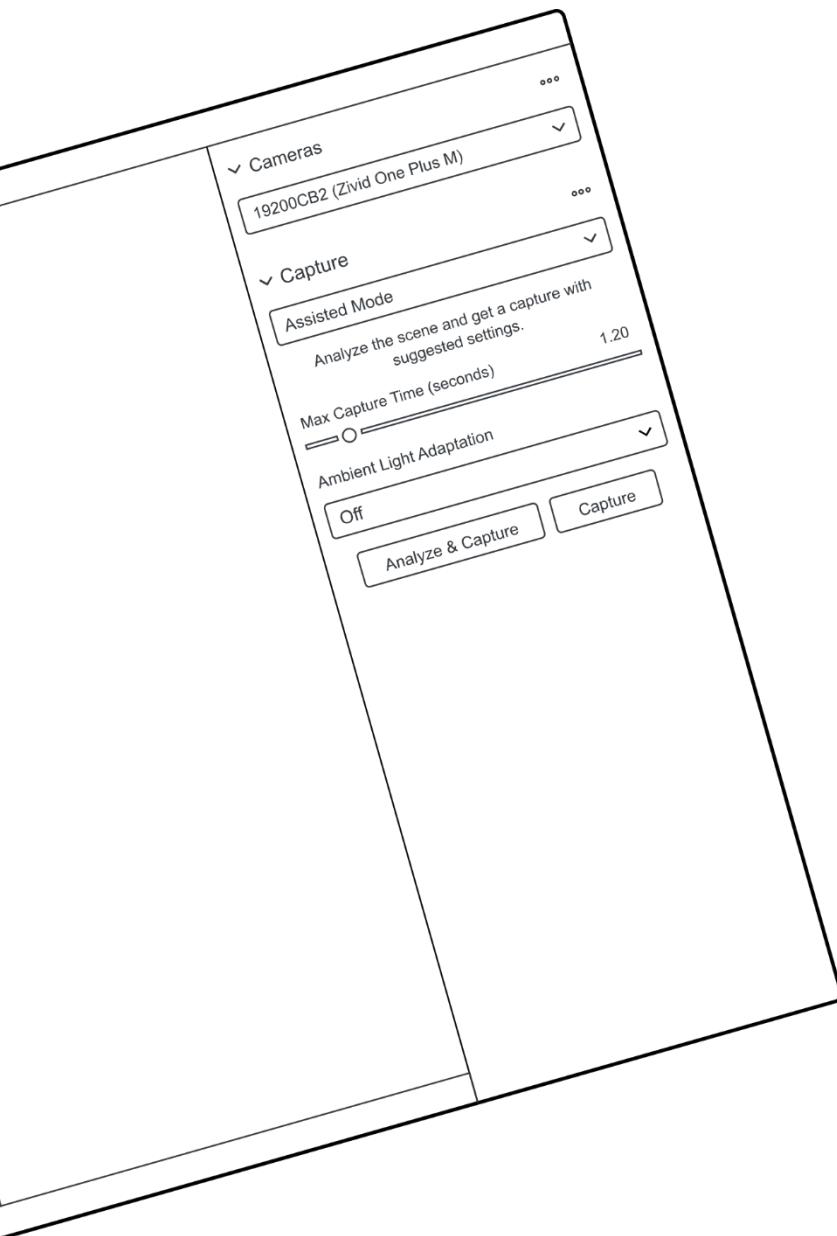




# Zivid Studio

## User Guide

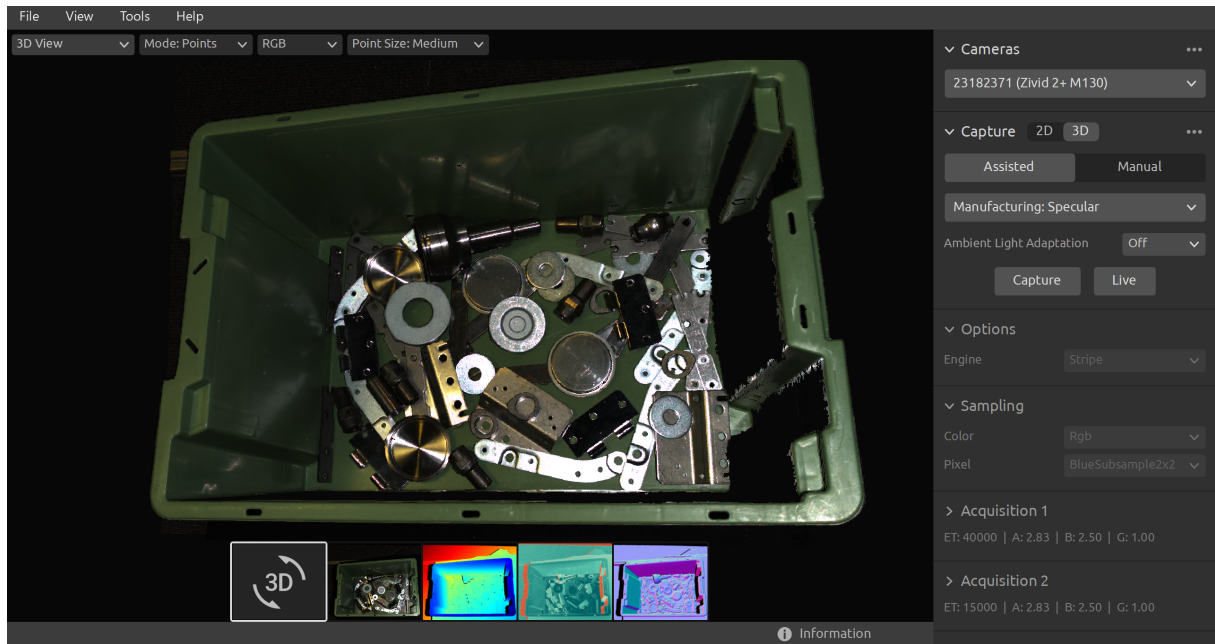


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# 1. Introduction

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



Use Zivid Studio to learn and understand how the majority of functions available in the Zivid SDK works. This is useful when developing your application. You can:

- Capture point clouds.
- Capture color images.
- Visualize point clouds, color images (2D), depth maps (Z axis), SNR (Signal-to-Noise-Ratio) maps, and normal maps.
- Analyze and evaluate 3D data quality.
- Determine correct settings and filters for your target objects and scenes.
- Save point clouds and color images to disk.

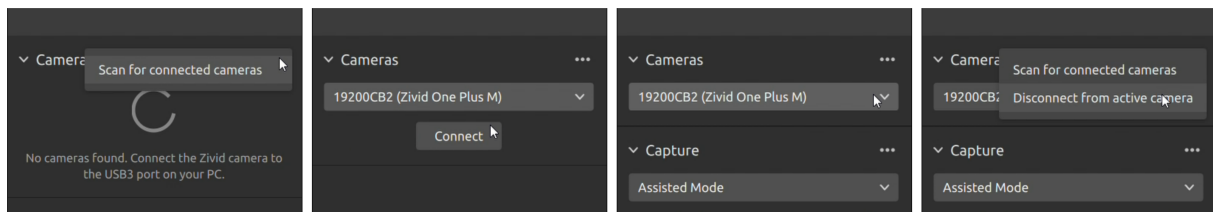
## 2. Control Panel

The control panel is located on the right side in the Zivid Studio GUI. It contains two sections:

- Camera
- Capture

### 2.1 Camera

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



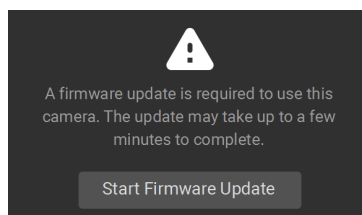
Camera	Function
Scan for connected cameras	Show all cameras plugged into the PC and list them by model and serial number.
Connect	Connect to the camera selected in the drop-down menu. Zivid Studio can connect to a single camera at a time.
Disconnect from active camera	Disconnect from the active camera.

#### **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 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 two modes:

- 3D capture
- 2D capture

### 3D Capture

The 3D capture has two modes:

- Assisted Mode
- Manual Mode

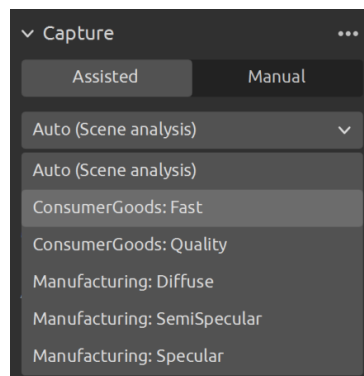
#### *Assisted Mode*

##### *Presets*

Part of the Zivid SDK is the presets, a set of pre-tuned settings. These presets are aimed to simplify tuning of the camera parameters and are an alternative to Capture Assistant. While Capture Assistant tries to optimize exposure settings for any scene depending on a time budget, presets are specifically tuned for the following categories:

- Consumer Goods
- Parcels
- Manufacturing
- Inspection

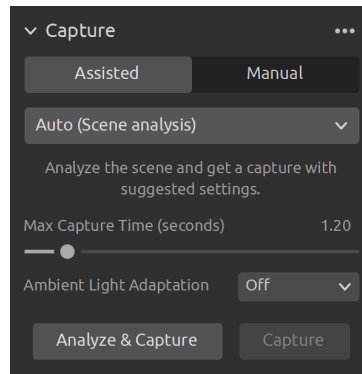
Within each category, you will find various presets. These are separated by scene complexity, working distance or by the typical type of material property of objects within that. Different cameras have different presets based on what they are commonly used for. Once a preset is selected the ambient light adaptation can be chosen.



Check Zivid Presets on the Knowledge Base to learn more.

### Auto (Scene analysis)

- Specify “Max Capture Time”
- Click “Analyze & Capture”



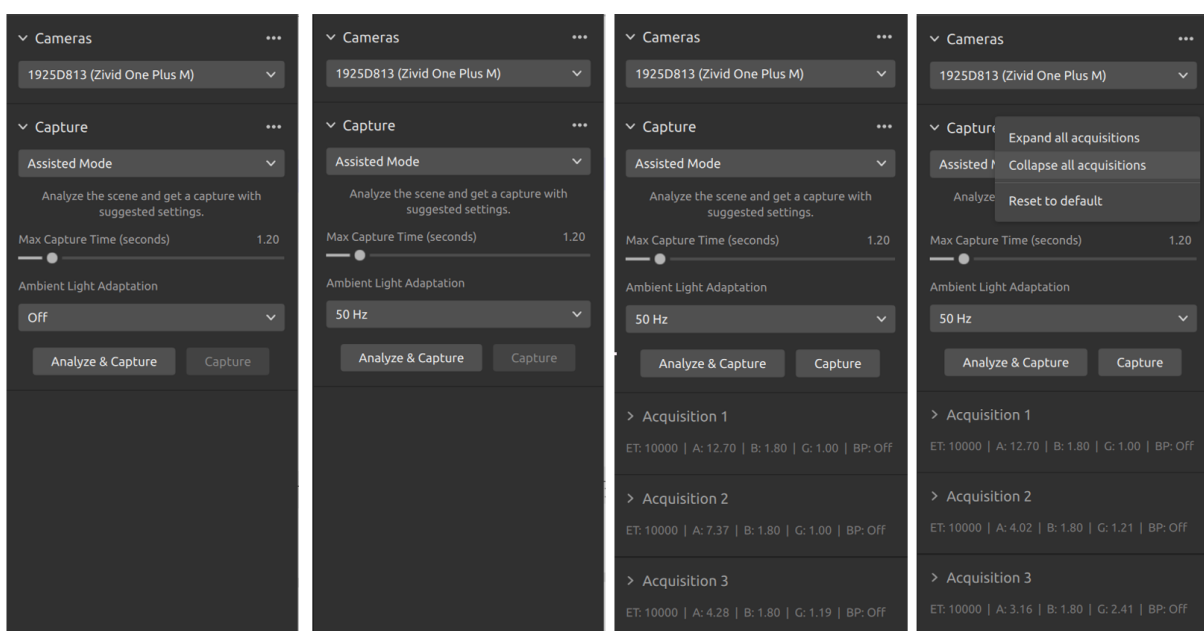
This triggers the camera to analyze the scene and output the camera settings required to cover as much of the dynamic range in the scene as possible. Immediately after this, the camera performs a second capture using these settings.

- The “Capture” button performs a capture with the settings suggested by the assisted capture, without additional scene analysis.

“Ambient Light Adaptation” is used when ambient light (AC powered) is mixed with the camera’s projector.

- Select your power grid frequency from the drop-down menu. 60 Hz is typically used in Japan, Americas, Taiwan, South Korea, and the Philippines. 50 Hz is the normal in the rest of the world.

Acquisition and filter settings appear at the bottom right corner of the “Capture” section after camera captures.

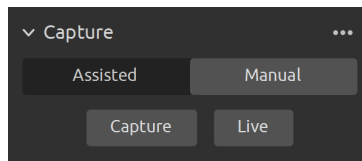


## Manual Mode

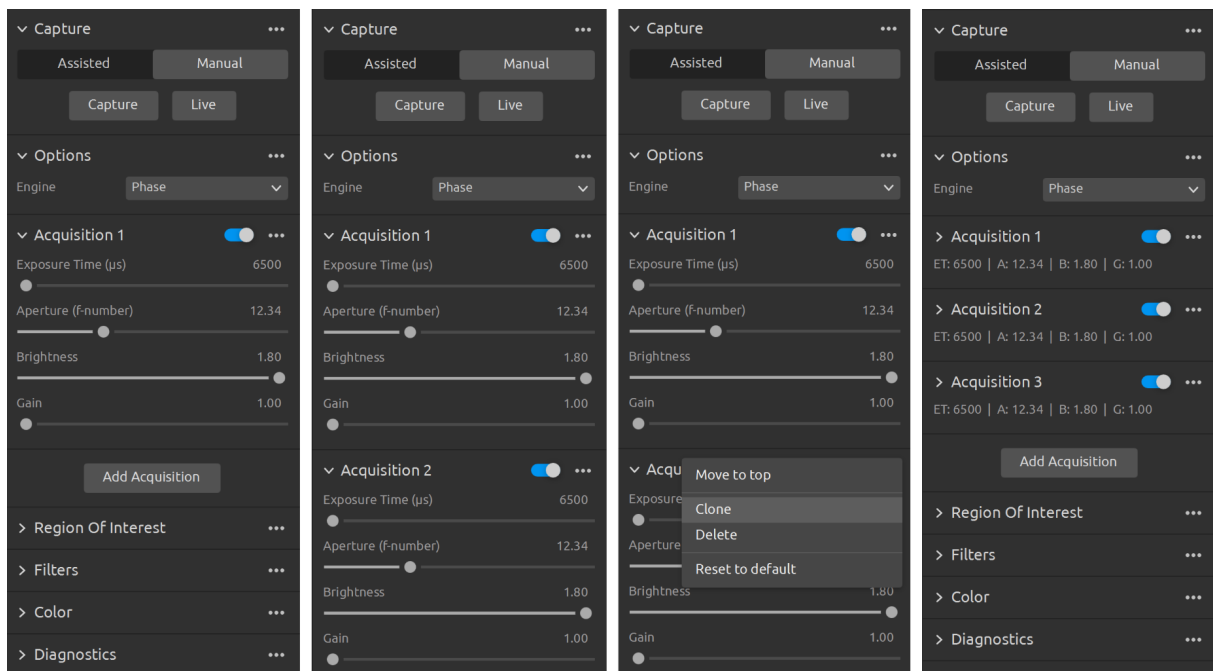
In the manual mode, users must configure all settings and filters manually.

### Capture and Live

- The “Capture” button captures a single acquisition or a multi-acquisition HDR with the specified settings, which is then displayed.
- The “Live” button triggers continuous captures, which enable you to view the scene in real-time.



For high dynamic range scenes, it is necessary to use multi-acquisition HDR. In this mode, the camera captures one image per acquisition. Each image captured uses the settings configured for the specific acquisition. These images are then automatically merged into a single, high-quality HDR frame.



Once you select the manual mode, you can click the “Add Acquisition” button to add additional acquisitions. By default, each new acquisition added uses the settings of the previous acquisition. You can clone a specific acquisition by clicking on the three dots next to that acquisition and then on the “Clone” acquisition option. Use the same menu to reset acquisition settings or delete individual acquisitions. Disable or enable acquisitions with the checkbox.

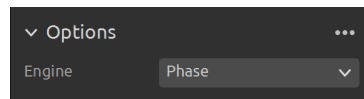
Click the “Capture” button to capture an image with the acquisition settings specified; unchecked acquisitions are ignored by the capture.

You can also use the Assisted mode to get suggested settings, and then switch to the Manual mode to fine tune these settings manually.

## 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.

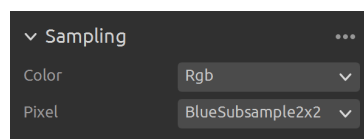
Setting	Function
Engine	Choose between different pattern projections.
Reset to default	Reset the Engine to the default value.



Check Vision Engine on the Knowledge Base to learn more.

## Sampling

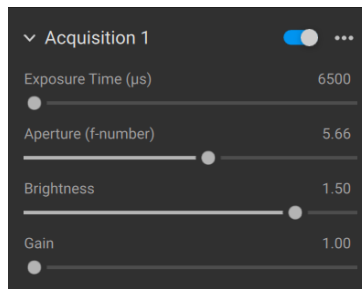
Setting	Function
Color	Selectively include or exclude color information in the captured point cloud.
Pixel	Choose the light color of the projected patterns and sampled pixels; this affects the point cloud resolution.



Check Sampling on the Knowledge Base to learn more.

## Exposure settings

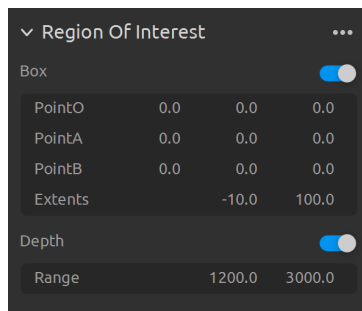
Setting	Function
Exposure Time	The duration a single camera image is exposed to light.
Aperture	The opening that controls the amount of light to the camera sensor through the lens.
Brightness	The output power (the amount of light) emitted by the LED projector.
Gain	The amplification of the signal from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



To learn how to tune settings check Capturing High Quality Point Clouds on the Knowledge Base.

### Region of Interest

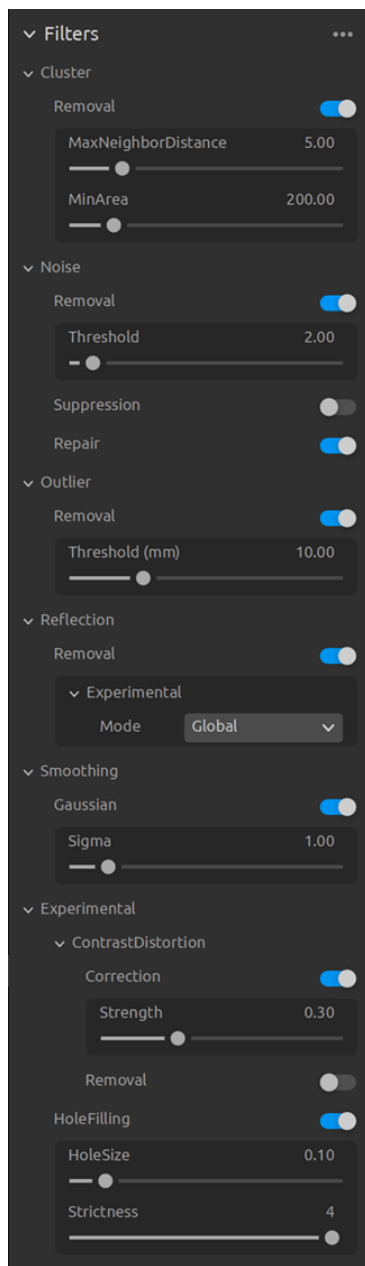
Setting	Function
Box	Create and configure a box in 3D and remove the points outside the box.
Depth	Remove points outside a user-defined depth range.



Check Region Of Interest on the Knowledge Base to learn more.

### Filters

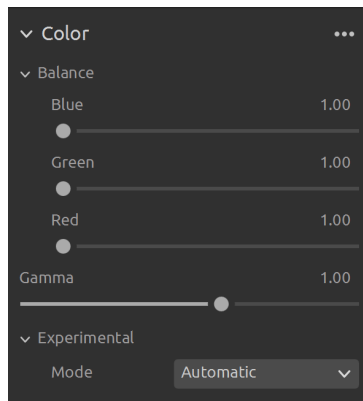
Setting	Function
Cluster Filter	Remove floating points and small isolated clusters from the point cloud.
Noise Filter	Remove or correct points where the projected pattern signal-to-noise-ratio is low.
Outlier Filter	Remove points if the distance to their neighboring pixels within the small local region 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	Corrects and/or removes points affected by blurring in the camera lens.
Hole Filling Filter	Fill in removed points, by interpolation between the remaining points.



To learn how to tune filters check [Capturing High Quality Point Clouds](#) on the Knowledge Base.

## Color

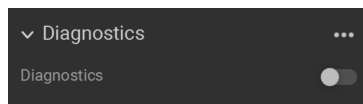
Setting	Function
Balance	The color temperature of ambient light affects the appearance of the color image. Adjust blue, green, and red color balance to make color images look natural.
Gamma	The output color image can appear too dark. Adjust the brightness of the color image.
Color Mode	Control how the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



To learn how to tune color settings check [Optimizing Color](#) and [Color Balance](#) on the Knowledge Base.

### **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.

### **2D Capture**

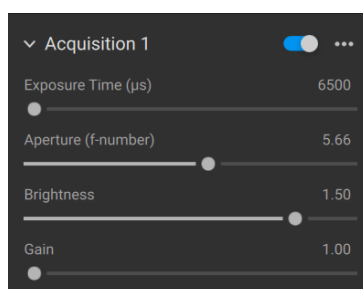
The 2D capture only has a manual mode, where the user configures 2D capture settings manually.

### **Capture and Live**

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

## Exposure 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.

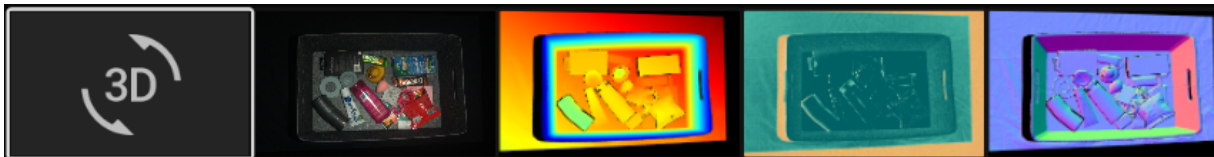


To learn how to tune color settings check [Optimizing Color](#) and [Color Balance](#) on the Knowledge Base.

### 3. Available Views

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

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



To navigate between views you can either:

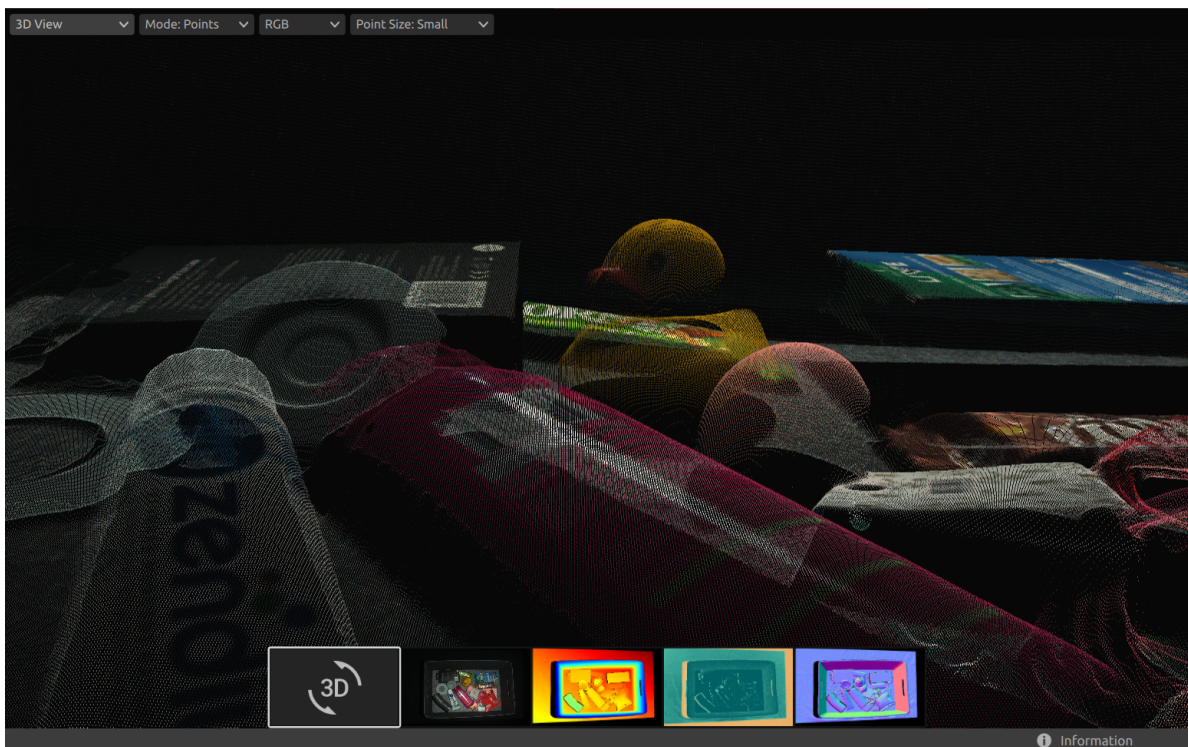
- Use the keyboard shortcuts 1 through 5
- Change the view manually at the bottom of the GUI by clicking on the thumbnails
- Select the view from the drop-down menu in the top left corner

### 3.1 Point Cloud

This view displays the point cloud of the scene after a 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.

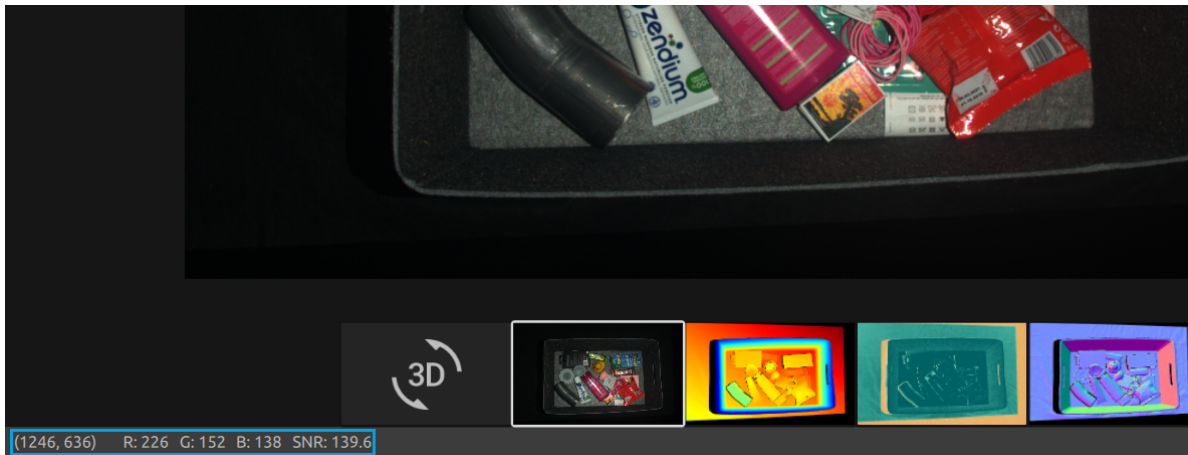
Turning color (C & D) and mesh (M) on and off in this view helps evaluate the point cloud quality. The point size is also adjustable through the drop-down menu at the top left. Adjusting the point size is for example helpful for inspecting areas where textures are important.



## 3.2 Color

This view displays the color 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, RGB, and SNR values. The pixel values are displayed in the status bar in the bottom left corner of the window.



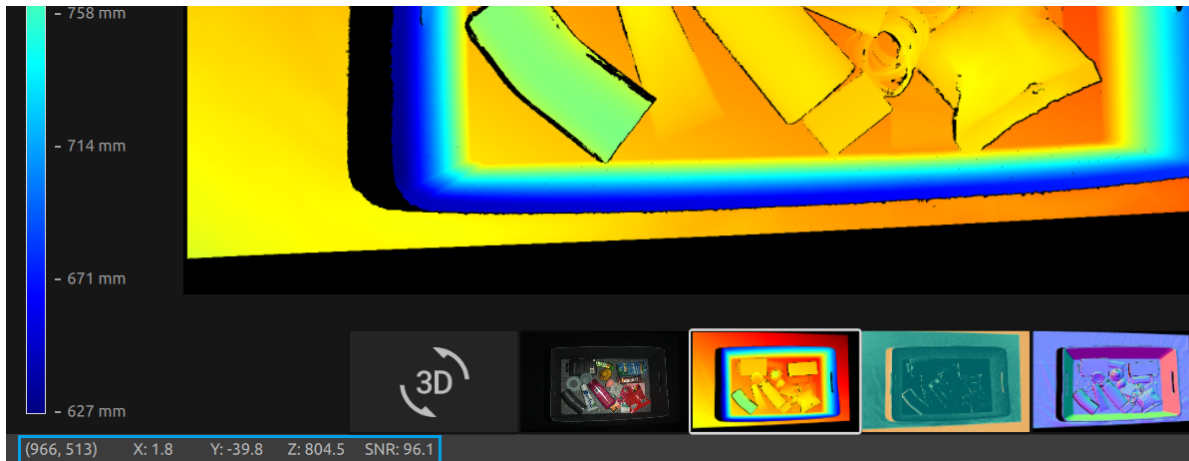
- Zoom in or out by rolling the mouse wheel or, if available, by the middle mouse button followed by dragging the mouse.
- Use the left mouse button to pan the view.



### 3.3 Depth

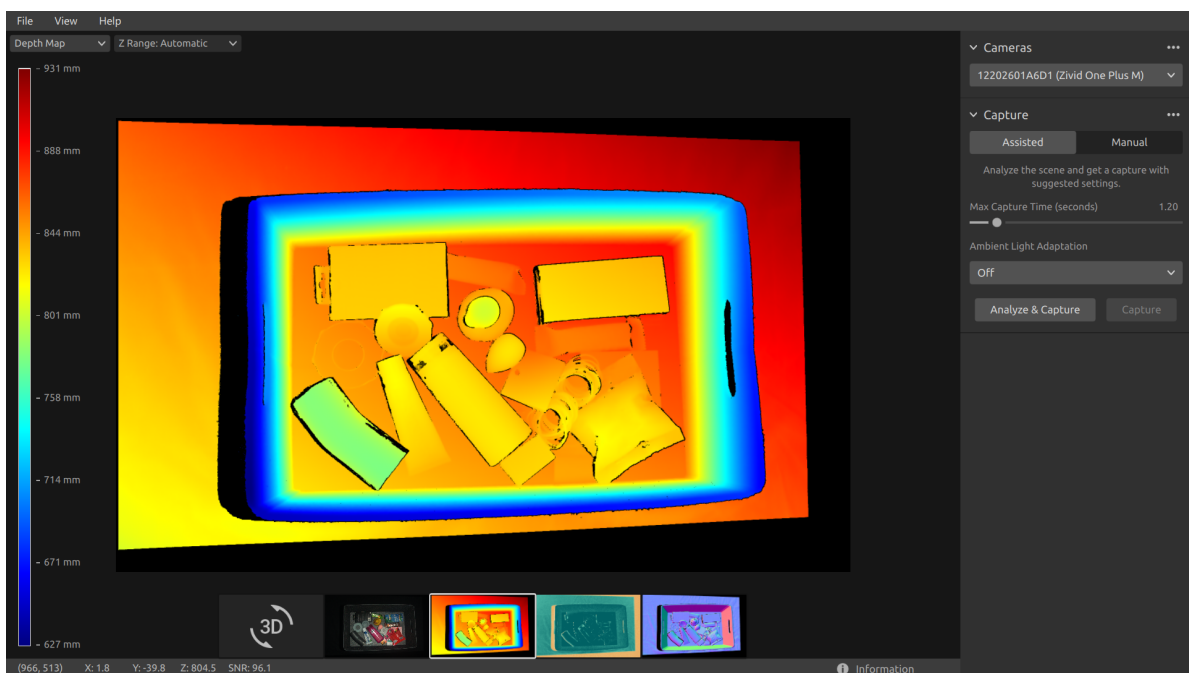
This view displays the depth image of the scene after a capture or after loading a ZDF file.

- Position the mouse pointer over a pixel in the image to get image coordinates, XYZ, 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.



### 3.4 Signal-to-Noise-Ratio

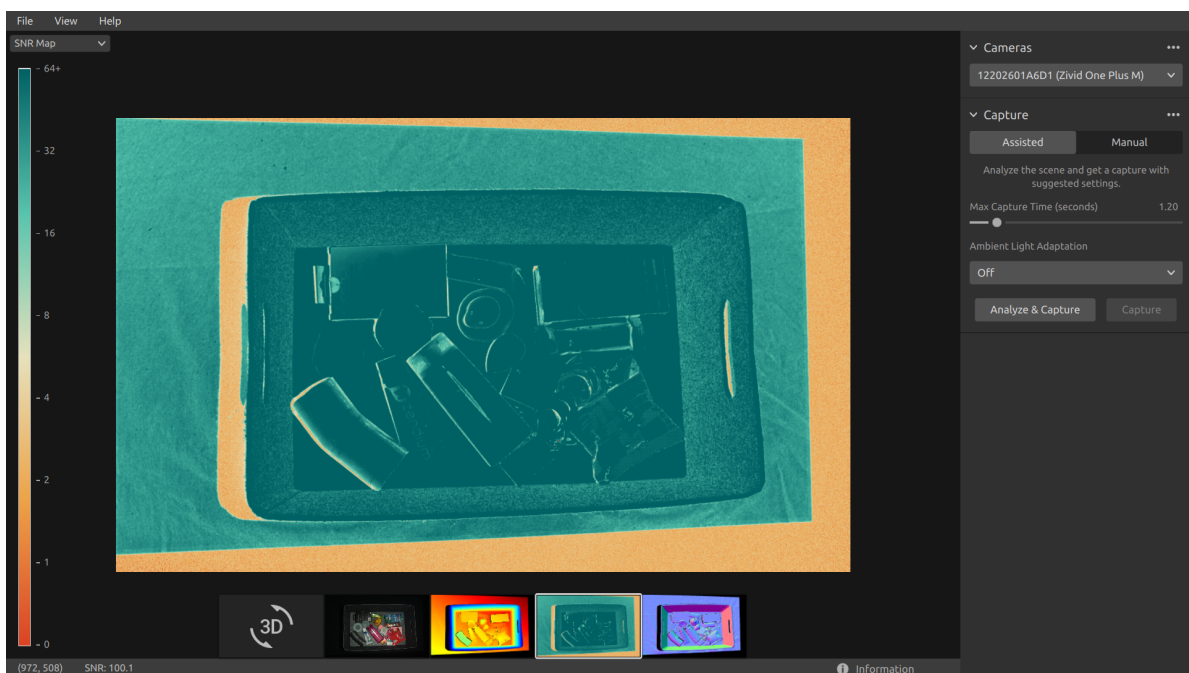
This view displays the SNR map of the scene after a capture or after loading a ZDF file.

- 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.

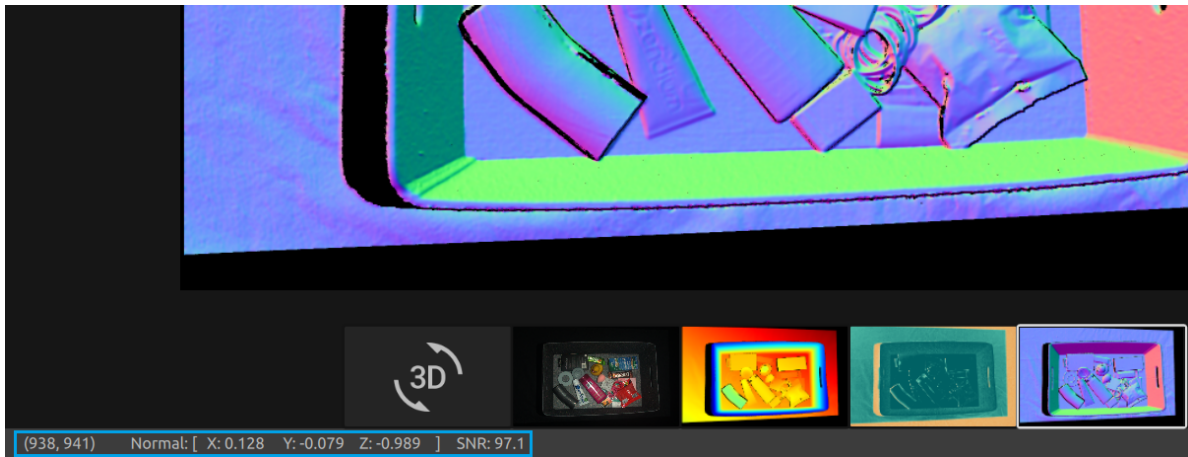
The color scale represents the variation in the SNR values. A pixel found at the higher end of the color scale represents a point associated with strong signal quality. For a point associated with a pixel found at the lower end of the color scale the ratio is more influenced by noise. Hence, these points involves higher uncertainty.



## 3.5 Normals

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

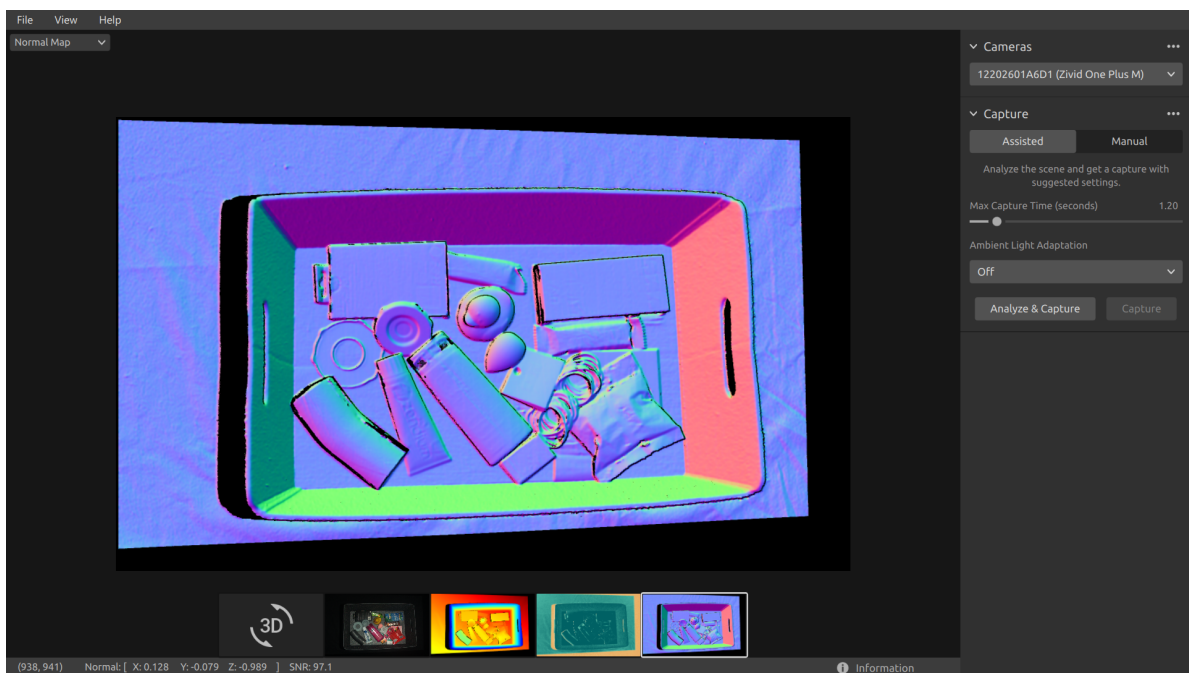
- Position the mouse pointer over a pixel in the image to get image coordinates, normal coordinates, and SNR values. The pixel values are displayed in the status bar in the bottom left corner of the window.



- 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. The relationship between the normal vectors and the color components are well visualized in the normal map by the bin walls and floor. This is because all the points on each surface have the normal vectors pointing more or less in the same direction.

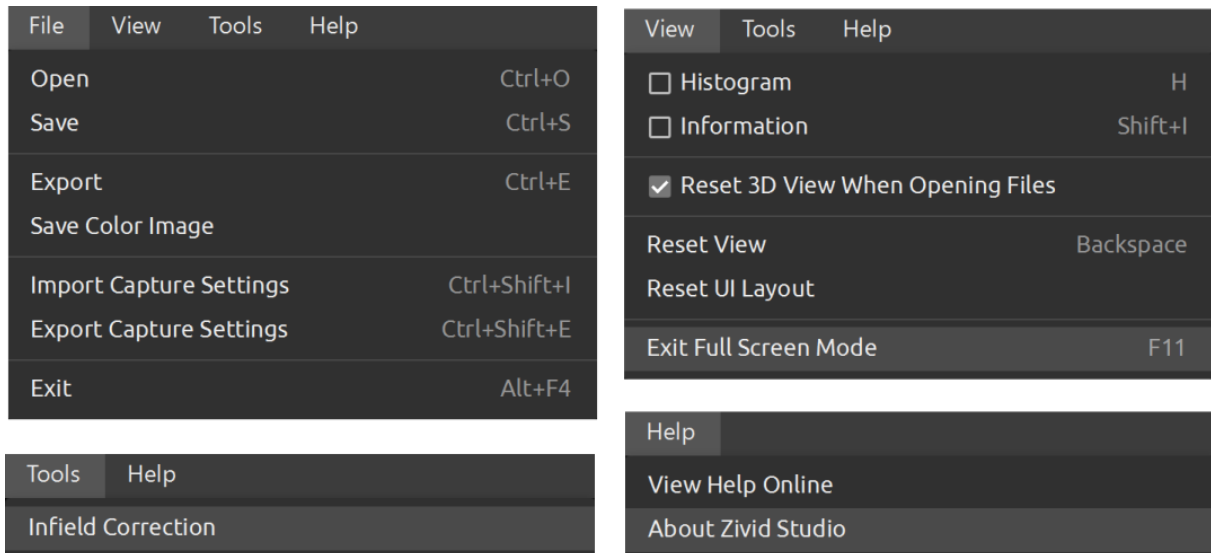
The color convention of the normal map is negatively aligned with the camera coordinate system. Hence, normal vectors represented by blue pixels point perpendicular towards the camera. Looking at the normal map, the blue pixels can be seen on the bin floor. These normals point in the negative direction of the Z-axis of the camera coordinate system. The status bar in the bottom left corner is then close to  $[0, 0, -1]$ . An example is outlined in the below image. Furthermore, the right bin wall is dominated by red pixels. These normals are negatively aligned with the X-axis of the camera coordinate system. This means that the surface has normal vectors pointing towards the left in the scene. Likewise, the bottom bin wall is colored green since the normals are pointing upwards in the scene. Hence, the status bar would respectively read close to  $[-1, 0, 0]$  for a red pixel and close to  $[0, -1, 0]$  for a green pixel.



As a result, the normal map is useful for seeing planes in the point cloud. The normal map is also helpful in inspecting surface curvatures, surface textures, and transitions between objects.

## 4. Toolbar

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



### 4.1 Save and Open

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:

##### **Note**

.zdf is the native Zivid file format that includes point cloud, color image, and depth image data.

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

##### **Note**

ZDF 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)<sup>1</sup>file format:

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

## Open Point Cloud

Opening a point cloud in Zivid Studio is only supported for ZDF file format:

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

### Tip

Drag and drop a ZDF file to load the point cloud to Zivid Studio - added in Zivid SDK 2.5.

## Save Color Image

You can also save the 2D color image in PNG, BMP, and JPG file format:

- Click on File → Save Color Image
- Navigate to the location where you want to save the color image
- Write down the file name
- Click Save

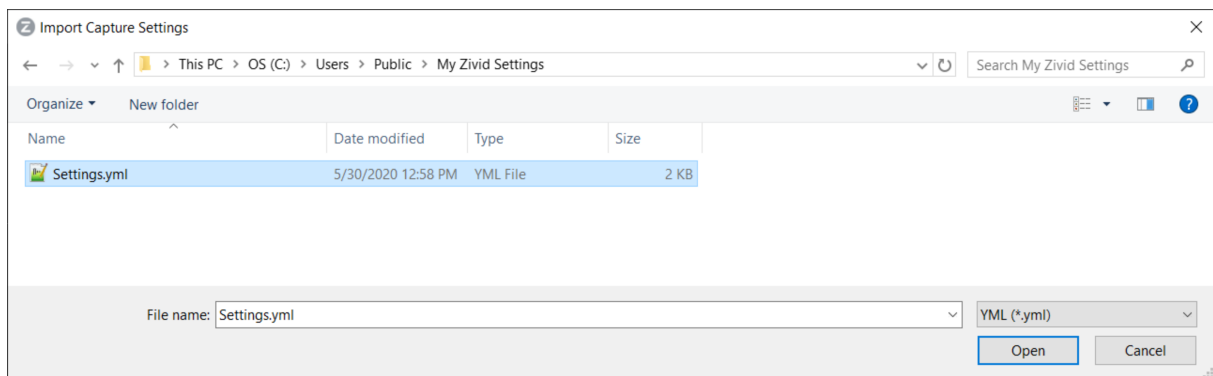
## Export Settings

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

---

<sup>1</sup>PCD is by default exported as unorganized points but can be configured to be exported as organized points. Check out the Zivid Knowledge Base for tutorial on how to export PCD as organized points.



## 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

### **i** Tip

Drag and drop a YML file to import the settings to Zivid Studio - added in Zivid SDK 2.5.

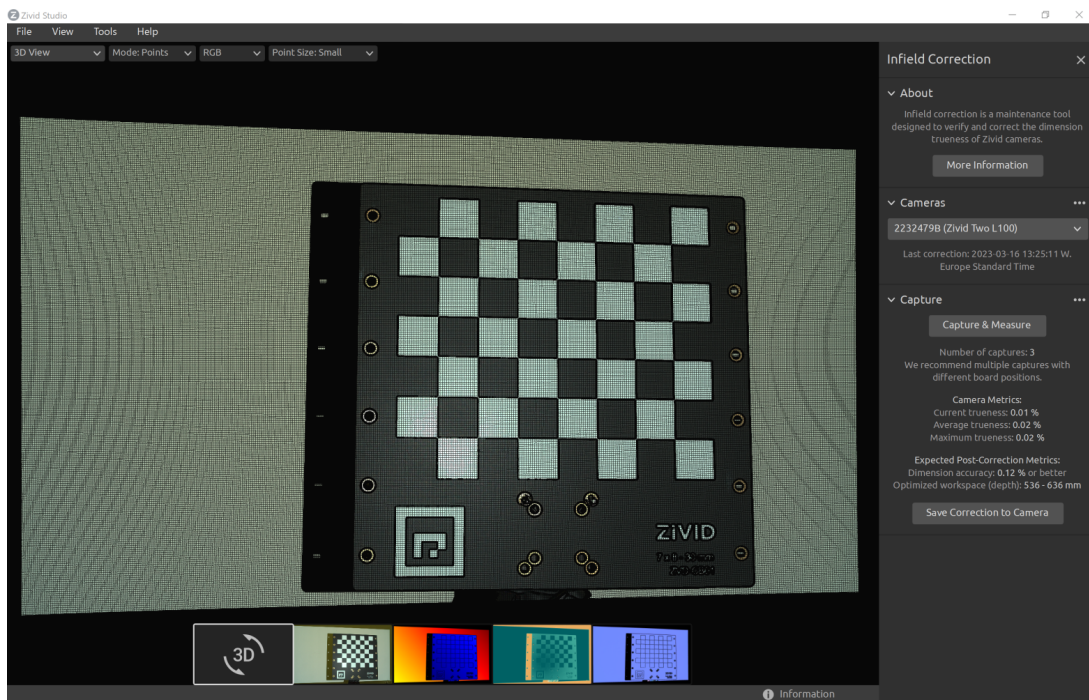
Settings can be loaded using the Zivid SDK as well.

## 4.2 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 of the point cloud where the Zivid calibration board is placed.
- Current Camera Metrics shows the local dimension trueness 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 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  $1\sigma$  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.

## 4.3 Dropdown Menus

File	Shortcut	Function
Open	Ctrl+O	Load a ZDF file. .zdf is the native Zivid file format that includes point cloud, color image, and depth image data.
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) file format.
Save Color Image		Save a color image to a file in PNG, BMG, or JPG 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
Histogram	H	Open the Histogram, a tool for analyzing pixel intensity distribution on an image.
Information	Shif+I	Open the Information panel to display capture information such as camera model, capture time and settings used. Provides ability to apply or save settings from previous captured 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		Enable/disable 3D view reset when opening files.
Reset UI Layout		Reset the layout of the Zivid Studio window.
Enter / Exit Full Screen Mode	F11	Toggle between full and regular screen mode.
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.
Legal Notice		Detailed information on Zivid and third-party software licenses.
System Info		Information on the system used by the Zivid software.

## 5. Quick Reference Index

File	Shortcut	Function
Open	Ctrl+O	Load a ZDF file. .zdf is the native Zivid file format that includes point cloud, color image, and depth image data.
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) file format.
Save Color Image		Save a color image to a file in PNG, BMG, or JPG 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
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, capture time and settings used. Provides ability to apply or save settings from previous captured point cloud.
Reset View	Backspace	Reset the point cloud, color image, and depth image view back to the default view.
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Help		Function
View help online		URL to the Zivid Knowledge Base.
Legal Notice		Detailed information on Zivid and third-party software licenses.
System Info		Information on the system used by the Zivid software.

Camera	Function
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.
Disconnect	Disconnect from the active camera.
3D Capture	Function
Assisted Mode	Switch to assisted capture mode.
Please select a preset ...	Opens a list of predefined settings, the last in the list Auto(Scene Analysis), is the only one that will not always produce the same settings.
Max Capture Time (seconds)	Maximum capture time in seconds for assisted capture.
Ambient Light Adaptation	Specify if and to what ambient light frequency the assisted capture is to adapt.
Analyze & Capture	Analyze the scene using the Capture Assistant and then capture with the suggested settings.
Capture (Assisted Mode)	Capture with the settings suggested by the Capture Assistant.
Manual Mode	Switch to manual capture mode.
Capture (Manual Mode)	Trigger a single acquisition or a multi-acquisition HDR with the settings specified in the checked acquisitions; unchecked acquisitions are ignored.
Live	Trigger a continuous capture that allows viewing the scene in real-time.
Expand all acquisitions	Expand the settings on all acquisitions.
Collapse all acquisitions	Collapse the settings on all acquisitions.
Reset to default	Reset the control panel to the default state.
Vision Engine	Function
Engine	Choose between different pattern projections.
Reset to default	Reset the Engine to the default value.
Sampling	Function
Color	Selectively include or exclude color information in the captured point cloud.
Pixel	Choose the light color of the projected patterns and sampled pixels; this affects the point cloud resolution.

Acquisition	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.
Toggle switch	Enable/disable the selected acquisition.
Clone acquisition	Add a new acquisition resembling the setting of the selected acquisition.
Delete acquisition	Delete the selected acquisition.
Add acquisition	Add a new acquisition resembling the setting of the last acquisition.
Reset acquisition to default	Reset the selected acquisition settings to default values.
Region of Interest	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	Function
Cluster Filter	Remove floating points and small isolated clusters from the point cloud.
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	Corrects and/ or removes points affected by blurring in the camera lens.
Hole Filling	Fill in removed points, by interpolation between the remaining points.
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.
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.
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.
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, ToneMapping, or UseFirstAcquisition.
Reset to default	Reset the blue, green, and red color balance to the default state.

Shortcut	Keyboard Shortcut Function
1	Navigate to 3D View
2	Navigate to Color Image
3	Navigate to Depth Map
4	Navigate to SNR Map
5	Navigate to Normal Map
C	Enable/disable Monochrome (Green) point cloud color
D	Enable/disable Depth Map point cloud color
M	Enable/disable Mesh in point cloud

## 6. Support and Troubleshooting

For more information, visit:

[support.zivid.com](https://support.zivid.com)



The Zivid Knowledge Base provides answers for commonly seen issues and questions related to Zivid products, for both software and hardware. You will also find in depth articles about our camera technology, best use practices, different types of 3D imaging methods and structured light, to get a better understanding for how to use this 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+, Zivid 2, and Zivid One+ 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.

To find out more about Zivid, visit:

[www.zivid.com](http://www.zivid.com)



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