ZiVID

Zivid Studio User Guide

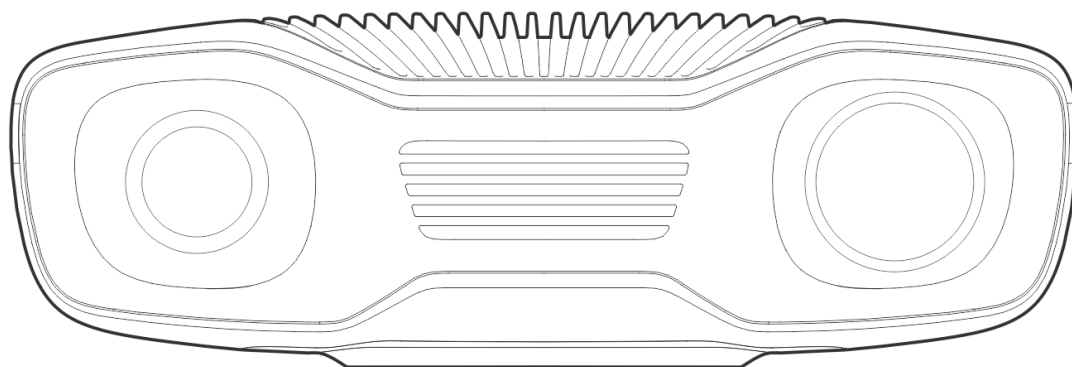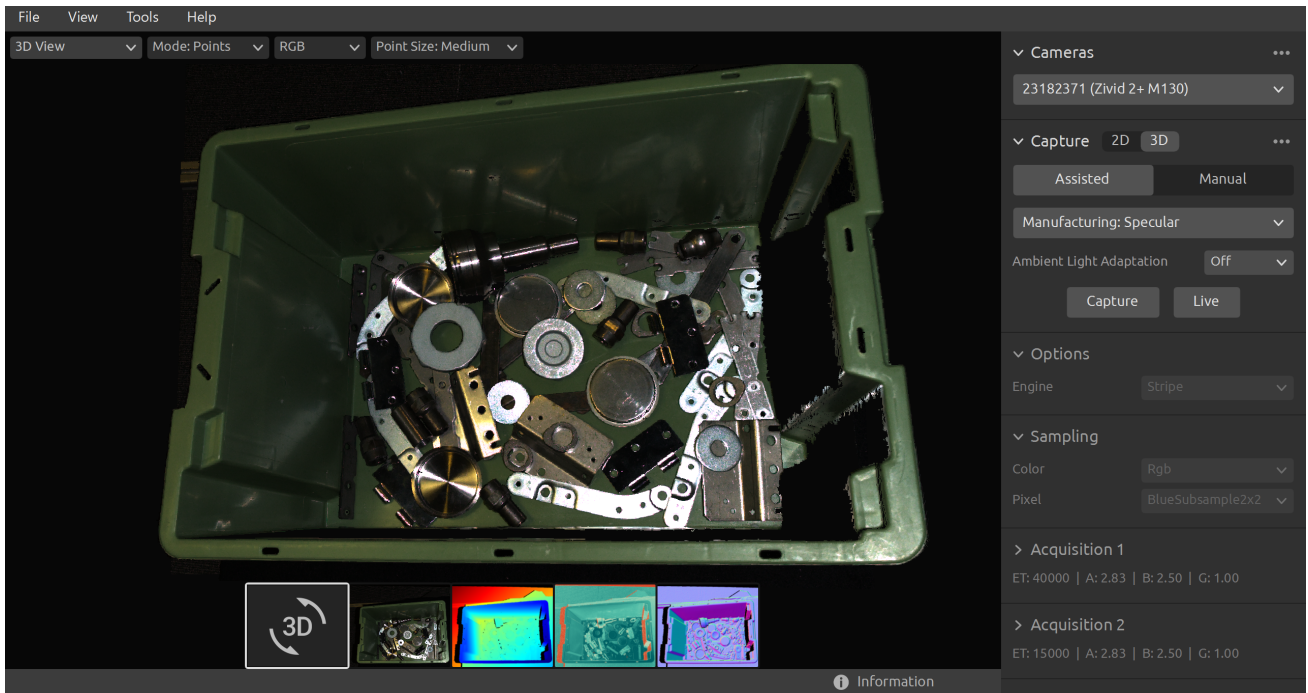SDK 2.14

Table of Contents

1. Studio Guide

Zivid Studio is the graphical user interface (GUI) for the Zivid SDK. This allows the user to explore the functionality of Zivid cameras and the capturing of 3D point clouds.

Use Zivid Studio to learn and understand how the majority of functions available in the Zivid SDK work. This is useful when developing your application. Among others, you can:

- Capture point clouds.
- Capture color images.
- Visualize point clouds, color images, depth maps, SNR (Signal-to-Noise-Ratio) maps, and normal maps.
- Analyze and evaluate 3D data quality.
- Determine the correct capture settings for your target objects and scenes.
- Configure the camera network configuration.
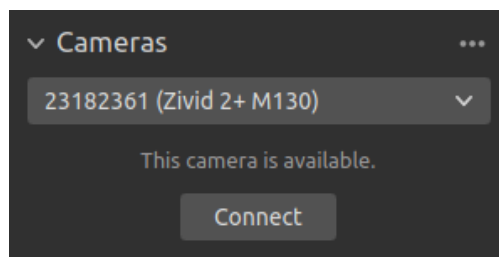- Perform infield calibration of the camera.

2.   Control Panel

The control panel is located on the right side of Zivid Studio. It contains three main sections:

- Cameras
- Capture
- Settings

2.1.   Cameras

This section is used to scan for, configure, connect to, and disconnect from available cameras.

Cameras	Function
List all cameras	Open the Cameras menu and list all cameras.
Scan for connected cameras	Show all cameras plugged into the PC and list them by model and serial number.
Connect	Connect to the camera selected in the drop-down menu. Zivid Studio can connect to a single camera at a time.
Configure this camera	Open the Cameras menu and configure the IP, subnet mask and mode of the selected camera.
Disconnect from active camera	Disconnect from the active camera.

> **ⓘ Note**
>
> If multiple cameras are physically connected, they will all appear in this section. However, Zivid Studio only supports establishing a connection with a single camera at a time. To capture with multiple cameras using Zivid Studio, start another instance of Zivid Studio.

Firmware Update

Each SDK version is matched with camera firmware, and the SDK will make sure that the camera runs compatible firmware. When Zivid Studio connects to a camera, it will check whether the camera has matching firmware. If the firmware does not match, you will get prompted to update the firmware on your camera.
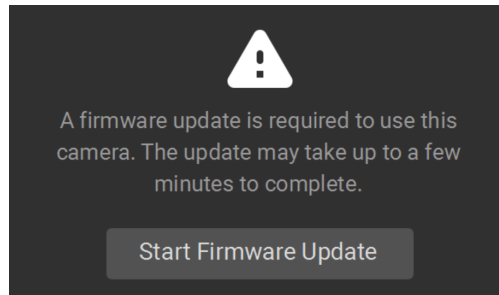
2.2. Capture

This section is used to capture 3D and 2D images. Here you can control and configure the camera settings. This section has three modes:

- 2D capture
- 2D + 3D capture
- 3D capture

A 3D capture triggers the camera to capture a 3D point cloud without color information, while a 2D capture triggers the camera to capture a 2D image with or without color information. A 2D + 3D capture triggers the camera to capture both a 3D point cloud and a 2D image.
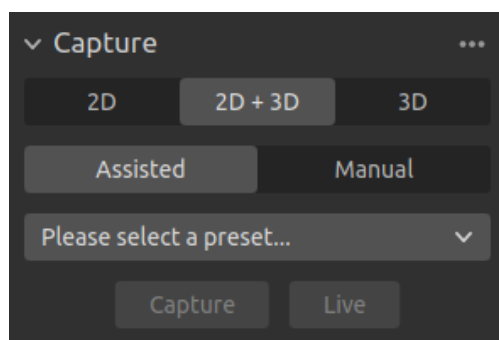
Each capture has two modes:

- Assisted Mode
- Manual Mode

Assisted Mode

In the assisted mode you can select from a list of predefined settings from the Presets . This is the recommended way to capture 2D and 3D images. The presets are specifically tuned for the following categories:

- Consumer Goods
- Parcels
- Manufacturing
- Inspection

Choose the category that best applies to your usage. This will then configure the camera settings for you based on the selected preset. Note that not all categories are available for all camera models. You can view and modify the selected settings in the Manual Mode.
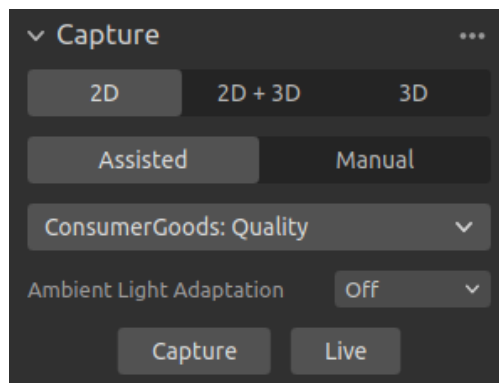
Once a preset is selected, the ambient light adaptation can be chosen.

> **ⓘ Note**
>
> Ambient light adaptation can increase acquisition and capture time. Default presets do not adapt to any ambient light frequency.

Capture and Live

- The Capture button triggers a single capture with the specified settings, which is then displayed.
- The Live button triggers continuous captures, which enables you to view the scene in real-time.

Manual Mode

In the manual mode you must configure all settings manually. For more information about the settings panel, see 2D Settings and 3D Settings below.

2.3. 2D Settings

Sampling

Setting	Function
Color	Choose how to sample colors for the 2D image.
Pixel	Choose the subsampling factor to downscale 2D image.
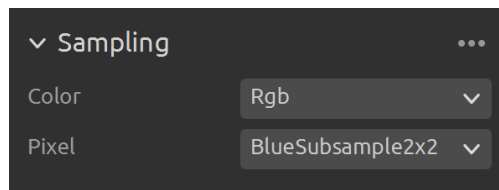
Acquisition Settings

Setting	Function
Exposure Time	The duration a single camera image is exposed to light.
Aperture	The opening that controls the amount of light to the camera sensor through the lens.
Brightness	The output power (the amount of light) emitted by the LED projector.
Gain	The amplification of the signal from the camera sensor.
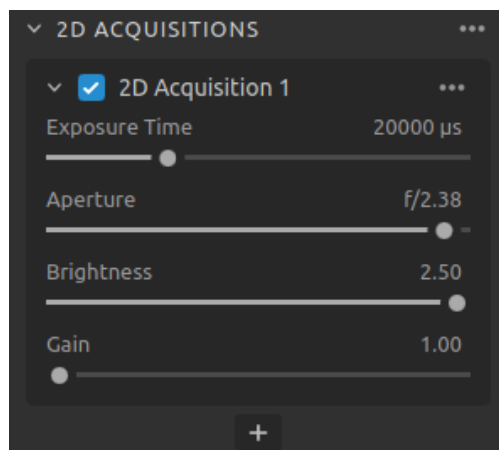
Color Balance and Gamma

Setting	Function
Balance	The color temperature of ambient light affects the appearance of the color image. Adjust blue, green, and red color balance to make color images look natural.
Gamma	The output color image can appear too dark. Adjust the brightness of the color image.
Color Mode	Control how the color image is computed. The options are Automatic and ToneMapping.
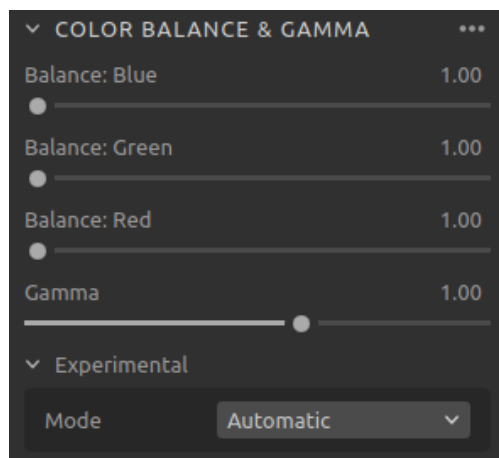
2.4.   3D Settings

Engine

The Vision Engine is the backbone of the point cloud computation. It controls the pattern projecting , imaging, and processing of the images of the projected pattern to generate the final 3D point cloud.

Setting	Function
Engine	Choose between different pattern projections.
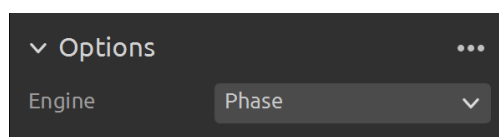
Sampling

Setting	Function
Pixel	Choose the subsampling factor to downscale the point cloud.
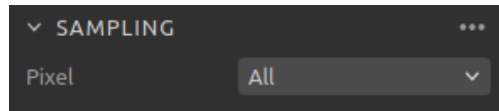
Acquisition Settings

Setting	Function
Exposure Time	The duration a single camera image is exposed to light.
Aperture	The opening that controls the amount of light to the camera sensor through the lens.
Brightness	The output power (the amount of light) emitted by the LED projector.
Gain	The amplification of the signal from the camera sensor.
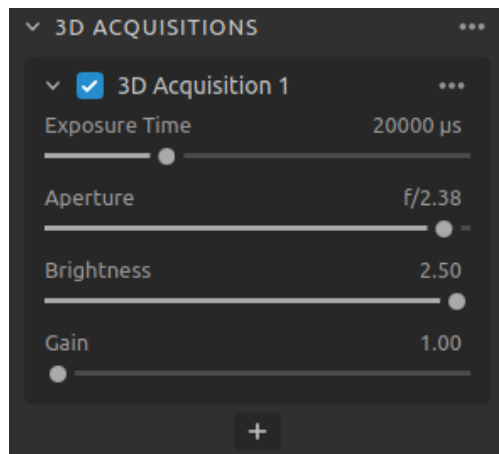
You can add multiple acquisitions within a capture by clicking the + button. This will allow you to capture the same scene with different exposure settings in an HDR capture, which can be useful for scenes with high dynamic range.

Region Of Interest

Setting	Function
Box	Create and configure a box in 3D and remove the points outside the box.
Depth	Remove points outside a user-defined depth range.
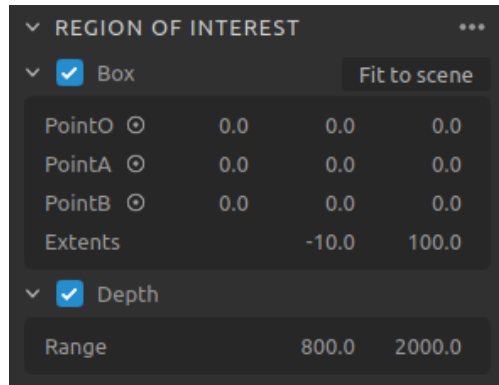
Filters

Setting	Function
Cluster Filter	Remove floating points and isolated clusters from the point cloud.
Hole Repair	Fill in removed points, by interpolation between the remaining points.
Noise Filter	Remove or correct points where the projected pattern signal-to-noise-ratio is low.
Outlier Filter	Remove points if the distance to their neighboring pixels within the small local region is larger than the threshold specified in mm.
Reflection Filter	Remove points impacted by reflections and thus erroneous.
Gaussian Smoothing	Perform Gaussian smoothing on the point cloud.
Contrast Distortion	Correct and/or remove points affected by blurring in the camera lens.

Resampling

Setting	Function
Mode	Reduce or increase the number of points in the point cloud.

Diagnostics

The diagnostics setting is used to collect extra diagnostic data from a capture. When this setting is enabled the additional data will be saved in the .zdf file. It is recommended to only enable it when reporting issues to Zivid's support team.
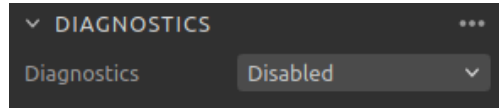
> ⚠️ **Caution**
>
> Diagnostics increases the capture time, the RAM usage, and the size of the .zdf file.

3. Available Views

There are five views available at the bottom of Zivid Studio. These views show the following features:

- The point cloud
- The color image
- The depth map
- The SNR map
- The normal map

To navigate between views you can either

- Use the keyboard shortcuts 1 through 5
- Change manually at the bottom of the GUI by clicking on the thumbnails
- Select from the drop-down menu in the top left corner
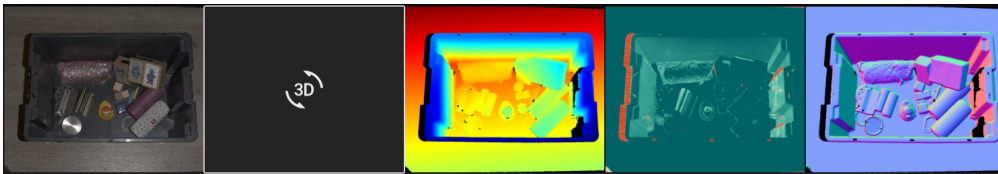
3.1. Point Cloud

This view displays the point cloud of the scene after a 3D capture or after loading a ZDF file.

- Use the left mouse button to rotate the point cloud.
- Use the right mouse button to pan.

- Zoom in or out by rolling the mouse wheel or, if available, by the middle mouse button followed by dragging the mouse.

Turning color (C , D and R) and mesh (M) on and off in this view helps evaluate the point cloud quality. The point size is also adjustable through the drop-down menu at the top left. Adjusting the point size is for example helpful for inspecting areas where textures are important. If you have enabled the Region Of Interest, you can also modify the visibility of this in the drop-down menu.

3.2. Color

This view displays the color image of the scene after a 2D capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates and RGB values. The pixel values are displayed in the status bar in the bottom left corner of the window.
- Zoom in or out by rolling the mouse wheel or, if available, by the middle mouse button followed by dragging the mouse.

- Use the left mouse button to pan the view.

When doing a 2D+3D capture with different pixel sampling you can switch between the 2D image from the 2D capture and 3D capture in the top-left drop-down.

3.3.   Depth

This view displays the depth image of the scene after a capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates, XYZ values, and SNR values . The pixel values are displayed in the status bar in the bottom left corner of the window.
- Use the drop-down menu located at the top left corner of the view to modify the Z range.
- Use zoom and pan functionalities in the same way as described in the Color View .
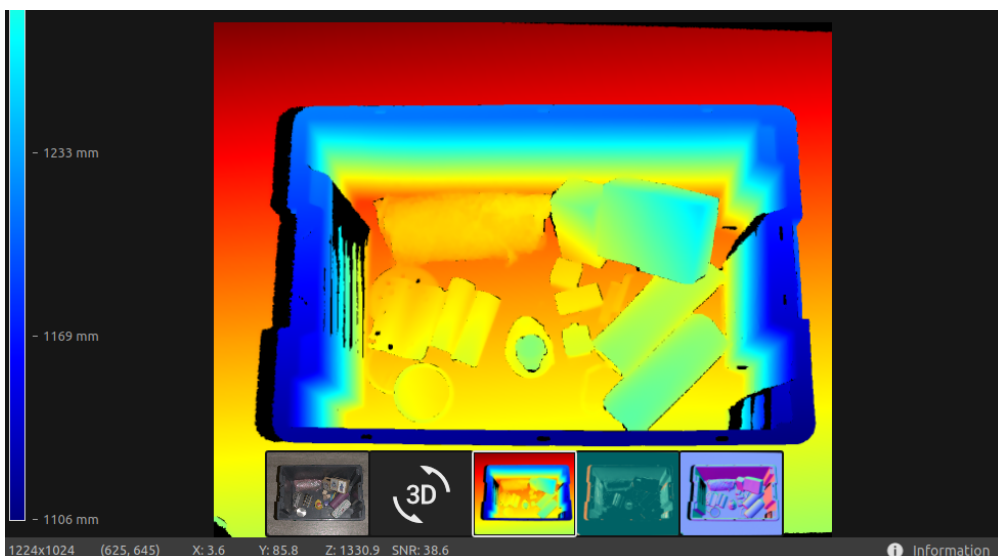
The color scale represents the distance variation along the z-axis from the camera to the surfaces of the imaged objects. To modify the range along the z-axis, you can use a fixed Z range in the top-left drop-down to narrow the color scale.

3.4.   Signal-to-Noise-Ratio

This view displays the SNR map of the scene after a capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates and SNR values . The pixel values are displayed in the status bar in the bottom left corner of the window.

- Use zoom and pan functionalities in the same way as described in the Color View .
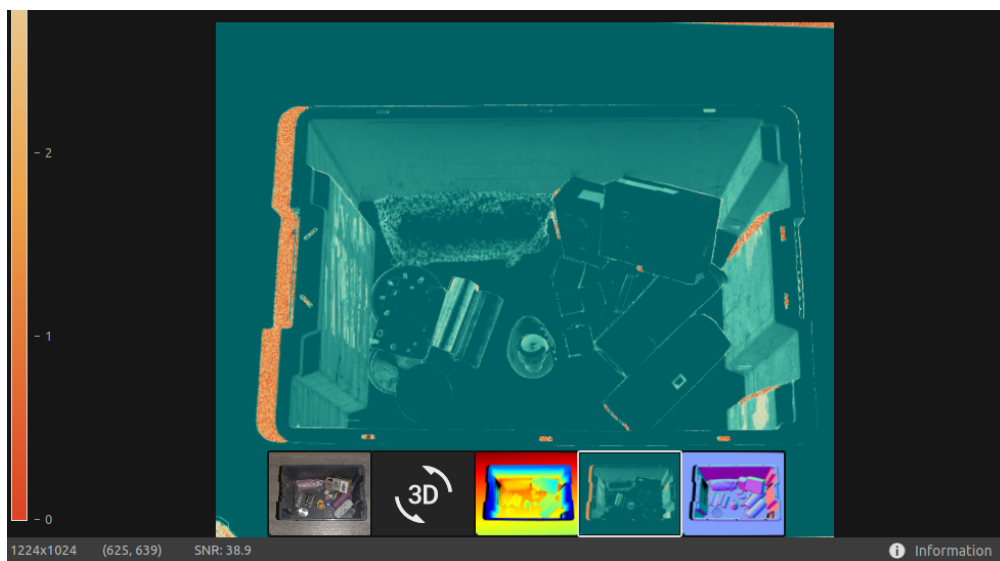
The color scale represents the variation in the SNR values . A pixel found at the higher end of the color scale represents a point associated with strong signal quality. For a point associated with a pixel found at the lower end of the color scale the ratio is more influenced by noise. Hence, these points involves higher uncertainty.

3.5.   Normals

This view displays the normal map of the scene after a capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates, normal coordinates, and SNR values . The pixel values are displayed in the status bar in the bottom left corner of the window.

- Use zoom and pan functionalities in the same way as described in the Color View .

The normal map provides a 2D representation of the surface normals of a scene where RGB color components describe the normal vectors. It is helpful in inspecting surface curvatures, surface textures, and transitions between objects as the color gradients describe these well.

4. Toolbar

The toolbar is located at the top of Zivid Studio. It consists of drop-down menus to handle files, control the GUI, configure cameras and get information about the Zivid software.

4.1. File

Zivid Studio offers various saving options for point clouds, color images, and settings to disk.

Save/Export Point Cloud

To save the point cloud in file ZDF format:

- Click on File → Save
- Navigate to the location where you want to save the point cloud
- Write down the file name
- Click Save

> **ℹ Note**
>
> ZDF is the native Zivid file format that includes point cloud, color image, and depth image data, and is the preferred file format for the Zivid Customer Success Team.

To export to one of our supported point cloud formats , unordered or ordered Polygon (PLY), ASCII (XYZ), or Point Cloud Data (PCD) [1] file format:

- Click on File → Export
- Navigate to the location where you want to save the point cloud
- Write down the file name
- Select the file format type and color space
- Click Save

[1] PCD is by default exported as unorganized points but can be configured to be exported as organized points. See Organized Pcd Format Label for a tutorial on how to export PCD as organized points.

Open Point Cloud / File Camera

Opening a point cloud in Zivid Studio is only supported for ZDF file format. A file camera can be opened in Zivid Studio in the ZFC file format.

- Click on File → Open
- Navigate to the location of your ZDF / ZFC file
- Click Open

You can also drag and drop a ZDF / ZFC file into Zivid Studio, or double-click it.

Save Color Image / Depth Map / SNR Map / Normal Map

You can save the 2D color image in one of our supported image formats , PNG, BMP and JPG. For all formats, you can choose between sRGB and linear RGB color space. The Depth Map, SNR Map and Normal Map can only be saved in PNG format.

- Click on File → Save Color Image / Save Depth Map / Save SNR Map / Save Normal Map
- Navigate to the location where you want to save the image
- Write down the file name
- Click Save

Export Settings

It is possible to save all settings to disk.

- Click on File → Export Capture Settings
- Navigate to the location where you want to save the settings
- Write down the file name
- Click Save

Import Settings

To import the settings in Zivid Studio:

- Click on File → Import Capture Settings
- Navigate to the location of your settings file
- Click Open

You can also drag and drop a YML file into Zivid Studio to import the settings.

4.2.   View

Histogram

To show the 2D image histogram:

- Click on View → 2D Color Image Histogram

- Swap between Linear and Logarithmic to change scales
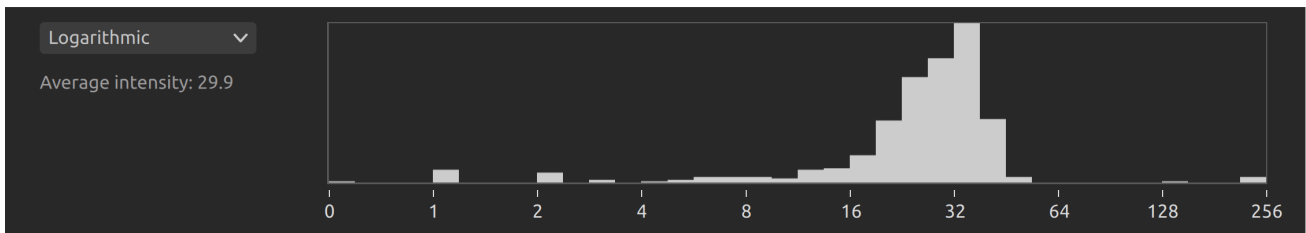
Information

To open the information panel:

- Click View → Information or Information in the bottom right corner

It is available only after you load a point cloud from a ZDF file or capture a point cloud or a color image.

The top part of the Information panel shows Acquisition Time, Capture Time, and Point Cloud / Color Image Size.
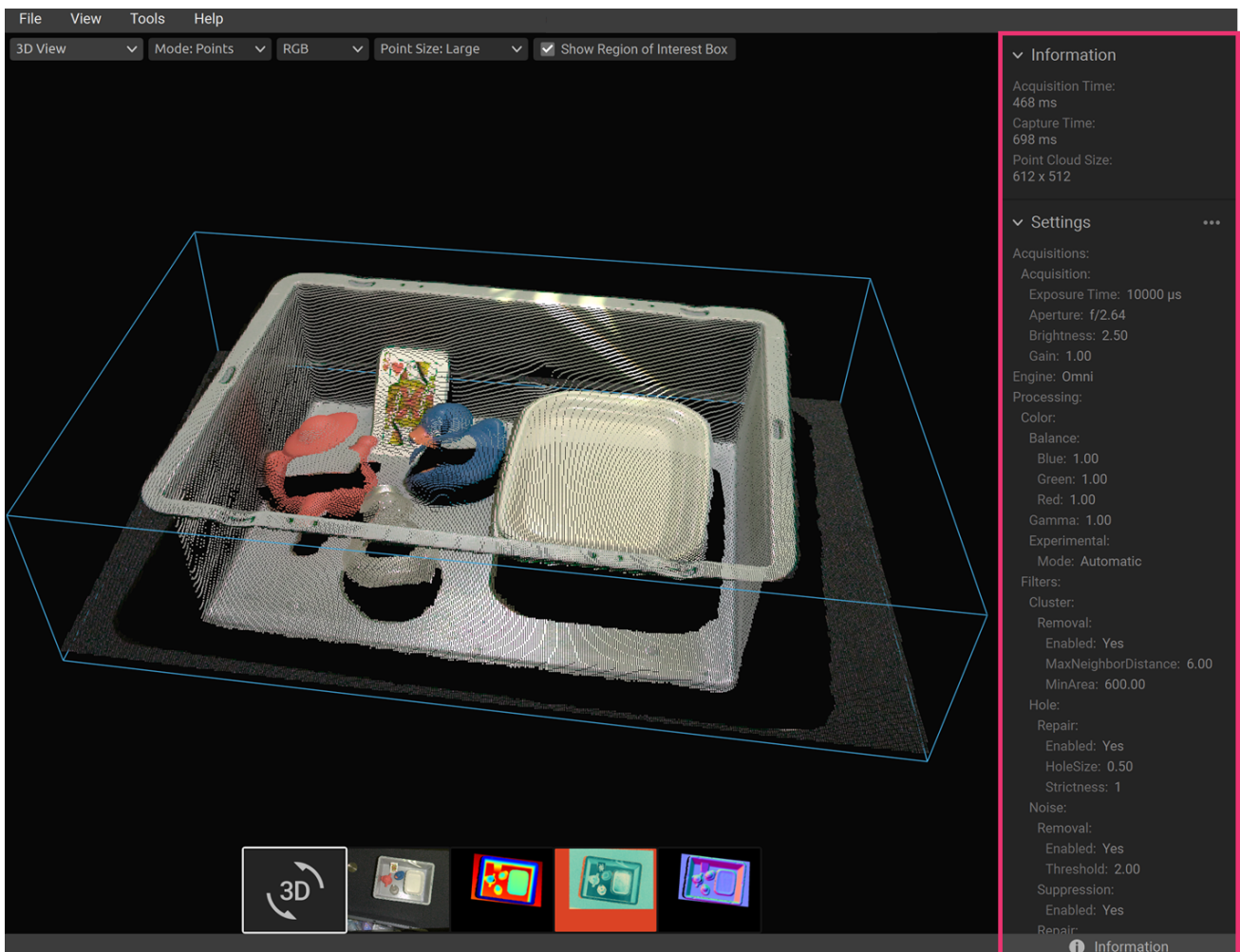
The bottom part shows the settings that were used in the capture. It is possible to save these settings to a file or apply them for use in the next capture.
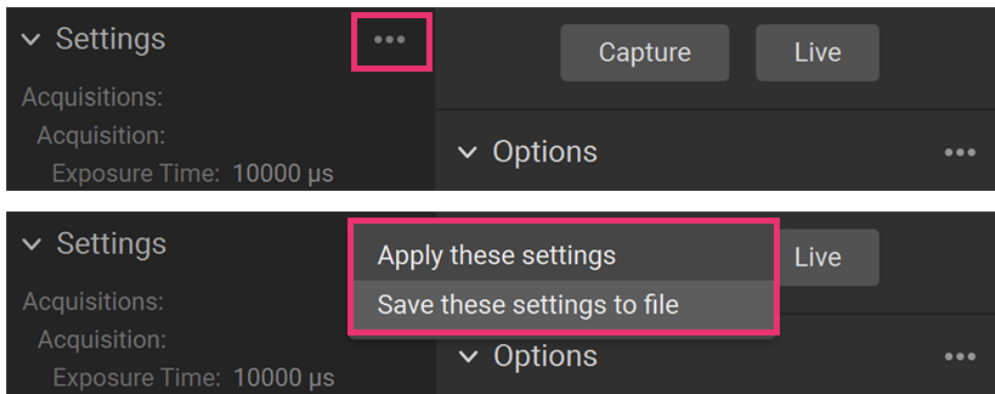
3D Axis Indicator

A 3D axis indicator is displayed in the bottom left corner of the point cloud view. To disable/ enable it, click on View → 3D Axis Indicator .

Show 4x4 Aruco Markers

To highlight any 4x4 Aruco markers in the point cloud, click on View → Show 4x4 Aruco Markers .
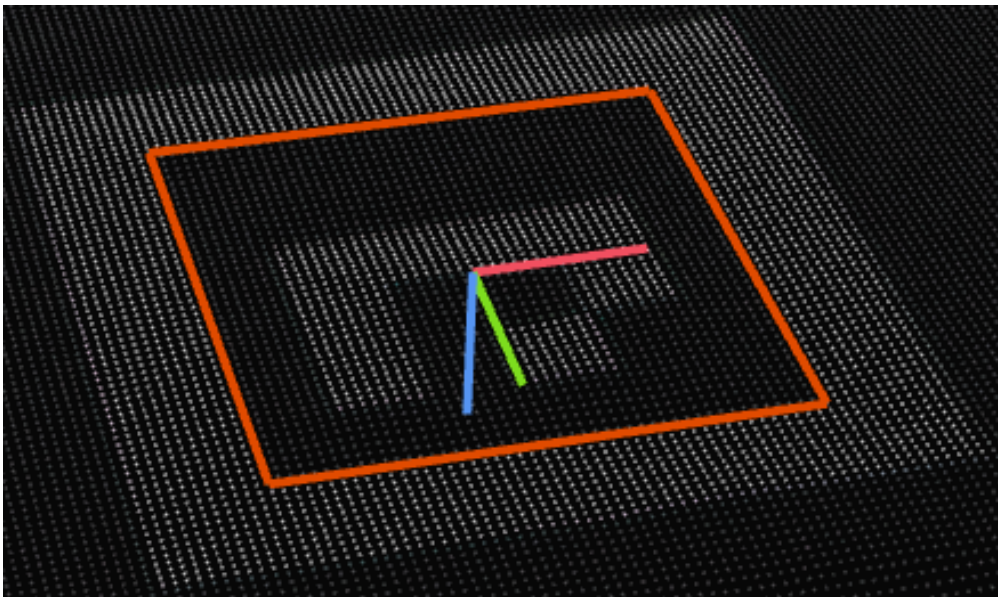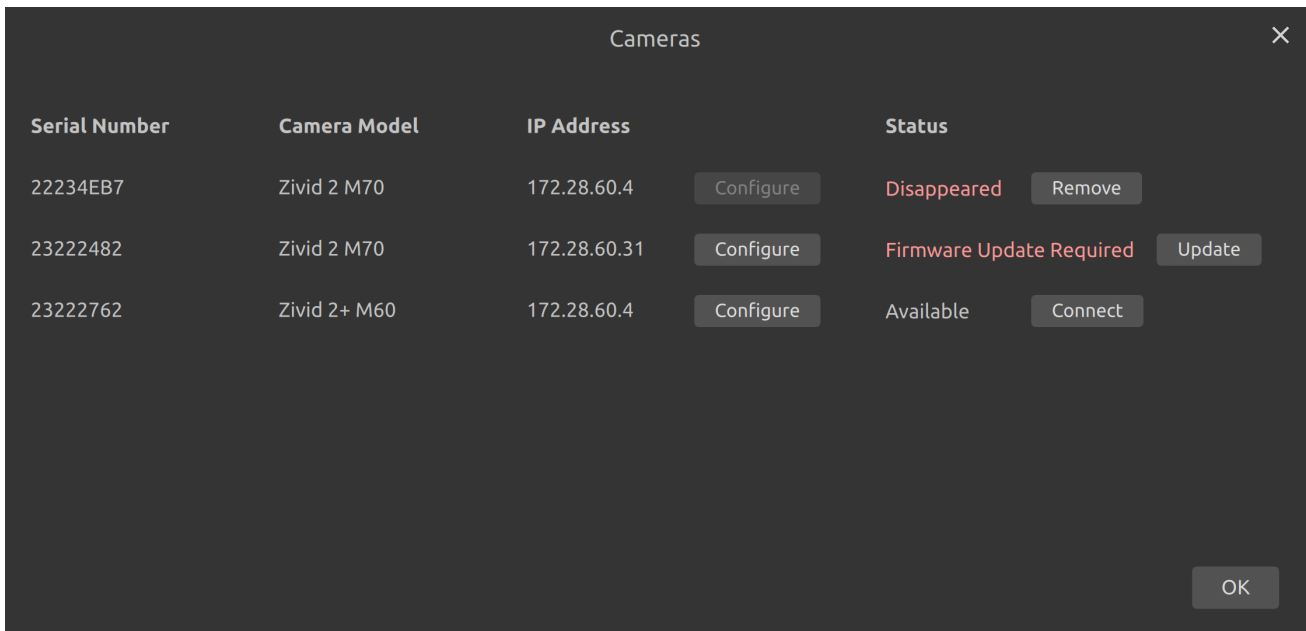
4.3. Cameras

All Cameras

To open the Cameras menu:

- Click on Cameras → All Cameras

This will list all discovered cameras and their serial numbers, models, IP addresses and statuses.

Serial Number	Camera Model	IP Address		Status	
22234EB7	Zivid 2 M70	172.28.60.4	Configure	Disappeared	Remove
23222482	Zivid 2 M70	172.28.60.31	Configure	Firmware Update Required	Update
23222762	Zivid 2+ M60	172.28.60.4	Configure	Available	Connect

The status-field allows the following actions:

- Connect to connect to the camera if it is available
- Disconnect to disconnect from the camera if it is connected
- Update to update the firmware of the camera if it is available but needs a firmware update
- Remove to remove the camera from the list if it is no longer found

You can change the network configuration of any discovered camera by clicking Configure . This will open the camera network configuration.

Here you can set the camera to use DHCP or a specific static IP address, and apply the configuration to the camera by clicking Apply . The status of the camera may change after applying the network configuration.

4.4. Tools

Infield Correction

To open the Infield Correction tool:

- Click on Tools → Infield Correction
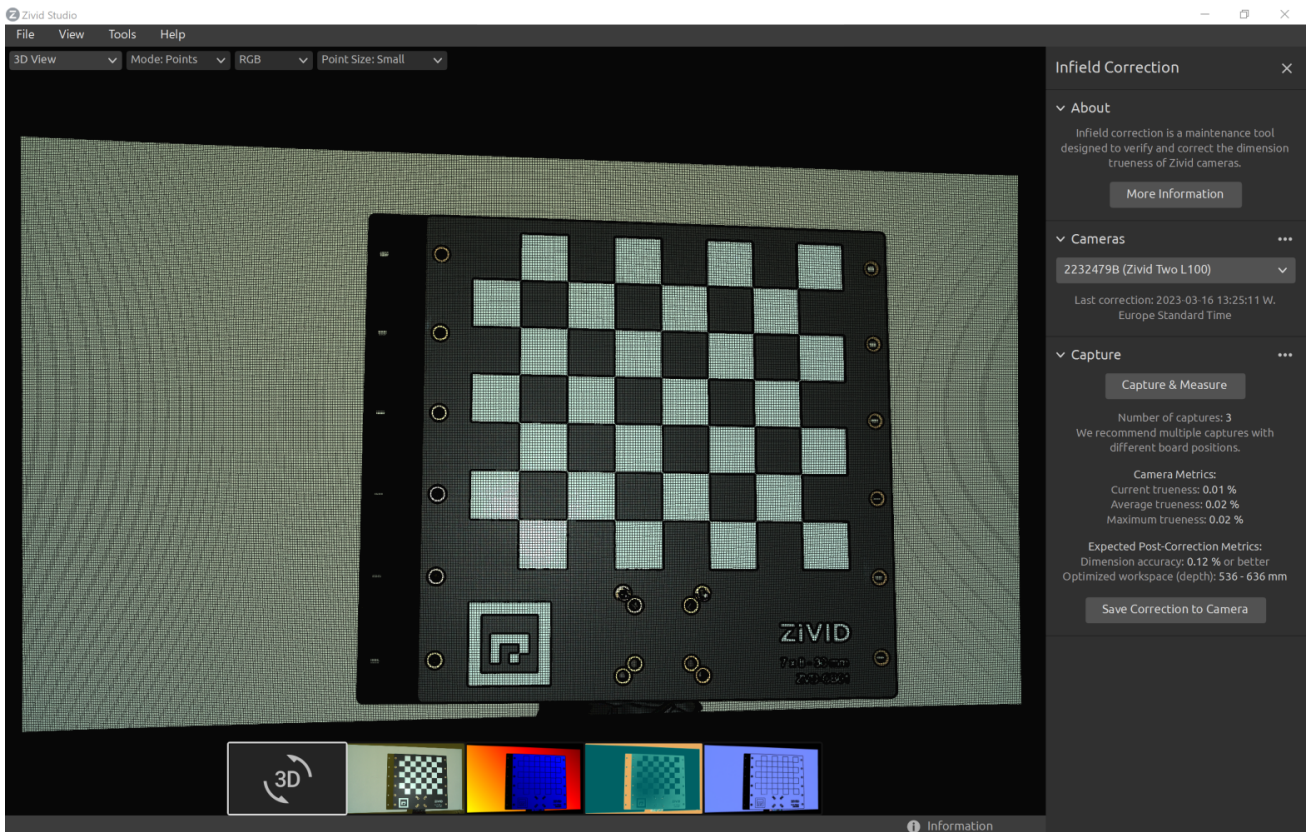
Infield Correction functionality overview

- Last correction shows the last date and time an infield correction was written to the camera.

- Capture & Measure captures to determine the local dimension trueness error of the point cloud where the Zivid calibration board is placed.

- Current Camera Metrics shows the local dimension trueness error for the last capture taken with Capture & Measure , as well as the average and the maximum for all the captures.

- Current trueness shows the local dimension trueness error for the last capture taken with Capture & Measure .

- Average trueness shows the average of the local dimension trueness errors for all the captures taken with Capture & Measure so far.

- Maximum trueness shows the maximum of the local dimension trueness errors for all the captures taken with Capture & Measure so far.

- Expected Post-Correction Metrics shows the estimated post-correction error within 1σ statistical uncertainty over the working distances the images were captured at.

- Save Correction to Camera writes to the camera the parameters for improving the accuracy of the point cloud determined from the captures of the Zivid calibration board taken with Capture & Measure .
- Reset Camera Correction removes any infield correction that has been applied in previous correct instances. It is not required to do a reset before doing a new infield correction.

4.5.   Dropdown Menus

File	Shortcut	Function
Open	`Ctrl + O`	Load a ZDF or ZFC file. ZDF is the native Zivid file format that includes point cloud, color image, and depth image data. ZFC is the native Zivid file format that contains a file camera.
Save	`Ctrl + S`	Save a point cloud, color image, and depth image data to a ZDF file, the native Zivid file format.
Export	`Ctrl + E`	Export a point cloud data to a file in unordered or ordered Polygon (PLY), ASCII (XYZ), or Point Cloud Data (PCD) [1] file format.
Save Color Image	N/A	Save a color image to a file in PNG, BMG, or JPG file format.
Save Depth Map	N/A	Save a colored depth map to a file in PNG file format.
Save SNR Map	N/A	Save a colored SNR map to a file in PNG file format.
Save Normal Map	N/A	Save a colored normal map to a file in PNG file format.
Import Capture Settings	`Ctrl + Shift + I`	Load saved capture settings from a file in YML into Zivid Studio
Export Capture Settings	`Ctrl + Shift + E`	Save current capture settings from Zivid Studio into a file in YML.
Exit	`Alt + F4`	Exit Zivid Studio.

View	Shortcut	Function
2D Color Image Histogram	`H`	Open the Histogram, a tool for analyzing pixel intensity distribution on an image.
Information	`Shift + I`	Open the Information panel to display capture information such as camera model, acquisition time, capture time and settings used. Provides ability to apply or save settings from previous captured point cloud.
3D Axis Indicator	`Ctrl + Shift + A`	Show or hide the 3D axis indicator in the 3D view.
Show 4x4 Aruco Markers	`Ctrl + M`	Highlight 4x4 Aruco markers in the point cloud.
Reset View	`Backspace`	Reset the point cloud, color image, and depth image view back to the default view.
Reset 3D view when opening files	N/A	Enable/disable 3D view reset when opening files.
Reset UI Layout	N/A	Reset the layout of the Zivid Studio window.
Enter/Exit Full Screen Mode	`F11`	Toggle between full and regular screen mode.

Cameras	Shortcut	Function
All Cameras	`Ctrl + Shift + C`	Open the Cameras menu to list and configure all discovered cameras.

Tools	Function
Infield Correction	Open Infield Correction , a maintenance tool designed to verify and correct the dimension trueness of Zivid cameras.

Help	Function
View Help Online	URL to the Zivid Knowledge Base.
About Zivid Studio	Detailed information about Zivid, third-party software licenses and system info.

5.   Quick Reference Index

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Import Capture Settings	`Ctrl + Shift + I`	Load saved capture settings from a file in YML into Zivid Studio
Export Capture Settings	`Ctrl + Shift + E`	Save current capture settings from Zivid Studio into a file in YML.
Exit	`Alt + F4`	Exit Zivid Studio.

[1]   PCD is by default exported as unorganized points but can be configured to be exported as organized points. See Organized Pcd Format Label for tutorial on how to export PCD as organized points.

View	Shortcut	Function
2D Color Image Histogram	`H`	Open the Histogram, a tool for analyzing pixel intensity distribution on an image.
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3D Axis Indicator	`Ctrl + Shift + A`	Show or hide the 3D axis indicator in the 3D view.
Show 4x4 Aruco Markers	`Ctrl + M`	Highlight 4x4 Aruco markers in the point cloud.
Reset View	`Backspace`	Reset the point cloud, color image, and depth image view back to the default view.
Reset 3D view when opening files	N/A	Enable/disable 3D view reset when opening files.
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All Cameras	`Ctrl + Shift + C`	Open the Cameras menu to list and configure all discovered cameras.

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Help	Function
View Help Online	URL to the Zivid Knowledge Base.
About Zivid Studio	Detailed information about Zivid, third-party software licenses and system info.

Function	Shortcut
Navigate to Color Image	`1`
Navigate to 3D View	`2`
Navigate to Depth Map	`3`
Navigate to SNR Map	`4`
Navigate to Normal Map	`5`
Enable/disable Monochrome (Green) point cloud color	`C`
Enable/disable Depth Map point cloud color	`D`
Enable/disable Rainbow point cloud color	`R`
Enable/disable Mesh in point cloud	`M`
Increase point size	`Ctrl + Alt + +`
Decrease point size	`Ctrl + Alt + -`

Cameras	Function
List all cameras	Open the Cameras menu and list all cameras.
Scan for connected cameras	Show all cameras plugged into the PC and list them by model and serial number.
Connect	Connect to the camera selected in the drop-down menu. Zivid Studio can connect to a single camera at a time.
Configure this camera	Open the Cameras menu and configure the IP, subnet mask and mode of the selected camera.
Disconnect from active camera	Disconnect from the active camera.

Capture	Shortcut	Function
Measure scene lighting conditions	N/A	Measure the ambient light frequency.
Reset all settings to default	N/A	Reset all settings to default values.
2D	`Shift + 1`	Switch to 2D capture mode.
2D+3D	`Shift + 2`	Switch to 2D+3D capture mode.
3D	`Shift + 3`	Switch to 3D capture mode.
Assisted / Manual Mode	`Shift + M`	Switch between Assisted and Manual Mode.
Please select a preset...	N/A	Opens a list of predefined settings.
Ambient Light Adaptation	N/A	Specify if and to what ambient light frequency the assisted capture is to adapt.
Capture	`F5`	Trigger a single capture with the specified settings.
Live	`Shift + F5`	Trigger a continuous capture that allows viewing the scene in real-time.
Stop (Live)	`Esc`	Stops the continuous capture that allows viewing the scene in real-time.
Expand all acquisitions	N/A	Expand the settings on all acquisitions.
Collapse all acquisitions	N/A	Collapse the settings on all acquisitions.
Reset to default	N/A	Reset the control panel to the default state.

Setting	Function
Engine	Choose between different pattern projections.
Reset to default	Reset the Engine to the default value.

Setting	Function
Color	Choose how to sample colors for the 2D image.
Pixel (2D) / Pixel (3D)	Choose the subsampling factor to downscale 2D image or point cloud.
Reset to default	Reset the Sampling to the default value.

Setting	Function
Exposure Time (2D) / Exposure Time (3D)	The duration a single camera image is exposed to light.
Aperture (2D) / Aperture (3D)	The opening that controls the amount of light to the camera sensor through the lens.
Brightness (2D) / Brightness (3D)	The output power (the amount of light) emitted by the LED projector.
Gain (2D) / Gain (3D)	The amplification of the signal from the camera sensor.
Checkbox	Enable/disable the selected acquisition.
Clone acquisition	Add a new frame resembling the setting of the selected acquisition.
Delete acquisition	Delete the selected acquisition.
Add acquisition	Add a new frame resembling the setting of the last acquisition.
Reset to default	Reset the selected acquisition settings to default values.

Setting	Function
Box	Create and configure a box in 3D and remove the points outside the box.
Depth	Remove points outside a user-defined depth range.
Reset to default	Reset the Region of Interest to the default values.

Setting	Function
Cluster Filter	Remove floating points and isolated clusters from the point cloud.
Hole Repair	Fill in removed points by interpolating remaining surrounding points.
Noise Filter	Remove or correct points where the projected pattern signal-to-noise-ratio is low.
Outlier Filter	Remove points if the distance to their neighboring pixels within the small local region is larger than the threshold specified in mm.
Reflection Filter	Remove points impacted by reflections and thus erroneous.
Gaussian Smoothing	Perform Gaussian smoothing on the point cloud.
Contrast Distortion	Correct and/or remove points affected by blurring in the camera lens.
Reset to default	Reset the filters to the default state.

Color	Function
Blue color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting blue color balance makes the color image look natural. The blue color balance parameter ranges between 1.0 and 8.0.
Green color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting green color balance makes the color image look natural. The green color balance parameter ranges between 1.0 and 8.0.
Red color balance	The color temperature of ambient light affects the appearance of the color image. Setting white balance by adjusting red color balance makes the color image look natural. The red color balance parameter ranges between 1.0 and 8.0.
Gamma	The output color image can appear too dark. Adjust the brightness of the image.
Color Mode	Control how the color image is computed. The options are Automatic and ToneMapping.
Reset to default	Resets blue, green, and red color balance to default values.

Setting	Function
Resampling Mode	Upsample or downsample the point cloud based on the selected resampling mode.
Reset to default	Reset the Resampling to the default value.

6. Support

The Zivid Knowledge Base offers solutions to frequently encountered issues and questions concerning Zivid products, encompassing both software and hardware aspects. Additionally, you'll discover comprehensive articles exploring our camera technology, best practices, and various 3D imaging techniques, including structured light. These resources aim to enhance your understanding and utilization of our product.

7. About Zivid

Zivid is a market-leading provider of 3D machine vision cameras and software for next generation robotics and industrial automation systems. Its Zivid 2+ and Zivid 2 products are regarded as the world's most accurate real-time 3D color cameras and bring human-like vision to the smart factories and warehouses of Industry 4.0.

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