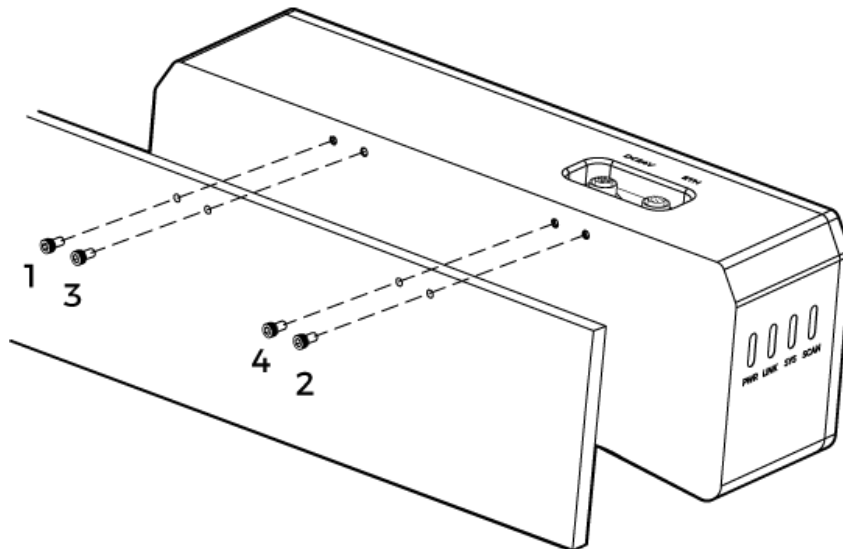
Use the wrench to tighten the two nuts, as shown below.



- The camera bracket is attached to the back of the camera when packaged.

### Mount through Threaded Holes

Use the wrench to loosely screw on the bolts in the order specified below, and then fully tighten all the bolts in the specified order.



- Before mounting the camera, use the wrench to detach the camera bracket from the camera.

## Connect the Camera



- Please connect the power cable last. The PWR indicator light should turn on after the cables are connected. If the light is not on, please contact Technical Support.

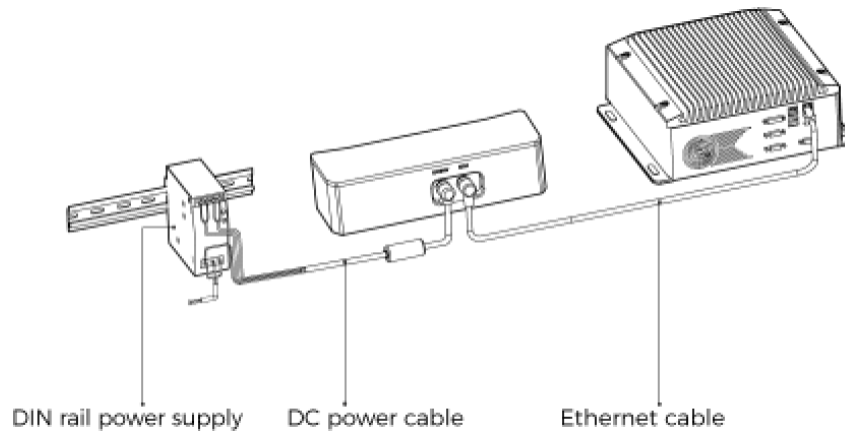
- The recommended tightening torque for the bolts is 16 N·m.
- The DIN rail power supply should be reliably grounded. If using multiple DIN rail power supplies, ensure enough distance in between.
- When mounting the camera onto a robot arm or other mobile equipment, please fasten the DC power and Ethernet cables on the camera end properly to avoid damaging the cables or connectors due to strain.

## Ethernet Cable

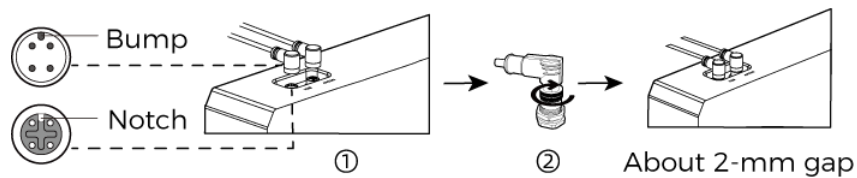
As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

## DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

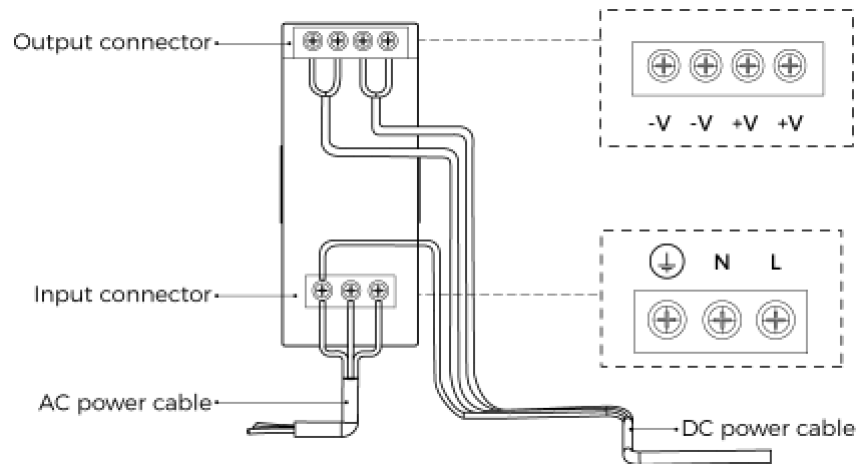


Connect the M12-A connectors of the cables to the corresponding ports:



1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.

## DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊕).
- The 24 V DC power cable has three wires: V+, V- and PE (⊕).

### Warning

The PE wires must be properly grounded! Please install the DIN rail power supply inside a control cabinet.



A network switch can be used to connect multiple cameras or computers.

## Technical Specifications

Product name	Mech-Eye Industrial 3D Camera
Model	UHP-140
Recommended working distance	300 ± 20 mm
FOV (near)	135 × 90 mm @ 280 mm
FOV (far)	150 × 100 mm @ 320 mm
Resolution	2048 × 1536
Pixels	3 MP
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	2.6 $\mu\text{m}$ @ 0.3 m
Regional Z-value repeatability ( $\sigma$ ) <sup>(2)</sup>	0.09 $\mu\text{m}$ @ 0.3 m
Measurement accuracy (VDI/VDE) <sup>(3)</sup>	0.03 mm @ 0.3 m
Typical capture time	0.6–0.9 s
Weight	About 1.9 kg
Baseline	About 80 mm
Dimensions	About 260 × 65 × 142 mm
Light source	Blue LED (459 nm, RG2)
Operating temperature	0–45°C

Product name	Mech-Eye Industrial 3D Camera
Communication interface	Gigabit Ethernet
Input	24 VDC, 3.75 A
Safety and EMC	CE/FCC/VCCI/UKCA/KC
IP rating <sup>(4)</sup>	IP65
Cooling	Passive

(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

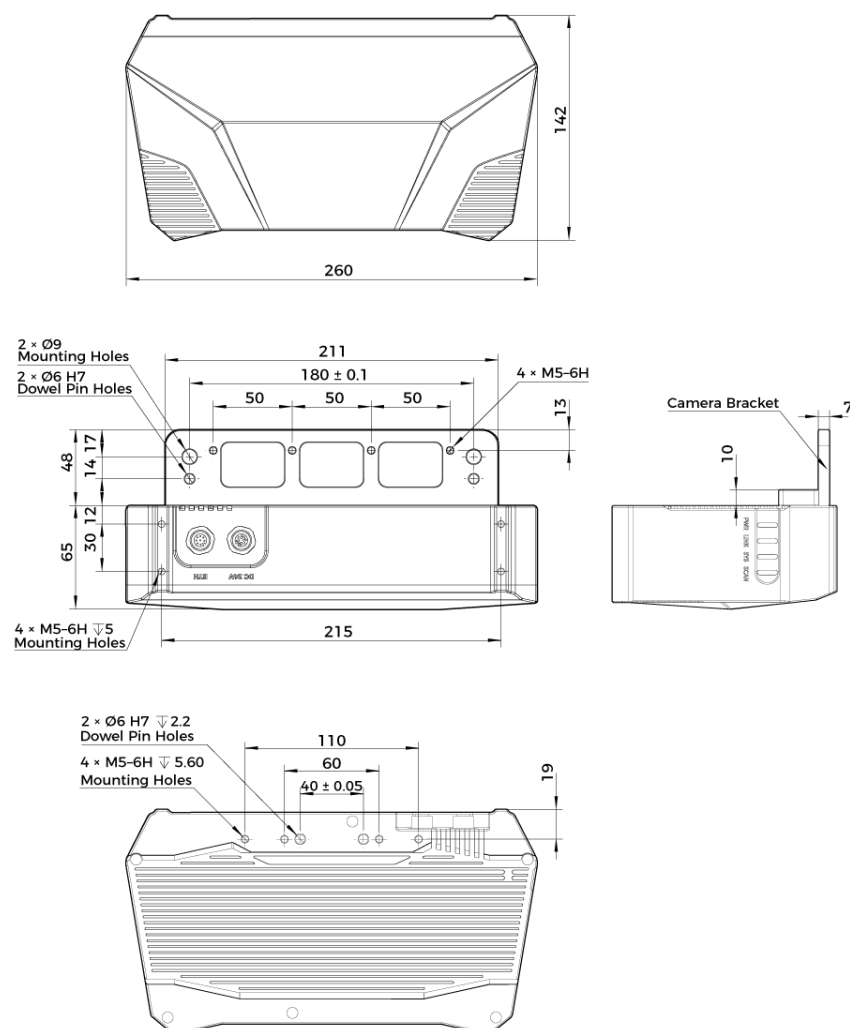
(2) One standard deviation of 100 measurements of the difference between the Z-value means of two same-sized regions. The measurement target was a ceramic plate.

(3) According to VDI/VDE 2634 Part II.

(4) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.

## Dimensions

Unit: mm



## Maintenance

### Cleaning the Camera

When cleaning the surface of the camera, please blow off the dust gently, and then use a clean soft cloth to gently wipe the surface. When cleaning the camera lenses, a liquid lens cleaner and clean lint-free cloth can be used to carefully wipe the lenses to avoid scratching.

#### Warning

- Do not clean the camera with corrosive or volatile solvents such as alcohol, gasoline and kerosene. These substances may damage the exterior and internal structure of the camera.
- Do not use a pressure washer gun or hose to spray and wash the camera. Water entering the camera may lead to malfunction, fire, or even explosion. Water or other liquid damage to the camera is not covered by the warranty.

### Storing the Camera

This product is rated as IP65. The enclosure of the camera can prevent dust from entering and affecting the functions of the camera. Soaking the camera in water or placing it in a highly humid environment may lead to malfunction. Rusting of the internal unit will lead to irreversible damage. When not using, please store the camera in an indoor, dry, cool and well ventilated place. To avoid damage caused by rain, snow, and other undesirable conditions, please do not place the camera outdoors for an extended period of time.

#### Warning

- Disconnect the camera from the power supply when storing to avoid fire.
- Do not leave the lens pointed at the sun or other intense light source for an extended period of time. Intense light may cause the image sensor to deteriorate and produce a white blur effect in images.

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 This icon indicates that failure to follow the instruction may lead to injury or death.

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## 8.5. DEEP

### Safety Instructions

- To ensure safe use, please do not use the product before reading this manual and becoming familiar with the correct usage. Improper use and maintenance may damage the product or cause other hazards. Mech-Mind shall not be liable for any injury or damage brought upon the user or any third party due to improper use and maintenance.
- Following the instructions and warnings in this manual can lower risks, but can not totally eliminate all risks.
- Every step has been inspected during the drafting of this user manual. Please do not hesitate to contact Mech-Mind if you find any problems or mistakes in the manual.
- This product is to be mounted, connected, used and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used and maintained properly.
- Laser is hazardous; please familiarize yourself with hazard prevention before using the camera.

### Precautions for Mounting and Using the Camera

- It is PROHIBITED to place any explosive or flammable substances near the camera. Do not expose the camera to open fire or high temperature.
- Do not throw, drop, or collide the camera with other objects. The camera may be damaged by strong shock or vibration. It is PROHIBITED to modify the camera in any form. Do not repair or disassemble the camera by yourself. Mech-Mind shall not be liable for any damage caused by repair or disassembly not performed by Mech-Mind.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the camera. Failure to do so may lead to fire, electric shock, malfunction, etc.
- Do not use the camera at extremely high or low temperature. The operating temperature range is -10–45°C for the LSR and DEEP series, and 0–45°C for other series.
- Please use the camera indoors.
- Please use the camera at elevations below 4,000 meters.
- Please install the camera in a well-circulated, open place.

### Check the Camera

- Before using, please check the camera carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the camera is in proper working conditions. If any of the above abnormalities occur, please disconnect the power immediately.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the cable has aged, please contact Mech-Mind to acquire a replacement.

### Usage of Adapter/DIN Rail Power Supply

- DO NOT use if the power port, adapter/DIN rail power supply, or power socket is wet.
- DO NOT heat or put the adapter/DIN rail power supply and power cable in fire.
- For power, please use a 24 V isolated adapter with an output power of at least 90 W or a 24 V isolated DIN rail power supply.

- Please use the specified voltage. Failure to do so may lead to fire, electric shock, malfunction, etc. The adapter/DIN rail power supply and power cable should be properly grounded. It is recommended to use the isolated adapter/DIN rail power supply provided by Mech-Mind.
- Power plugs should be properly grounded. Do not place the adapter/DIN rail power supply in a place that is hard to disconnect the power.
- Please install the DIN rail power supply inside a control cabinet.


#### Precautions for Using Laser Cameras

- DO NOT look into the laser beam or the reflected laser beam directly. Do not look into the laser beam with optical instruments. Failure to do so may lead to eye injuries. DO NOT direct the laser at other people.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. If there is a possibility that personnel may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Do not enter the areas that the laser/reflected laser output reaches. Do not place any reflective light object (mirror, glass, metal, etc.) in the path of the laser beam.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS. NOTE: The risk of skin injury is only likely for highly divergent beams for exposure close to the aperture.

#### Notice for Disposal

- Please comply with local laws and regulations when disposing of the camera to avoid polluting the environment. Please do not dispose of the camera irresponsibly. Improper disposal may pollute the environment.

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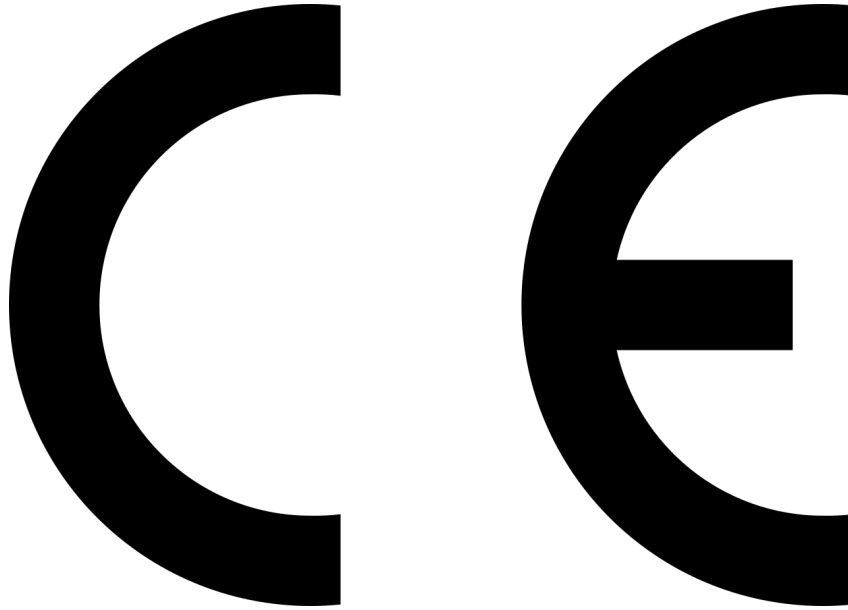
 This icon indicates that failure to follow the instruction may lead to injury or death.

#### Certifications

Mech-Eye Industrial 3D Camera is compliant with the following standards and assessment requirements. Please note that the registration statuses may be updated. If you need more information, please contact the local agents.

CE

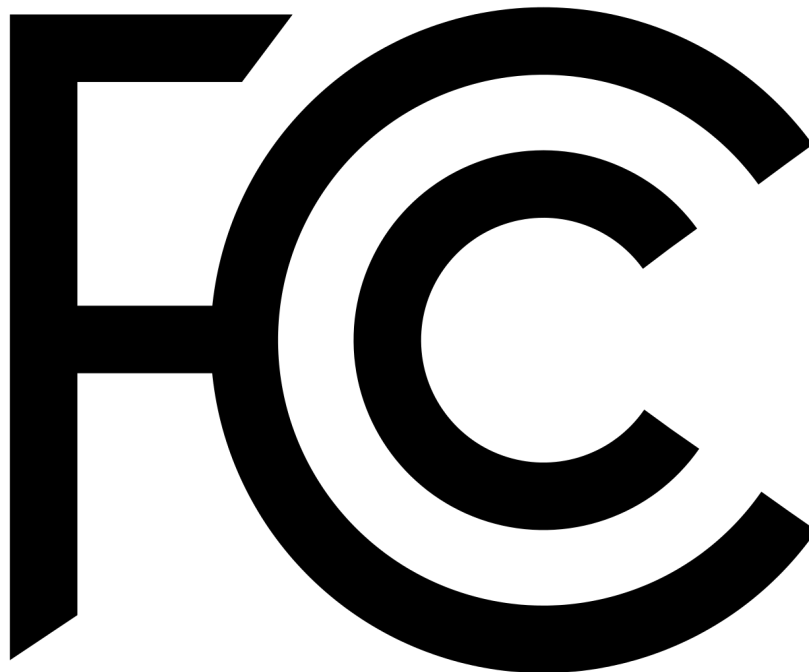




Compliant with the following European Electromagnetic Compatibility Standards:

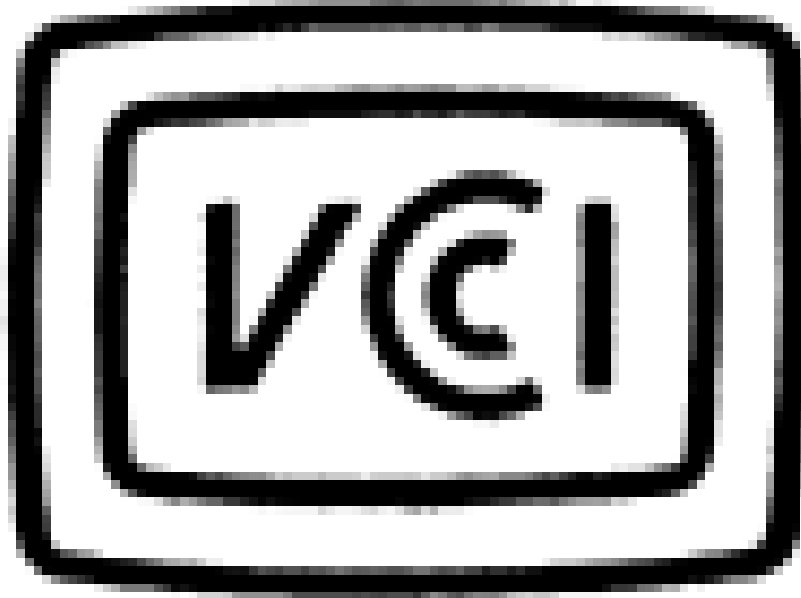
- EN55032: 2015+A11: 2020
- EN IEC 61000-3-2: 2019+A1: 2021
- EN 61000-3-3: 2013+A1: 2019
- EN 55035: 2017+A11: 2020

FCC



- Compliant with US ANSI C63.4 and 47 CFR PART 15B.
- Compliant with Canada ICES-003.

## VCCI



Compliant with Japanese VCCI-CISPR 32: 2016 standard.

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

## Safety of Laser Products

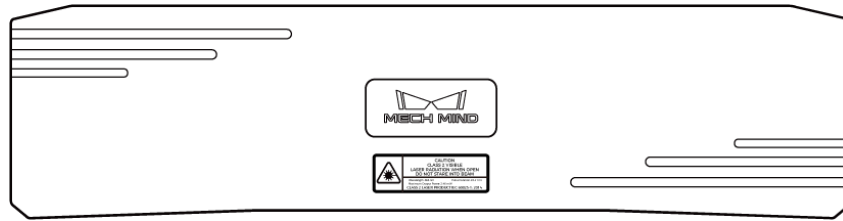
The Laser classification is implemented based on IEC 60825-1 in accordance with the requirements of Laser Notice No. 56 of the FDA (CDRH).

Model	Wavelength	IEC 60825-1	
		Maximum output power	Laser class
LSR L	638 nm	2.46 mW	Class 2
DEEP			

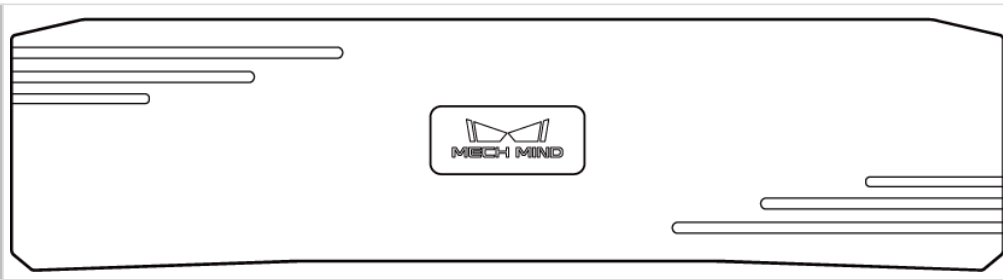
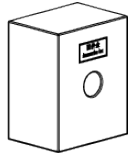

## Warning Label



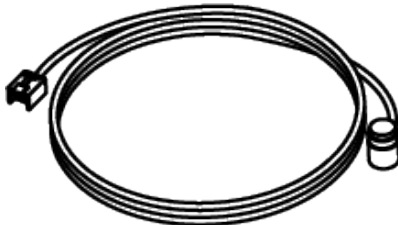
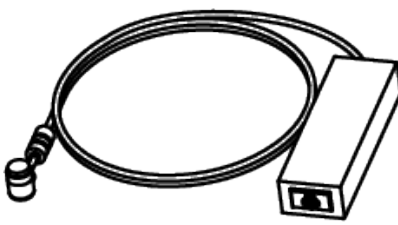
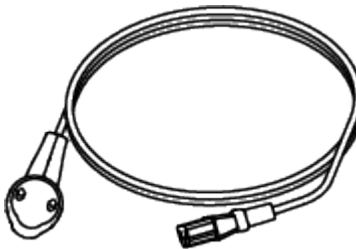
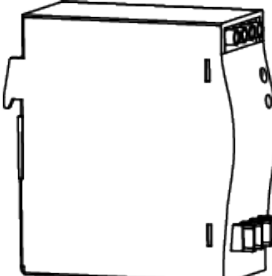

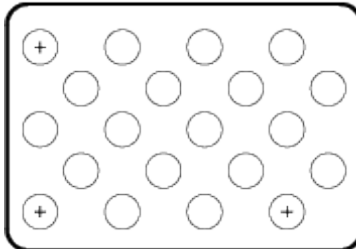
## Warning Label Attachment



### Package Contents

Camera	
Accessory box	
User manual	

### Cables and Accessories

Ethernet cable	Adapter	AC power cable
		
DIN rail power supply	DC power cable	Calibration board
		

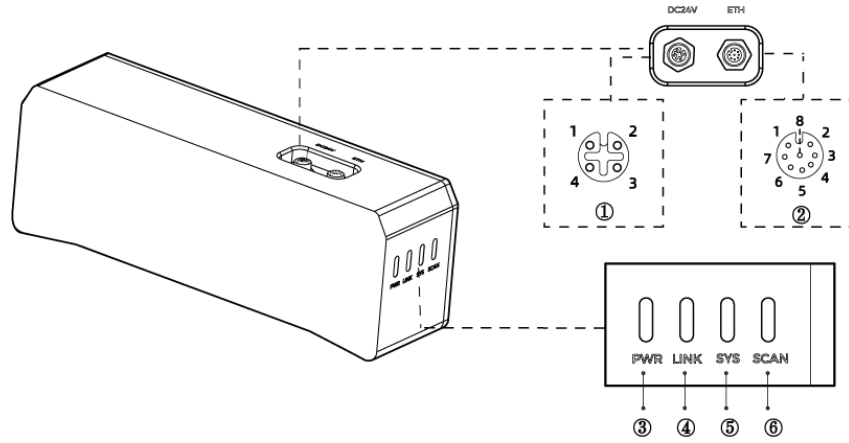


• All the above cables and accessories are optional; please select the type and length

based on your actual needs. For detailed usage instructions, please see [Connect the Camera](#).

- Before using, please make sure that the package and the camera are intact, and that no accessories are missing.

## Functional Diagram



The above figure is for reference only. The actual product may differ.

No.	Name	Function
①	DC 24V port	1: GND
		2: GND
②	ETH port	3: 24 VDC
		4: 24 VDC
		1: MD3_P
		2: MD2_N
③	PWR indicator light	3: MD2_P
		4: MD0_P
		5: MD1_P
		6: MD0_N
④	LINK indicator light	7: MD3_N
		8: MD1_N
		Off: not connected to power
		Green: normal voltage
⑤	SYS indicator light	Yellow: abnormal voltage, but system is still functioning
		Red: voltage too high or too low, system power is disconnected
		Off: not connected to network
		Blinking green: data being transmitted
⑥	SCAN indicator light	Solid green: no ongoing data transmission
		Off: system not started
		Solid green: system starting up
		Blinking green: system operating properly
		Blinking yellow: system operating with error but still functioning
Blinking red: system not operating		

⑥	SCAN indicator light	Solid: capturing and processing in progress
		Off: not capturing or processing

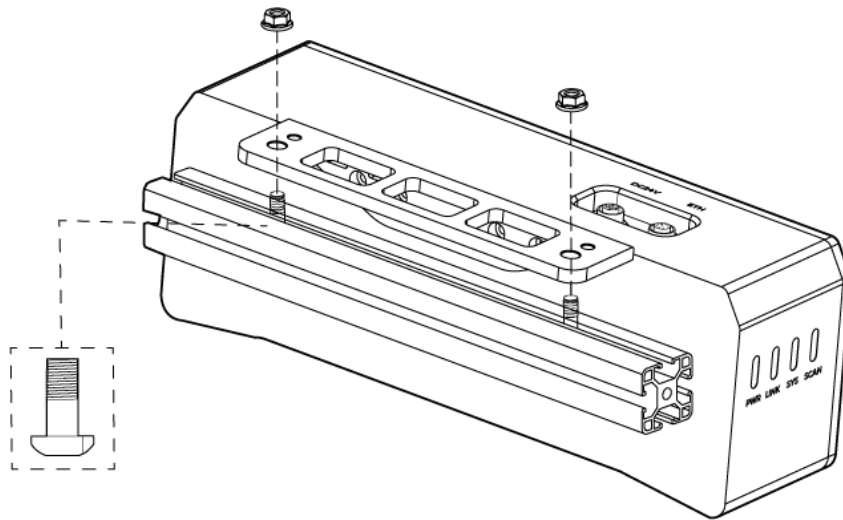
## Mount the Camera



When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the [Dimensions](#) section of Technical Specifications.

### Mount through the Camera Bracket

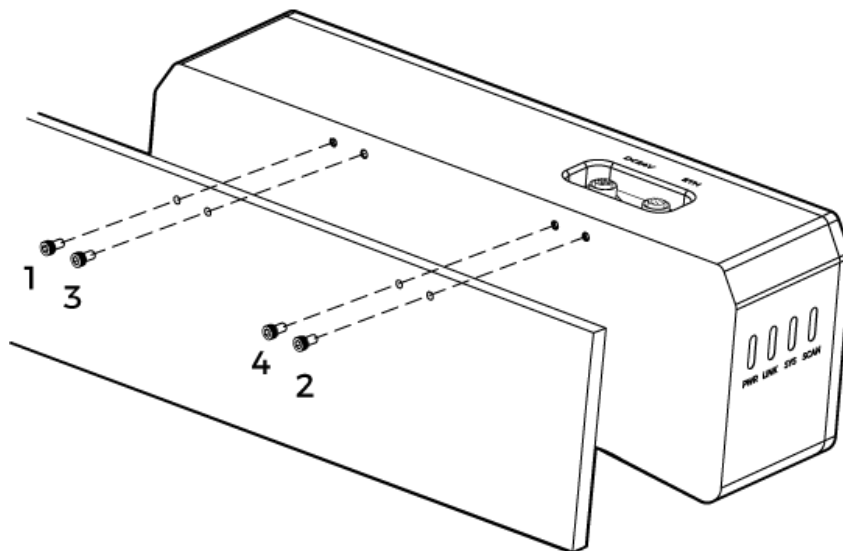
Use the wrench to tighten the two nuts, as shown below.



- The camera bracket is attached to the back of the camera when packaged.

### Mount through Threaded Holes

Use the wrench to loosely screw on the bolts in the order specified below, and then fully tighten all the bolts in the specified order.



- Before mounting the camera, use the wrench to detach the camera bracket from the camera.

## Connect the Camera



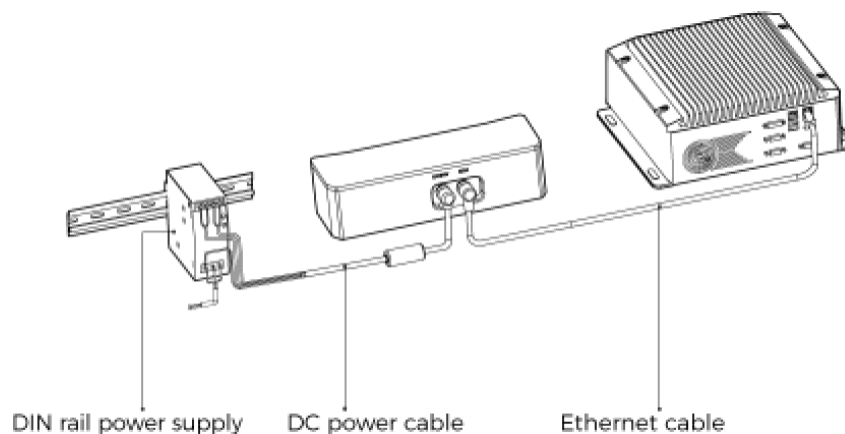
- Please connect the power cable last. The PWR indicator light should turn on after the cables are connected. If the light is not on, please contact Technical Support.
- The recommended tightening torque for the bolts is 16 N·m.
- The DIN rail power supply should be reliably grounded. If using multiple DIN rail power supplies, ensure enough distance in between.
- When mounting the camera onto a robot arm or other mobile equipment, please fasten the DC power and Ethernet cables on the camera end properly to avoid damaging the cables or connectors due to strain.

## Ethernet Cable

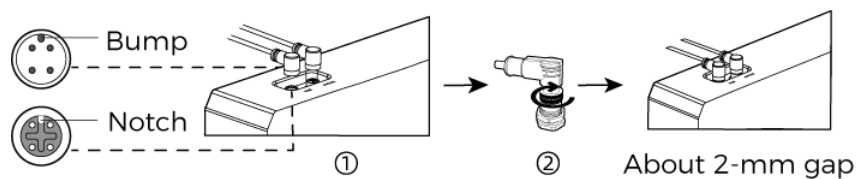
As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

## DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

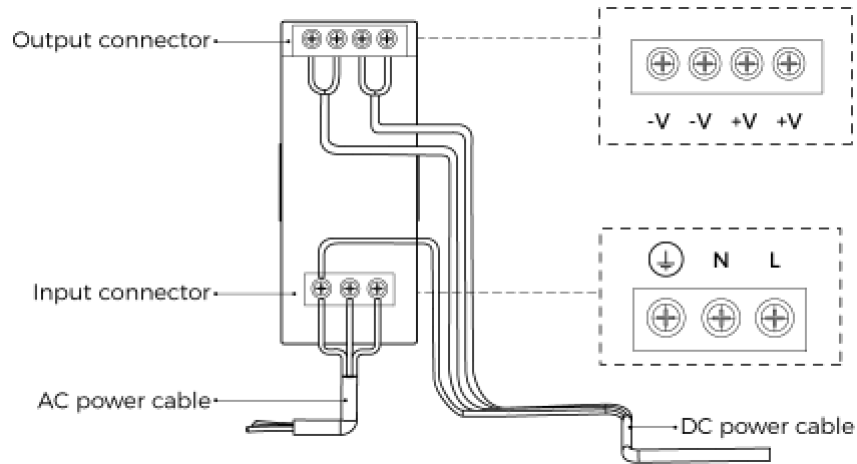


Connect the M12-A connectors of the cables to the corresponding ports:



1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.

## DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊕).
- The 24 V DC power cable has three wires: V+, V- and PE (⊕).

### Warning

The PE wires must be properly grounded! Please install the DIN rail power supply inside a control cabinet.



A network switch can be used to connect multiple cameras or computers.

## Technical Specifications

Product name	Mech-Eye Industrial 3D Camera
Model	DEEP
Recommended working distance	1200–3500 mm
FOV (near)	1200 × 1000 mm @ 1.2 m
FOV (far)	3500 × 2800 mm @ 3.5 m
Depth map resolution	2048 × 1536 / 1024 × 768
RGB resolution	2000 × 1500
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	1.0 mm @ 3 m
Measurement accuracy (VDI/VDE) <sup>(2)</sup>	3.0 mm @ 3 m
Typical capture time	0.5–0.9 s
Weight	About 2.4 kg
Baseline	About 300 mm
Dimensions	About 366 × 77 × 92 mm
Light source	Red laser (638 nm, class 2)
Operating temperature	-10–45°C
Communication interface	Gigabit Ethernet

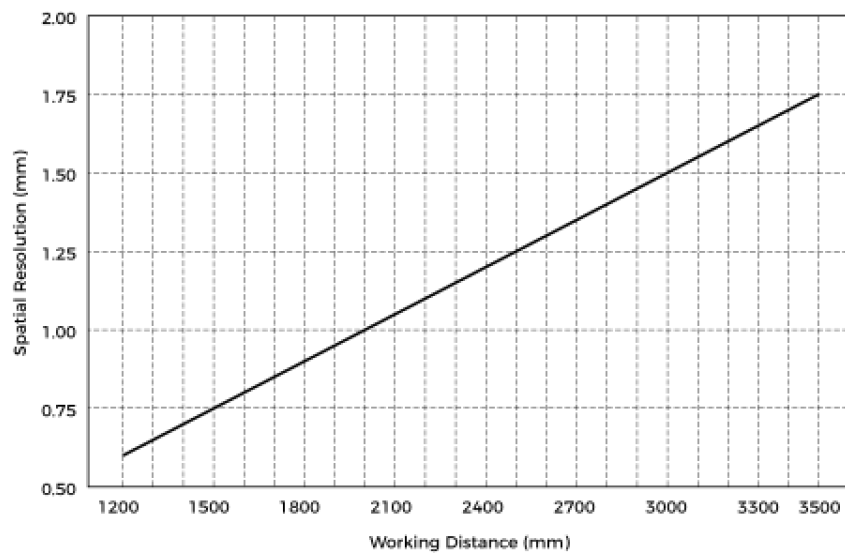
Input	24 VDC, 3.75 A
Safety and EMC	CE/FCC/VCCI/UKCA/KC
IP rating <sup>(3)</sup>	IP65
Cooling	Passive

(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

(2) According to VDI/VDE 2634 Part II.

(3) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.

### Spatial Resolution



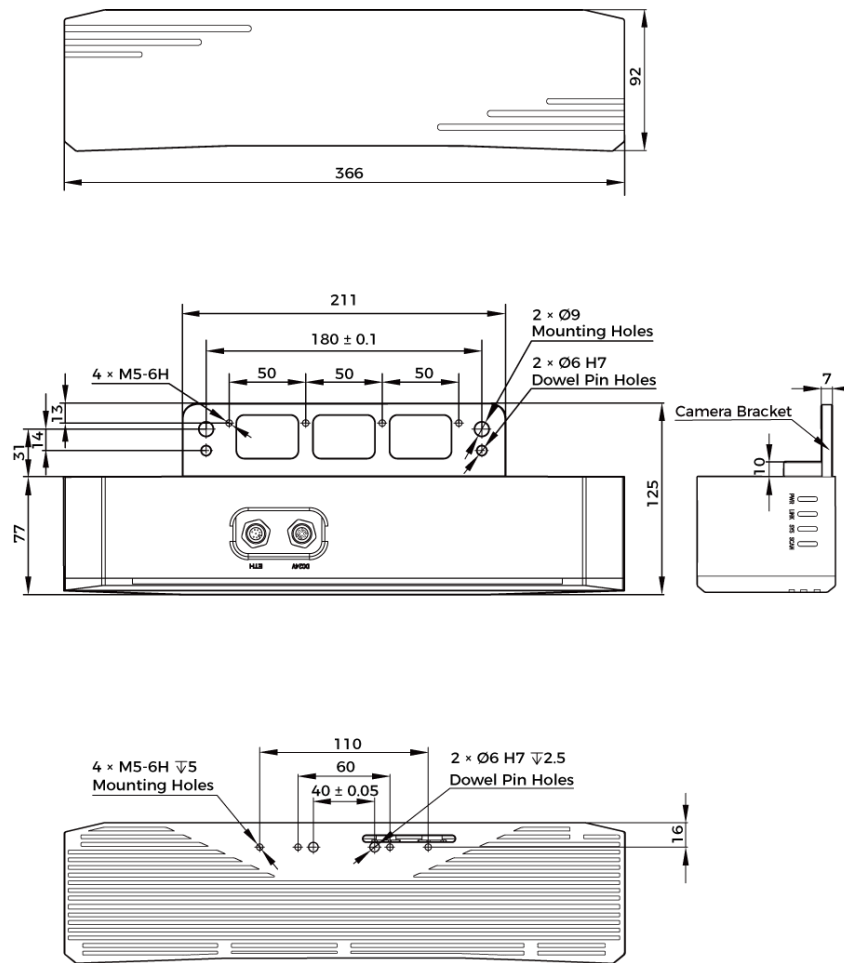
### Point Z-Value Repeatability



### Dimensions

Unit: mm





## Maintenance

### Cleaning the Camera

When cleaning the surface of the camera, please blow off the dust gently, and then use a clean soft cloth to gently wipe the surface. When cleaning the camera lenses, a liquid lens cleaner and clean lint-free cloth can be used to carefully wipe the lenses to avoid scratching.

#### Warning

- Do not clean the camera with corrosive or volatile solvents such as alcohol, gasoline and kerosene. These substances may damage the exterior and internal structure of the camera.
- Do not use a pressure washer gun or hose to spray and wash the camera. Water entering the camera may lead to malfunction, fire, or even explosion. Water or other liquid damage to the camera is not covered by the warranty.

### Storing the Camera

This product is rated as IP65. The enclosure of the camera can prevent dust from entering and affecting the functions of the camera. Soaking the camera in water or placing it in a highly humid environment may lead to malfunction. Rusting of the internal unit will lead to irreversible damage. When not using, please store the camera in an indoor, dry, cool and well ventilated place. To avoid damage caused by rain, snow, and other undesirable conditions, please do not place the camera outdoors for an extended period of time.

### Warning

- Disconnect the camera from the power supply when storing to avoid fire.
- Do not leave the lens pointed at the sun or other intense light source for an extended period of time. Intense light may cause the image sensor to deteriorate and produce a white blur effect in images.

 This icon indicates that failure to follow the instruction may lead to injury or death.

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## 8.6. LSR L

### Safety Instructions

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- Following the instructions and warnings in this manual can lower risks, but can not totally eliminate all risks.
- Every step has been inspected during the drafting of this user manual. Please do not hesitate to contact Mech-Mind if you find any problems or mistakes in the manual.
- This product is to be mounted, connected, used and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used and maintained properly.
- Laser is hazardous; please familiarize yourself with hazard prevention before using the camera.

### Precautions for Mounting and Using the Camera

- It is PROHIBITED to place any explosive or flammable substances near the camera. Do not expose the camera to open fire or high temperature.

- Do not throw, drop, or collide the camera with other objects. The camera may be damaged by strong shock or vibration. It is PROHIBITED to modify the camera in any form. Do not repair or disassemble the camera by yourself. Mech-Mind shall not be liable for any damage caused by repair or disassembly not performed by Mech-Mind.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the camera. Failure to do so may lead to fire, electric shock, malfunction, etc.
- Do not use the camera at extremely high or low temperature. The operating temperature range is -10–45°C for the LSR and DEEP series, and 0–45°C for other series.
- Please use the camera indoors.
- Please use the camera at elevations below 4,000 meters.
- Please install the camera in a well-circulated, open place.

### Check the Camera

- Before using, please check the camera carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the camera is in proper working conditions. If any of the above abnormalities occur, please disconnect the power immediately.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the cable has aged, please contact Mech-Mind to acquire a replacement.

### Usage of Adapter/DIN Rail Power Supply


- DO NOT use if the power port, adapter/DIN rail power supply, or power socket is wet.
- DO NOT heat or put the adapter/DIN rail power supply and power cable in fire.
- For power, please use a 24 V isolated adapter with an output power of at least 90 W or a 24 V isolated DIN rail power supply.
- Please use the specified voltage. Failure to do so may lead to fire, electric shock, malfunction, etc. The adapter/DIN rail power supply and power cable should be properly grounded. It is recommended to use the isolated adapter/DIN rail power supply provided by Mech-Mind.
- Power plugs should be properly grounded. Do not place the adapter/DIN rail power supply in a place that is hard to disconnect the power.
- Please install the DIN rail power supply inside a control cabinet.

### Precautions for Using Laser Cameras

- DO NOT look into the laser beam or the reflected laser beam directly. Do not look into the laser beam with optical instruments. Failure to do so may lead to eye injuries. DO NOT direct the laser at other people.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. If there is a possibility that personnel may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Do not enter the areas that the laser/reflected laser output reaches. Do not place any reflective light object (mirror, glass, metal, etc.) in the path of the laser beam.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS. NOTE: The risk of skin injury is only likely for highly divergent beams for exposure close to the aperture.

### Notice for Disposal

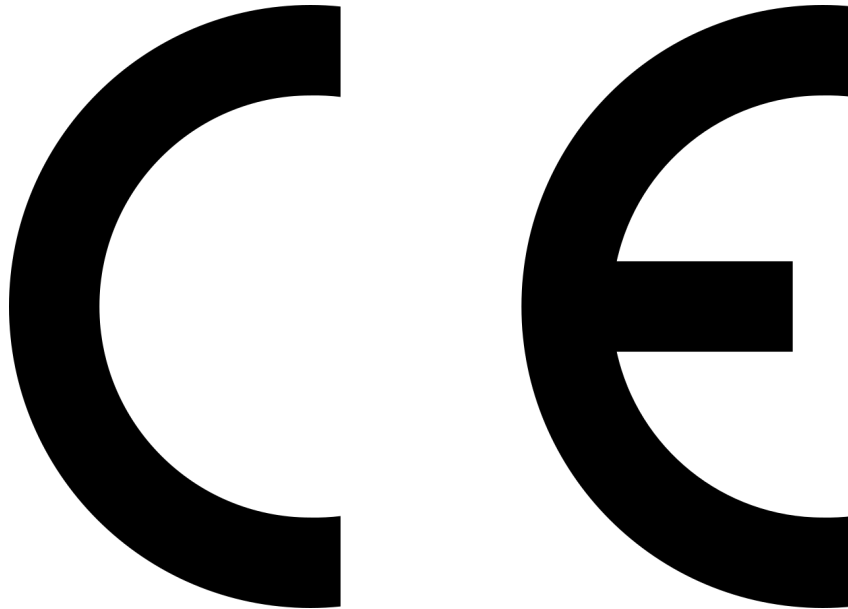
- Please comply with local laws and regulations when disposing of the camera to avoid polluting the environment. Please do not dispose of the camera irresponsibly. Improper disposal may pollute the environment.

 This icon indicates that failure to follow the instruction may lead to injury or death.

### Certifications

Mech-Eye Industrial 3D Camera is compliant with the following standards and assessment requirements. Please note that the registration statuses may be updated. If you need more information, please contact the local agents.

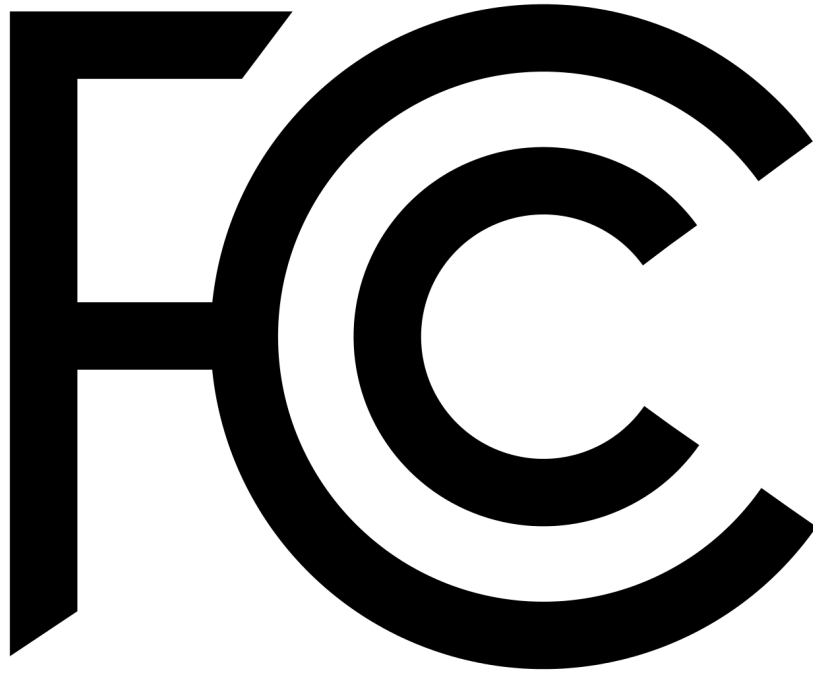
#### CE



Compliant with the following European Electromagnetic Compatibility Standards:

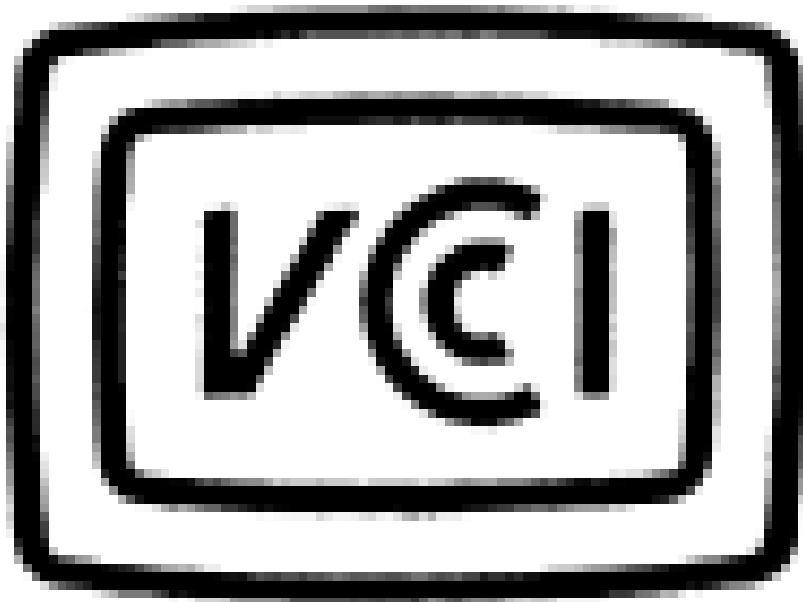
- EN55032: 2015+A11: 2020
- EN IEC 61000-3-2: 2019+A1: 2021
- EN 61000-3-3: 2013+A1: 2019
- EN 55035: 2017+A11: 2020

#### FCC



- Compliant with US ANSI C63.4 and 47 CFR PART 15B.
- Compliant with Canada ICES-003.

#### VCCI



Compliant with Japanese VCCI-CISPR 32: 2016 standard.

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

### Safety of Laser Products

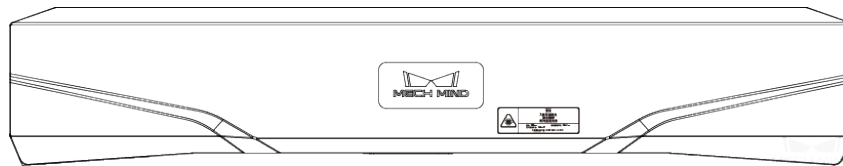
The Laser classification is implemented based on IEC 60825-1 in accordance with the requirements of Laser Notice No. 56 of the FDA (CDRH).

Model	Wavelength	IEC 60825-1	
		Maximum output power	Laser class
LSR L	638 nm	2.46 mW	Class 2
DEEP			

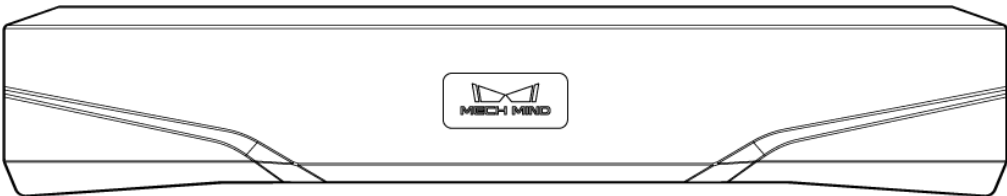
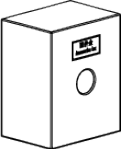

### Warning Label



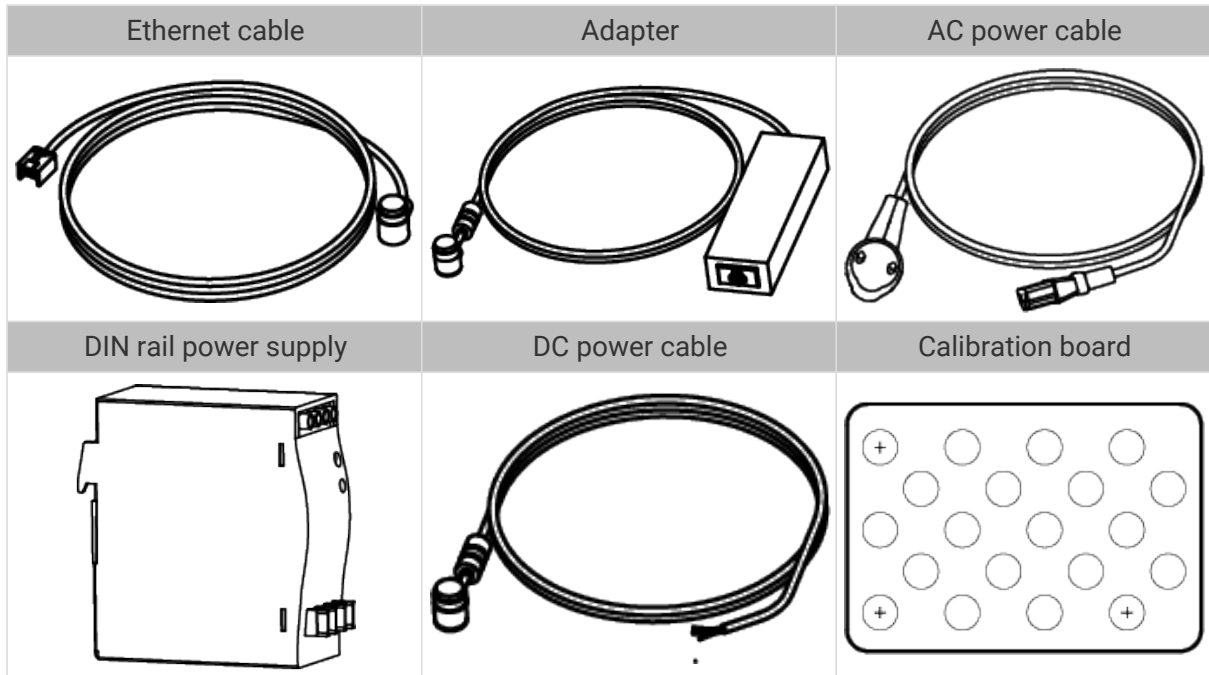
### Warning Label Attachment



### Package Contents

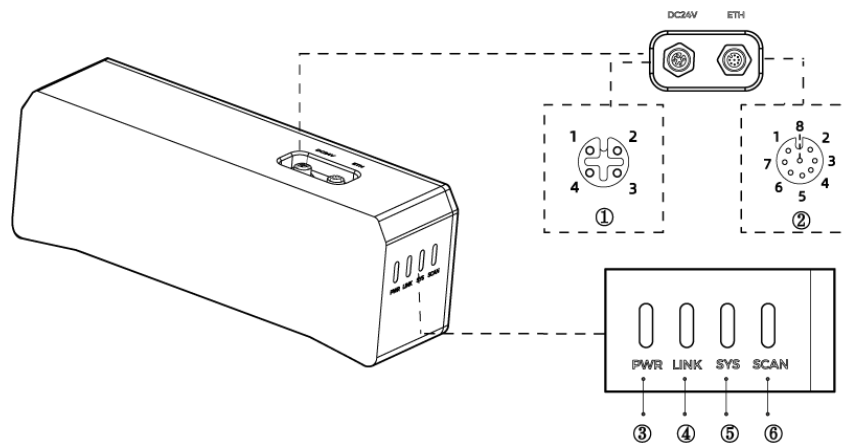
Camera	
Accessory box	
User manual	

## Cables and Accessories



- All the above cables and accessories are optional; please select the type and length based on your actual needs. For detailed usage instructions, please see [Connect the Camera](#).
- Before using, please make sure that the package and the camera are intact, and that no accessories are missing.

## Functional Diagram



The above figure is for reference only. The actual product may differ.

No.	Name	Function	
①	DC 24V port	1: GND	2: GND
		3: 24 VDC	4: 24 VDC

②	ETH port	1: MD3_P	2: MD2_N
		3: MD2_P	4: MD0_P
		5: MD1_P	6: MD0_N
		7: MD3_N	8: MD1_N
③	PWR indicator light	Off: not connected to power	
		Green: normal voltage	
		Yellow: abnormal voltage, but system is still functioning	
		Red: voltage too high or too low, system power is disconnected	
④	LINK indicator light	Off: not connected to network	
		Blinking green: data being transmitted	
		Solid green: no ongoing data transmission	
⑤	SYS indicator light	Off: system not started	
		Solid green: system starting up	
		Blinking green: system operating properly	
		Blinking yellow: system operating with error but still functioning	
		Blinking red: system not operating	
⑥	SCAN indicator light	Solid: capturing and processing in progress	
		Off: not capturing or processing	

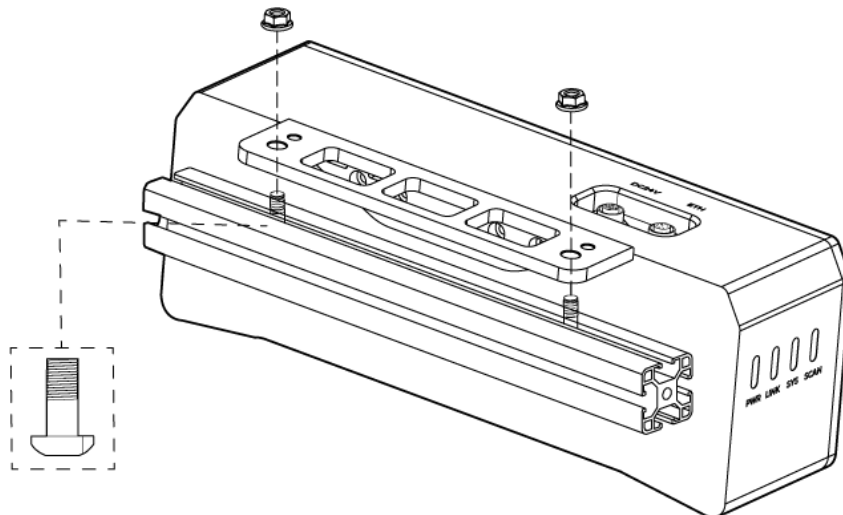
## Mount the Camera



When mounting the camera, please prepare bolts, nuts and wrench of appropriate specifications according to the [Dimensions](#) section of Technical Specifications.

## Mount through the Camera Bracket

Use the wrench to tighten the two nuts, as shown below.



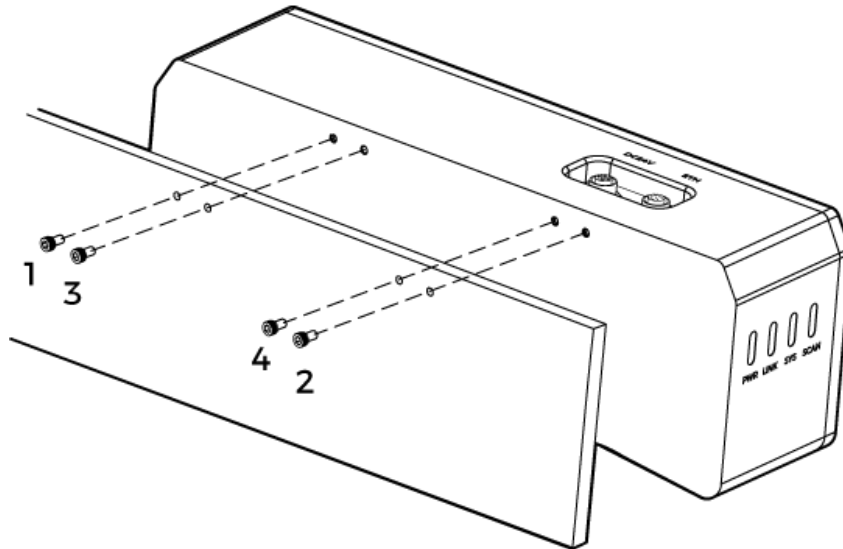




- The camera bracket is attached to the back of the camera when packaged.

## Mount through Threaded Holes

Use the wrench to loosely screw on the bolts in the order specified below, and then fully tighten all the bolts in the specified order.



- Before mounting the camera, use the wrench to detach the camera bracket from the camera.

## Connect the Camera



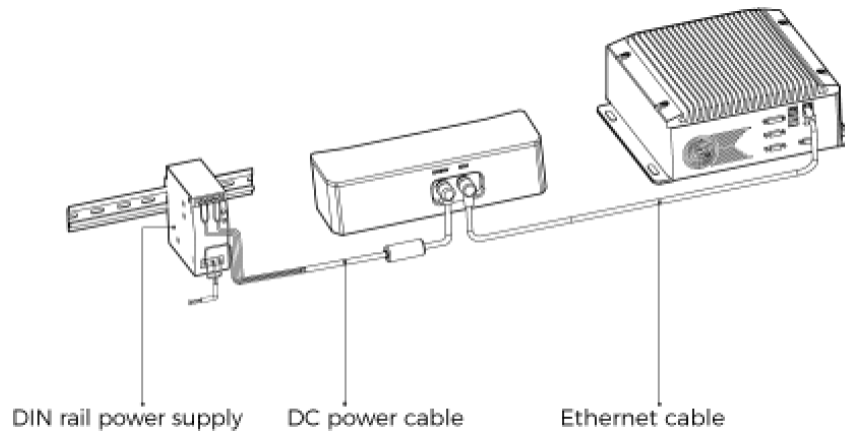
- Please connect the power cable last. The PWR indicator light should turn on after the cables are connected. If the light is not on, please contact Technical Support.
- The recommended tightening torque for the bolts is 16 N·m.
- The DIN rail power supply should be reliably grounded. If using multiple DIN rail power supplies, ensure enough distance in between.
- When mounting the camera onto a robot arm or other mobile equipment, please fasten the DC power and Ethernet cables on the camera end properly to avoid damaging the cables or connectors due to strain.

## Ethernet Cable

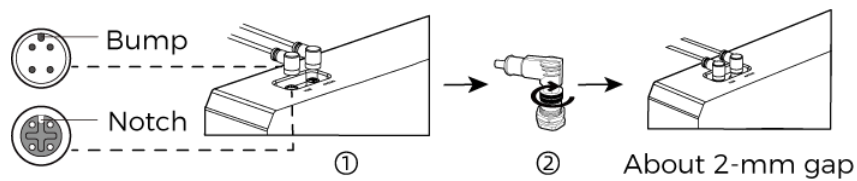
As shown below, insert the M12-A connector of the Ethernet cable to the ETH port on the camera, and insert the RJ45 connector to the Ethernet port on the computer.

## DC Power Cable

As shown below, insert the M12-A connector of the DC power cable to the DC 24V port on the camera.

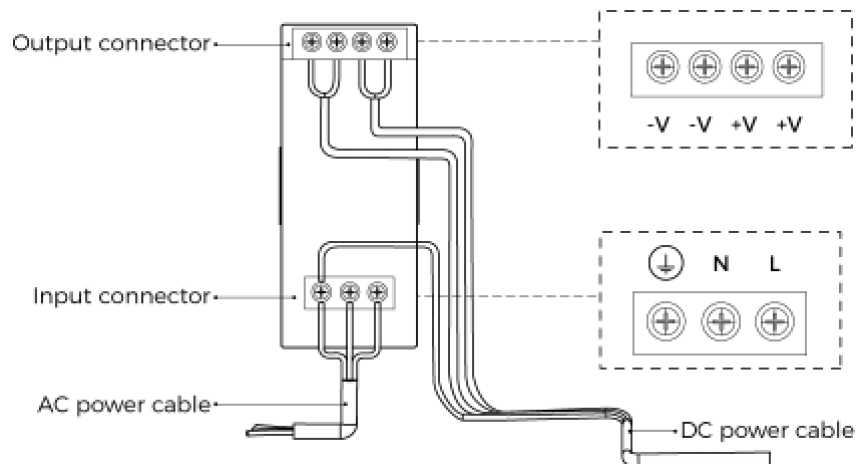


Connect the M12-A connectors of the cables to the corresponding ports:



1. When inserting, align the bump in the connector with the notch in the port.
2. Tighten the nut. A gap of about 2 mm remains after the nut is fully tightened.

### DIN Rail Power Supply



When wiring the DIN rail power supply, wires of the power cable must be inserted to the corresponding input/output terminals, as shown above.

- The AC power cable has three wires: L, N, and PE (⊖).
- The 24 V DC power cable has three wires: V+, V- and PE (⊖).

### ⚠ Warning

The PE wires must be properly grounded! Please install the DIN rail power supply inside a control cabinet.



A network switch can be used to connect multiple cameras or computers.

## Technical Specifications

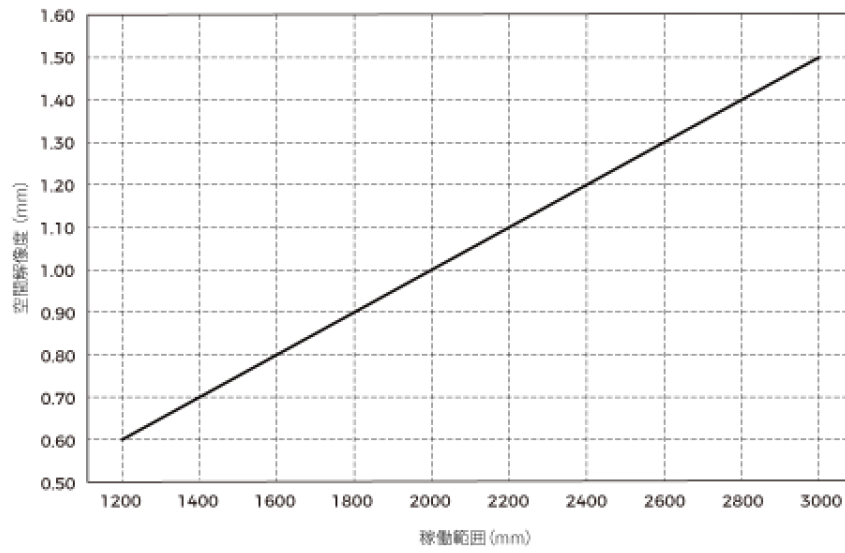
Product name	Mech-Eye Industrial 3D Camera
Model	LSR L
Recommended working distance	1200–3000 mm
FOV (near)	1200 × 1000 mm @ 1.2 m
FOV (far)	3000 × 2400 mm @ 3.0 m
Depth map resolution	2048 × 1536
RGB resolution	4000 × 3000 / 2000 × 1500
Point Z-value repeatability ( $\sigma$ ) <sup>(1)</sup>	0.5 mm @ 3 m
Measurement accuracy (VDI/VDE) <sup>(2)</sup>	1.0 mm @ 3 m
Typical capture time	0.5–0.9 s
Weight	About 2.9 kg
Baseline	About 380 mm
Dimensions	About 459 × 77 × 86 mm
Light source	Red laser (638 nm, class 2)
Operating temperature	-10–45°C
Communication interface	Gigabit Ethernet
Input	24 VDC, 3.75 A
Safety and EMC	CE/FCC/VCCI/UKCA/KC
IP rating <sup>(3)</sup>	IP65
Cooling	Passive

(1) One standard deviation of 100 Z-value measurements of the same point. The measurement target was a ceramic plate.

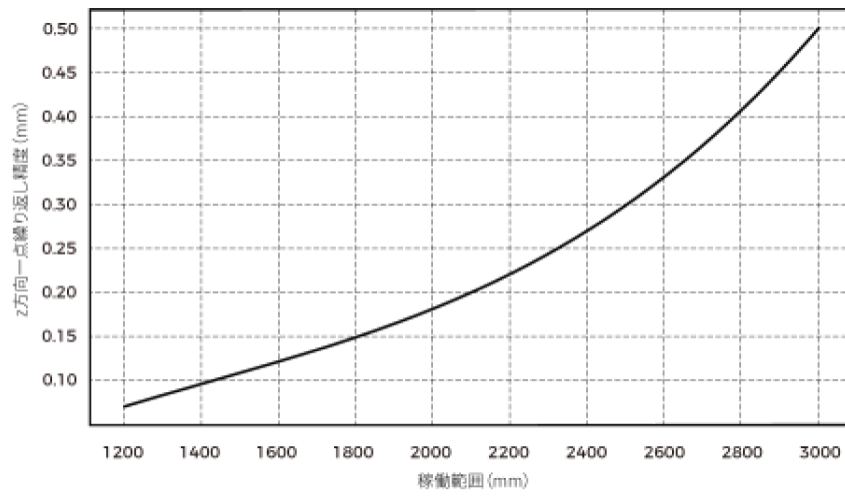
(2) According to VDI/VDE 2634 Part II.

(3) Test implemented based on IEC 60529. 6: dust-tight; 5: protected against water jets.

## Spatial Resolution

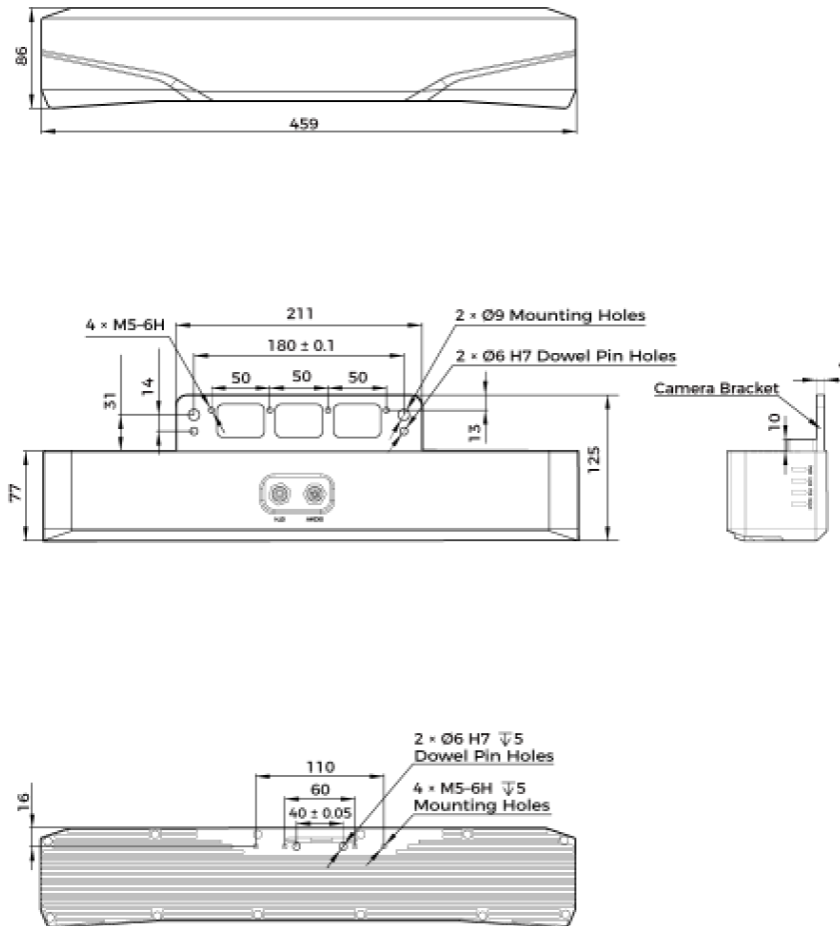


### Point Z-Value Repeatability



### Dimensions

Unit: mm



## Maintenance

### Cleaning the Camera

When cleaning the surface of the camera, please blow off the dust gently, and then use a clean soft cloth to gently wipe the surface. When cleaning the camera lenses, a liquid lens cleaner and clean lint-free cloth can be used to carefully wipe the lenses to avoid scratching.

#### Warning


- Do not clean the camera with corrosive or volatile solvents such as alcohol, gasoline and kerosene. These substances may damage the exterior and internal structure of the camera.
- Do not use a pressure washer gun or hose to spray and wash the camera. Water entering the camera may lead to malfunction, fire, or even explosion. Water or other liquid damage to the camera is not covered by the warranty.

### Storing the Camera

This product is rated as IP65. The enclosure of the camera can prevent dust from entering and affecting the functions of the camera. Soaking the camera in water or placing it in a highly humid environment may lead to malfunction. Rusting of the internal unit will lead to irreversible damage. When not using, please store the camera in an indoor, dry, cool and well ventilated place. To avoid damage caused by rain, snow, and other undesirable conditions, please do not place the camera outdoors for an extended period of time.

#### Warning

- Disconnect the camera from the power supply when storing to avoid fire.
- Do not leave the lens pointed at the sun or other intense light source for an extended period of time. Intense light may cause the image sensor to deteriorate and produce a white blur effect in images.

 This icon indicates that failure to follow the instruction may lead to injury or death.

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## 9. Extended Reading

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Here you can find helpful and informative topics that can aid you with using the camera.

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A brief introduction of the imaging mechanism of structured light cameras:

[Structured-Light 3D Scanning Mechanism](#)

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Instructions on setting the IP address of the computer Ethernet port connected to the camera:

[Set IP Address on Computer](#)

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### 9.1. Structured-Light 3D Scanning Mechanism

As a structured-light 3D scanner, Mech-Eye Industrial 3D Camera ("3D camera") consists of a projector and 2D camera(s). The projector projects structured light (light of pre-designed, specific patterns) onto the objects, and the shapes of the objects cause the light patterns to deform. Based on the deformation of the patterns, the 3D camera can calculate the depth data of the object surfaces.

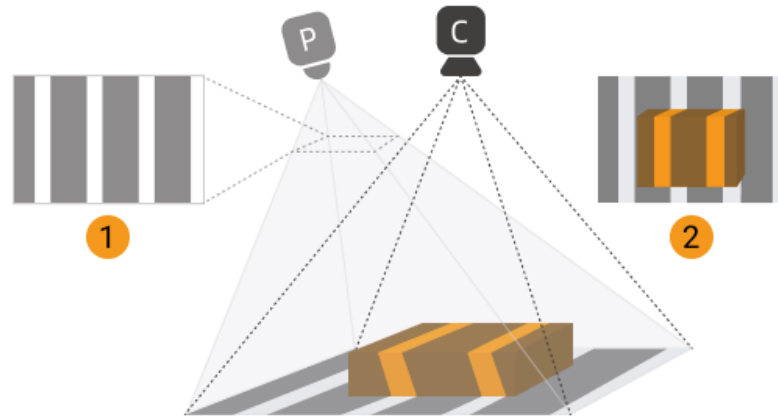
The 3D camera can also obtain the 2D image of the objects, just like a regular 2D camera.

The entire scanning process of the 3D camera can be divided into three phases: image capturing, calculation and processing, and output.

#### Image Capturing

The 3D camera is triggered to capture images by Mech-Eye SDK. During image capturing, the following processes take place:

1. The projector (P in the figure below) projects stripe patterned light onto the objects. Due to the shapes and structures of the objects, the stripe patterns deform.
2. The 2D camera(s) (C in the figure below) captures images that record the deformation of the stripe patterns.



In the meantime, the 3D camera also captures the regular 2D image of the objects while the structured light is not projected.

### Calculation and Processing

The 3D camera calculates the depth data of the object surfaces based on the deformation of the stripe patterns. Using the depth data, the 3D camera then generates the depth map and point cloud.

### Output

The 3D camera outputs the generated data to Mech-Eye SDK. Now you can see the 2D image, depth map and point cloud of the objects!

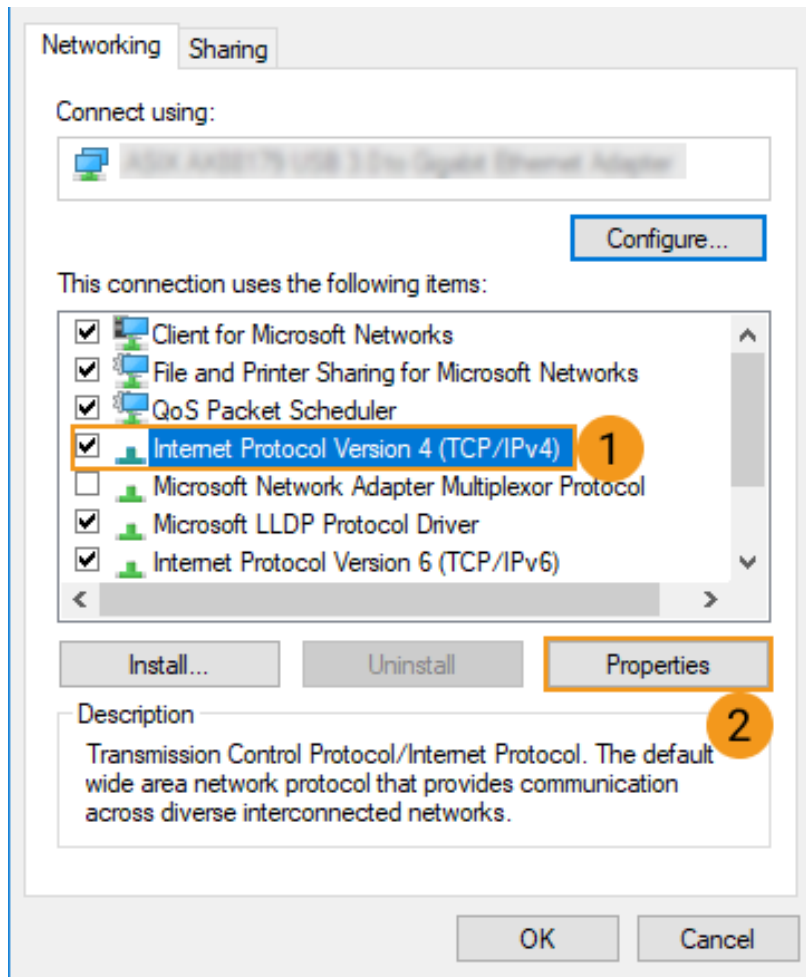
- 2D image: the image captured without structured light projection.
- Depth map: an image containing depth information.
- Point cloud: a collection of data points that contain the 3D coordinates (XYZ) of the object surface.

## 9.2. Set IP Address on Computer

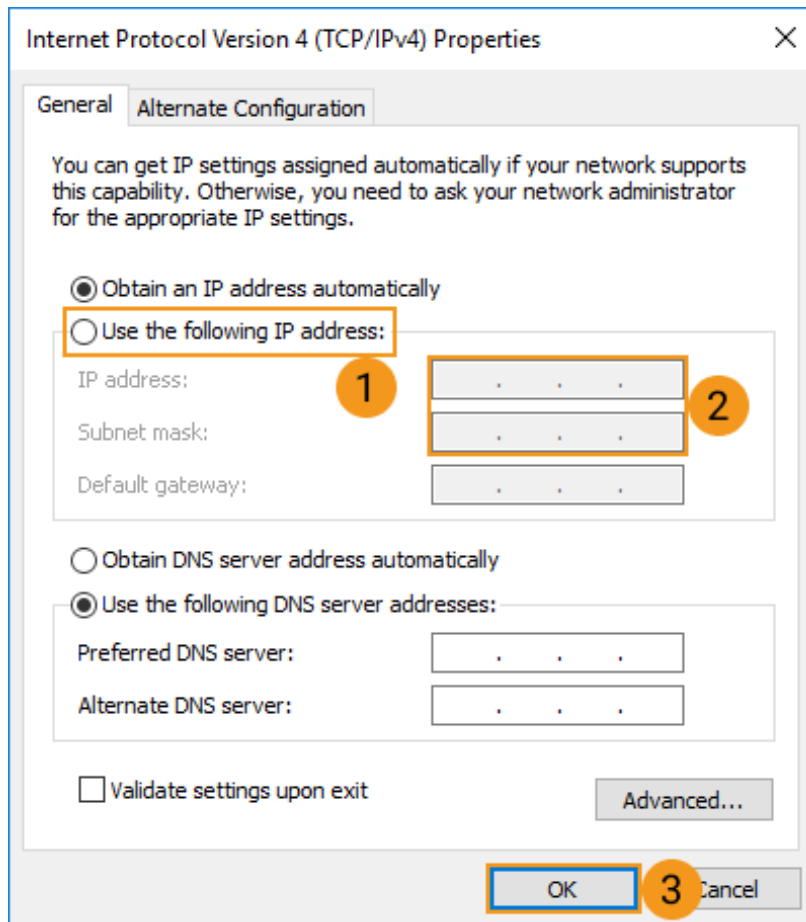
This topic provides instructions on setting the IP address of the computer Ethernet port connected to the camera.

1. On the computer, select Control Panel > Network and Internet > Network and Sharing Center > Change adapter settings. The **Network Connections** page will be displayed.
2. Right-click the Ethernet port connected to the camera, and select **Properties** to enter the **Ethernet Properties** page.
3. Select **Internet Protocol Version 4 (TCP/IPv4)**, and then click [ **Property** ] to enter the **Internet Protocol Version 4 (TCP/IPv4) Properties** page.





4. Select **Use the following IP address**, and set the **IP address** and **Subnet mask** according to your actual needs. Click [ **OK** ] to save the changes.



To have the IP address automatically assigned, please select **Obtain an IP address automatically**.

# 10. Troubleshooting

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This topic provides troubleshooting guidance for commonly encountered problems.

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Troubleshooting guidance for camera connection issues:

- [Camera Not Found in Mech-Eye SDK](#)
  - [Camera Cannot Be Connected in Mech-Eye SDK \(Unreachable\)](#)
  - [Camera Cannot Be Connected in Mech-Eye SDK \(Windows Server\)](#)
- 

Troubleshooting guidance for data transmission issues of the camera:

- [Enable Jumbo Frames](#)
- 

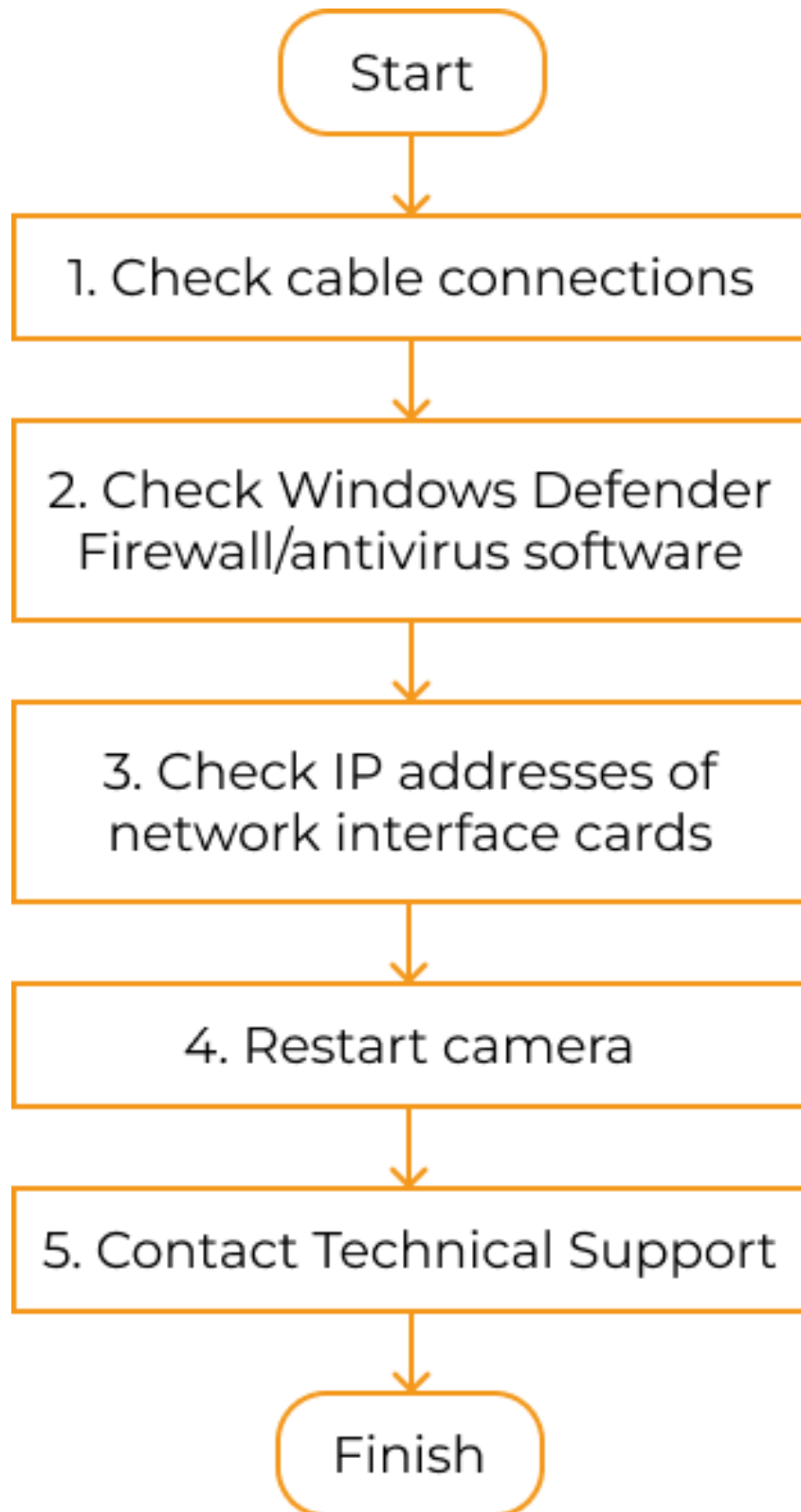
## 10.1. Camera Not Found in Mech-Eye SDK

Symptom: In Mech-Eye SDK, the camera to which you want to connect does not show up in the list of available cameras. This topic provides the possible causes, troubleshooting guidelines and detailed troubleshooting procedures for this problem.

### Possible Causes

- Some of the cables are not properly connected.
- Windows Defender Firewall or antivirus software prevents the communication.
- Multiple Ethernet ports of the computer have IP addresses in the same subnet.
- Other causes.

### Troubleshooting Guidelines



When the camera to which you want to connect does not show up in Mech-Eye SDK, follow these guidelines to troubleshoot:

1. Make sure that **the cables are properly connected**. If the camera still does not show up in Mech-Eye SDK, proceed to the next step.
2. Make sure that **Windows Defender Firewall and/or antivirus software is not preventing the**

**communication.** If the camera still does not show up in Mech-Eye SDK, proceed to the next step.

3. Make sure that **the IP addresses of multiple Ethernet ports are not in the same subnet.**
4. If the camera still does not show up in Mech-Eye SDK, proceed to the next step.
5. **Restart the camera.** If the camera still does not show up, please contact Technical Support.

## Troubleshooting Procedures

### Check Cable Connections

Device	Cable	Description of proper cable connection
Camera	Power cable	PWR indicator light is solid green.
	Ethernet cable	V3 cameras: ETH indicator light is either green (gigabit network) or yellow (megabit network). V4 cameras: LINK indicator light is <a href="#">blinking or solid green</a> .
Computer	Ethernet cable	The indicator light of the Ethernet port is lit.
Router/Network switch	Ethernet cable	Cable is connected to an Ethernet port (router)/access port (network switch), and the indicator light of the port is lit.



- If the camera and computer are connected directly, you do not need to check for the cable connection of the router/network switch.
- If the LINK/ETH indicator light of the camera blinks several times and goes off, and this phenomenon recurs, please check the connection of Ethernet cable(s). This phenomenon is usually caused by Ethernet cables not fully inserted into ports.

### Check Windows Defender Firewall and Antivirus Software

#### Procedure:

1. Configure Windows Defender Firewall: You can turn off Windows Defender Firewall completely, or unblock Mech-Eye Viewer in Windows Defender Firewall.
  - Turn off Windows Defender Firewall:
 

Select Control Panel › System and Security › Windows Defender Firewall › Turn Windows Defender Firewall on or off › Turn off Windows Defender Firewall, and then click [ **OK** ] at the bottom to turn off the firewall.
  - Unblock Mech-Eye Viewer in Windows Defender Firewall:
    - a. Select Control Panel › System and Security › Windows Defender Firewall › Allow an app or feature through Windows Defender Firewall › Change settings, and then click [ **Allow another app...** ] at the bottom to open the **Add an app** page.
    - b. Click [ **Browse** ], navigate to the installation path of Mech-Eye Viewer, and select Mech-Eye Viewer.exe. Click [ **Add** ] to finish.
2. Check antivirus software: If an antivirus software is running, please turn it off.

## IP Addresses of Multiple Ethernet Ports in the Same Subnet

### Procedure:

1. Disable Ethernet ports not connected to the camera.

On the computer, select Control Panel > Network and Internet > Network and Sharing Center > Change adapter settings. The **Network Connections** page will be displayed. Right-click an Ethernet port and select **Disable**.

2. Open Mech-Eye SDK and connect to the camera.
3. If the camera is successfully connected, one or more of the disabled Ethernet ports have IP address in the same subnet as the port connected to the camera. Enable the other ports one at a time and connect to the camera in Mech-Eye SDK each time. The camera connection will fail when the Ethernet port with the problematic IP address is enabled. Please change the IP address of this Ethernet port to a different subnet.



If the camera still cannot be connected, disable the Ethernet port connected to the camera and enable it again. If the camera still cannot be connected afterward, connect the camera to a different Ethernet port.

### Restart the Camera

If the camera still does not show up after the above procedures have been performed, please try restarting the camera.

### Restart procedure:

1. Unplug the power cable from the camera.
2. Wait for about 20 seconds, and plug the power cable into the camera.

### Contact Technical Support

If the camera still does not show up after the above procedures have been performed, please contact Technical Support.

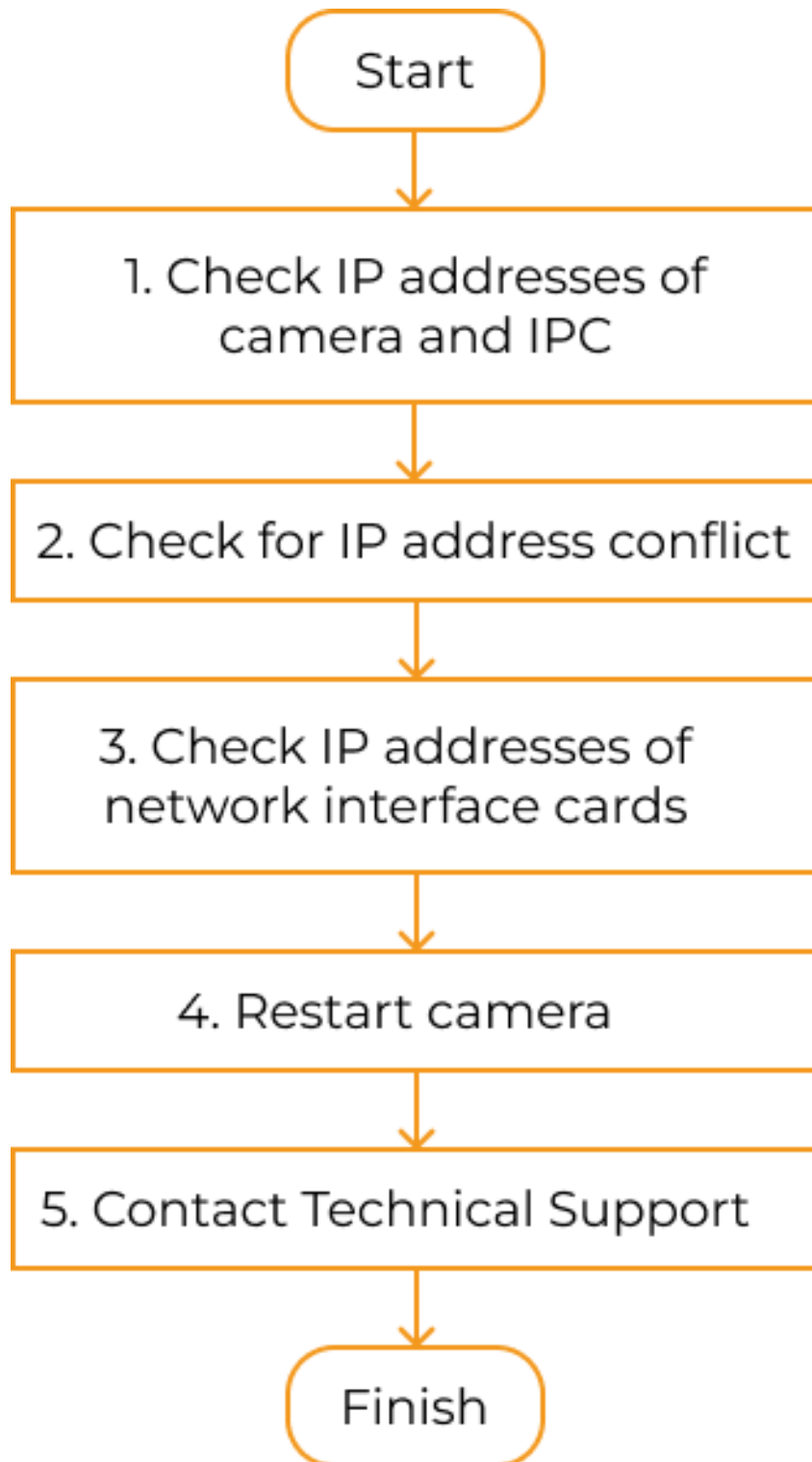
## 10.2. Camera Cannot Be Connected in Mech-Eye SDK (Unreachable)

Symptom: The camera shows up in Mech-Eye SDK but cannot be connected. The status of the IP address displayed in the camera info card in Mech-Eye Viewer is Unreachable. This topic provides the possible causes, troubleshooting guidelines and detailed troubleshooting procedures for this problem.

### Possible Causes

- The IP addresses of the camera and computer are not in the same subnet.
- IP address conflict is present.
- Multiple Ethernet ports of the computer have IP addresses in the same subnet.
- Other causes.

### Troubleshooting Guidelines



When you cannot connect to the camera in Mech-Eye SDK, follow these guidelines to troubleshoot:

1. Make sure that **the IP addresses of the camera and computer are in the same subnet**. If the camera still cannot be connected, proceed to the next step.
2. Make sure that **no IP address conflicts are present**. If the camera still cannot be connected, proceed to the next step.

3. Make sure that the IP addresses of multiple Ethernet ports are not in the same subnet.
4. If the camera still cannot be connected, proceed to the next step.
5. **Restart the camera.** If the camera still cannot be connected, please contact Technical Support.

## Troubleshooting Procedures

### Check IP Addresses of Camera and computer

#### Procedure:

1. Check the IP address of the computer. For instructions, please refer to [Set IP Address on Computer](#).
2. Check the IP address of the camera. For instructions, please refer to [Set Camera IP Address](#).
3. Make sure that the IP addresses of the camera and computer are in the same subnet. If not, please [change the camera IP address](#), so that it is in the same subnet as the IP address of the computer.
4. Open Mech-Eye SDK and connect to the camera.

### Check for IP Address Conflict

IP conflict is present among the devices connected to the computer, router, and network switch. IP conflict is where two or more devices have identical IP addresses.

#### Procedure:

1. Disconnect all devices other than the camera from the computer, router and/or network switch.
2. Open Mech-Eye SDK and connect to the camera.
3. If the camera is successfully connected, one or more other devices have IP addresses identical to the camera. Please reconnect the other devices one at a time and connect to the camera in Mech-Eye SDK each time. The camera connection will fail when the device(s) with identical IP address is reconnected. Please change the IP address of this device or the camera, so that the two are no longer identical.

### IP Addresses of Multiple Ethernet Ports in the Same Subnet

#### Procedure:

1. Disable Ethernet ports not connected to the camera.

On the computer, select Control Panel > Network and Internet > Network and Sharing Center > Change adapter settings. The **Network Connections** page will be displayed. Right-click an Ethernet port and select **Disable**.

2. Open Mech-Eye SDK and connect to the camera.
3. If the camera is successfully connected, one or more of the disabled Ethernet ports have IP address in the same subnet as the port connected to the camera. Enable the other ports one at a time and connect to the camera in Mech-Eye SDK each time. The camera connection will fail when the Ethernet port with the problematic IP address is enabled. Please change the IP address of this Ethernet port to a different subnet.





If the camera still cannot be connected, disable the Ethernet port connected to the camera and enable it again. If the camera still cannot be connected afterward, connect the camera to a different Ethernet port.

### Restart the Camera

If the camera still cannot be connected after the above procedures have been performed, please try restarting the camera.

#### Restart procedure:

1. Unplug the power cable from the camera.
2. Wait for about 20 seconds, and plug the power cable into the camera.

### Contact Technical Support

If the camera still cannot be connected after the above procedures have been performed, please contact Technical Support.

## 10.3. Camera Cannot Be Connected in Mech-Eye SDK (Windows Server)

Symptom: The camera shows up in Mech-Eye SDK but cannot be connected. The status of the IP address displayed in the camera info card in Mech-Eye Viewer is Windows Server. This topic provides the possible causes, troubleshooting guidelines and detailed troubleshooting procedures for this problem.

### Possible Causes

This is a bug in Mech-Eye SDK 1.6.1 and below.

### Solution

If this problem occurs, it is recommended to upgrade Mech-Eye SDK to the latest version. For instructions, please refer to [Upgrade Mech-Eye SDK](#).

If you cannot upgrade Mech-Eye SDK, please contact Technical Support.

## 10.4. Enable Jumbo Frames

Standard Ethernet frames carry up to about 1500 bytes of data. Jumbo frames are Ethernet frames that can carry up to about 9000 bytes of data. Using jumbo frames can reduce CPU processing load and speed up data transmission.

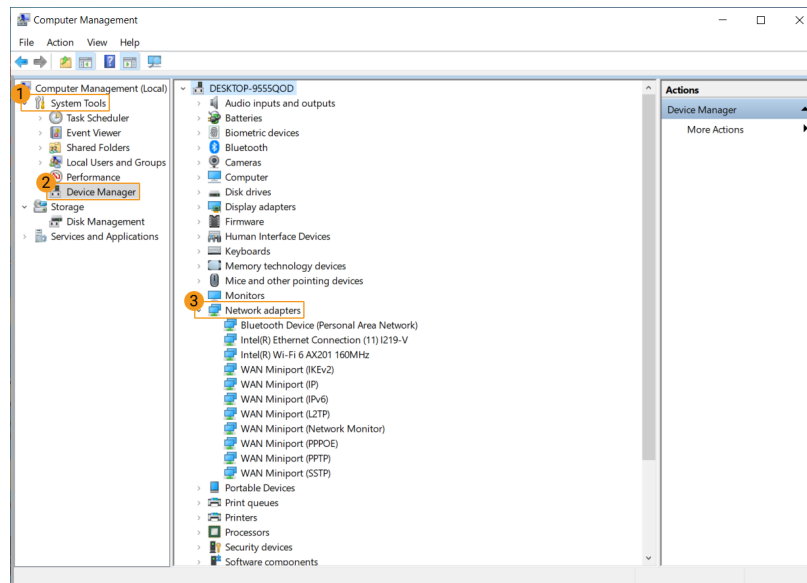
If the camera is directly connected to the computer or connected through a network switch, and the camera MTU size is set to 9000, please enable the jumbo frame function on the computer to improve data transmission speed.



The camera MTU size can be set in the **Administrator** account. If you need to change it, please contact Technical Support.

Follow these steps to enable jumbo frames:

1. Right-click **This PC** and select **Manage** to open the **Computer Management** window.
2. In the left panel, select **System Tools > Device Manager**. Then in the middle panel, select to expand **Network adapters**.



3. Right-click the network interface card connected to the camera and select **Properties**.
4. Select the **Advanced** tab. Next, select **Jumbo Packet** in the **Property** box, and then select **9014 Bytes** for **Value** to the right. Click **[ OK ]** to save the change.

