



# Typical Case Practices of 3D Vision System

v1.8.2

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# 1. Typical Case Practices

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Mech-Mind typical case practices are practical application guides derived from numerous successful use cases in various application scenarios. Each application case practice includes the application scenario of typical cases, getting started guidance, tuning recommendations, and common issue troubleshooting guidance, helping you easily deploy 3D vision guided applications step by step.

## Loading and Unloading

### Neatly Arranged Cylindrical Shaft Loading

- **Basics:** the application scope, unsupported functions and technical specifications of the neatly arranged cylindrical shaft loading solution.
- **Getting started:** entry-level usage instructions of the neatly arranged cylindrical shaft loading solution.
- **Troubleshooting:** common problems and corresponding solutions for the neatly arranged cylindrical shaft loading solution.

## Depalletizing

### Single-Case Carton Depalletizing

- **Basics:** the application scope, unsupported functions and technical specifications of the single-case carton depalletizing solution.
- **Getting started:** entry-level instructions for the single-case carton depalletizing solution.
- **Troubleshooting:** common problems and fixes for the single-case carton depalletizing solution.

### Single-Case Sack Depalletizing

- **Basics:** the application scope, unsupported functions and technical specifications of the single-case sack depalletizing solution.
- **Getting started:** entry-level instructions for the single-case sack depalletizing solution.
- **Troubleshooting:** common problems and fixes for the single-case sack depalletizing solution.

### Turnover Box Depalletizing

- **Basics:** the application scope, unsupported functions and technical specifications of the turnover box depalletizing solution.
- **Getting started:** entry-level instructions for the turnover box depalletizing solution.
- **Troubleshooting:** common problems and fixes for the turnover box depalletizing solution.

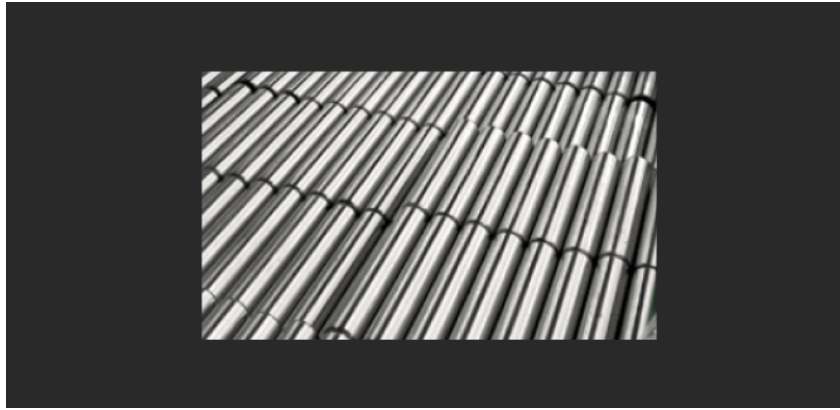
## 2. Loading and Unloading

### 2.1. Neatly Arranged Cylindrical Shaft Loading

#### Overview

Neatly arranged cylindrical shaft loading refers to the loading of shafts or rods stacked in multiple layers in an orderly manner. The shaft is made of finely processed metal with highly reflective surface.

This solution uses 3D matching with the aid of deep learning to instantly recognize the shafts/rods from the incoming bins, and output results that meet requirements by verifying the sizes, orientations, positions, and angles.



#### Reading Guide

You can check the following sections to learn about the basic information, getting started instructions, common problems and fixes of the neatly arranged cylindrical shaft loading solution.

No.	Section	Description
1	<a href="#">Basics</a>	The applicability, unsupported functions and technical specifications of the neatly arranged cylindrical shaft loading solution.
2	<a href="#">Getting Started</a>	Entry-level usage instructions of the neatly arranged cylindrical shaft loading solution.
3	<a href="#">Troubleshooting</a>	Common problems and corresponding solutions for the neatly arranged cylindrical shaft loading solution.

#### 2.1.1. Basics

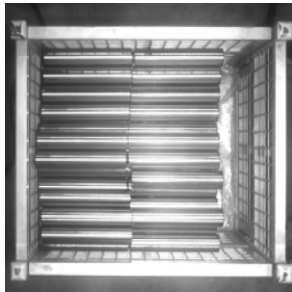


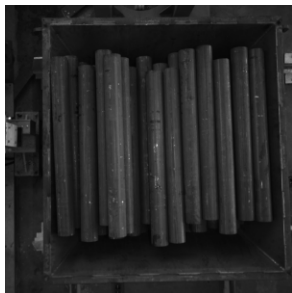

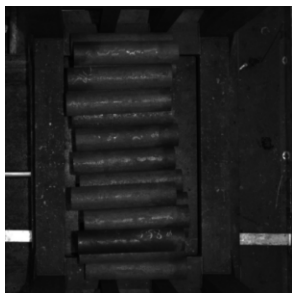
This section introduces the basics of the neatly arranged cylindrical shaft loading solution, including the applicability, unsupported functions and technical specifications.

### Applicability

This section describes the applicability of the neatly arranged cylindrical shaft loading solution in terms of the shaft types, project requirements, and the shaft placement.

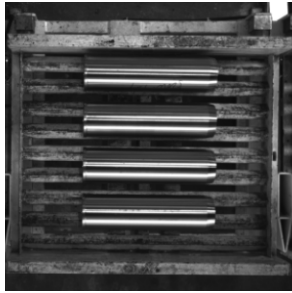

### Shaft Types

The table below illustrates the solution’s applicability to shaft types.

Feasible	Illustration	Not feasible	Illustration
The shafts are placed in an orderly manner.		The shafts are placed in a random manner.	
Only one type of shaft exists in the same bin.		Various types of shafts exist in the same bin.	
The shafts are standard cylinders.		The workpieces are not standard cylinders. For example, the shaft is thinner at both ends and thicker in the middle or thicker at one end and thinner at the other.	
There is no need to differentiate the thin end and thick end of the shafts, as the shafts are standard cylinders with no significant differences between the two ends.		It is needed to differentiate the big-endian and little-endian of the shafts, as there are significant differences between the two ends of the shafts.	
There are no significant grooves or grinding traces in the middle of the shafts.		There are significant grooves or grinding traces in the middle of the shafts.	

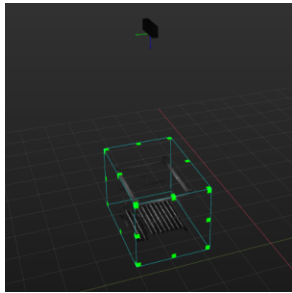

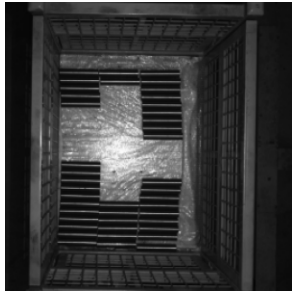

### Project Requirements

The table below illustrates the neatly arranged cylindrical shaft loading solution’s applicability to project requirements.

Feasible	Illustration	Not feasible	Illustration
<p>Loading of shafts. Pick the shafts from the bins, and then place them on the loading platform or secondary positioning platform.</p>		<p>Unloading of the shafts.</p>	


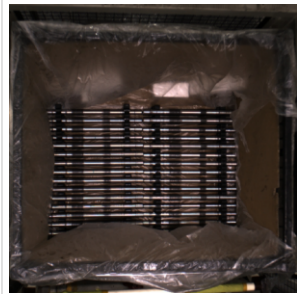
### Shaft Placement

The table below illustrates the solution’s applicability to shaft placement.

Feasible	Illustration	Not feasible	Illustration
<p>The shafts are placed in an orderly manner. The long sides of the shafts are parallel to the long side of the camera.</p>		<p>The shafts are placed in a random manner.</p>	
<p>The shafts are placed in a left-right manner.</p>		<p>The shafts are placed in a north-south manner.</p>	

### Shaft Carriers

The table below illustrates the solution’s applicability to shaft carriers.

Feasible	Illustration	Not feasible	Illustration
<p>Four-wall bins with no significant reflection on the bin walls. There is no plastic film that obscures the shafts.</p>		<p>There is significant reflection on the bin walls, or there is plastic film obscuring the shafts.</p>	

## Dimensions

The table below illustrates the solution's applicability to shaft dimensions.

Feasible	Not feasible
Shafts of known dimensions.	Shafts of unknown dimensions.

## Unsupported Functions

The neatly arranged cylindrical shaft loading solution does not support the following functions.

- Identify the orientations of the shafts. The neatly arranged cylindrical shaft loading solution does not support the recognition of shafts with different ends, or the orientations of the shafts.
- Identify different materials in the incoming shafts. The neatly arranged cylindrical shaft loading solution cannot be used to identify whether there are other types of materials in the incoming shafts.
- Identify the dimensions of the shafts. The neatly arranged cylindrical shaft loading solution does not support the recognition of dimensions of the shafts.

## Technical Specifications

The technical specifications of the neatly arranged cylindrical shafts loading solution are as follows.

- Positioning accuracy:  $\pm 5$  mm
- Recognition success rate: more than 99%
- Execution time of vision system: within 4 s

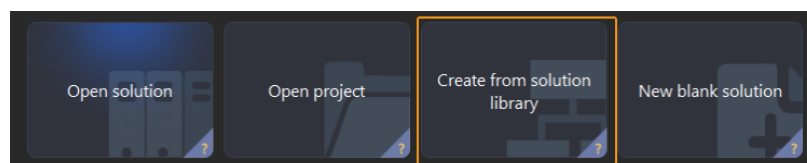
### 2.1.2. Getting Started

This section will introduce how to easily load the neatly arranged cylindrical shafts from a beginner's perspective. The overall process is shown in the figure below.

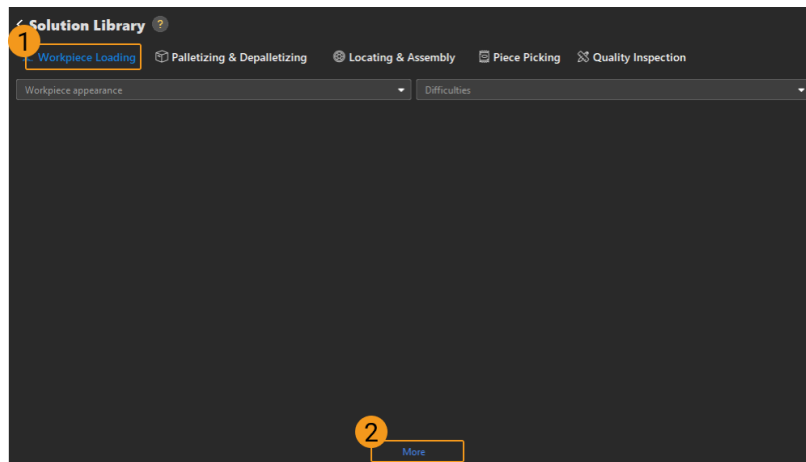


## Acquire the Solution

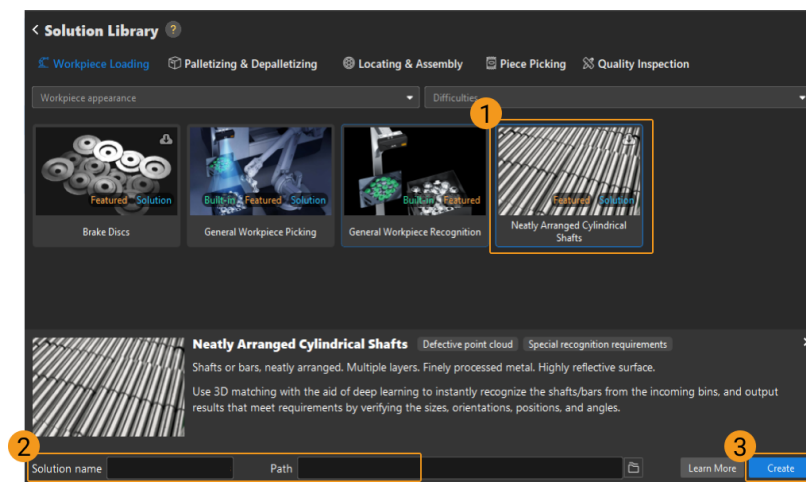
1. Run Mech-Vision.
2. In the Welcome interface of Mech-Vision, click [ **Create from Solution Library** ] to open the Solution Library.



3. Enter **Workpiece loading** in the Solution Library, then click on [ **More** ] at the bottom, and click [ **Yes** ] in the pop-up window.



- After acquiring the solution resources, select **Neatly Arranged Cylindrical Shafts**. Then, fill in the Solution name and Path at the bottom, and finally click [ **Create** ] to download the neatly arranged cylindrical shaft loading solution.



Once the solution is downloaded, it will be automatically opened in Mech-Vision.

## Set up Communication

When deploying a Mech-Mind vision solution, you need to set up the communication between the Mech-Mind Vision System and the robot side (robot, PLC or host computer).

The neatly arranged cylindrical shaft loading solution uses **Standard Interface communication**. For specific operations, please refer to [Standard Interface Communication Configuration](#).

## Hand-Eye Calibration

Hand-eye calibration establishes the transformation relationship between the camera and robot reference frames. With this relationship, the object pose determined by the vision system can be transformed into that in the robot reference frame, which guides the robot to perform its tasks.

Please refer to [Hand-Eye Calibration Guide](#) to complete hand-eye calibration.

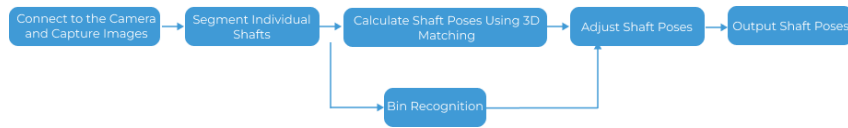


Every time the camera is mounted, or the relative position of the camera and the robot changes after calibration, it is necessary to perform hand-eye calibration again.



## Locate Shafts

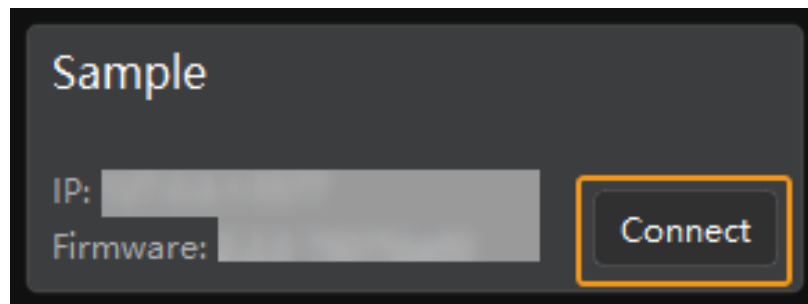
After completing the communication configuration and hand-eye calibration, you can use Mech-Vision to recognize the shafts. The process for shaft recognition is shown in the figure below.



### Connect to the Camera and Capture Images

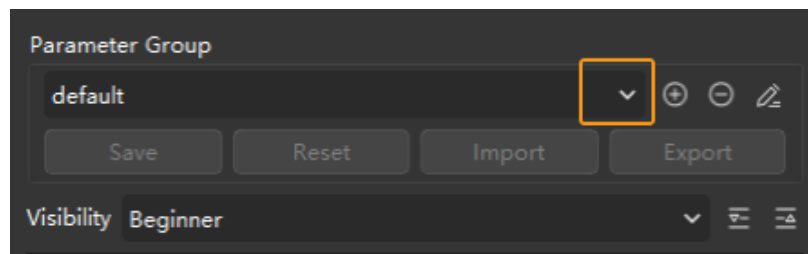
1. Connect to the camera.

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




2. Set parameter group.

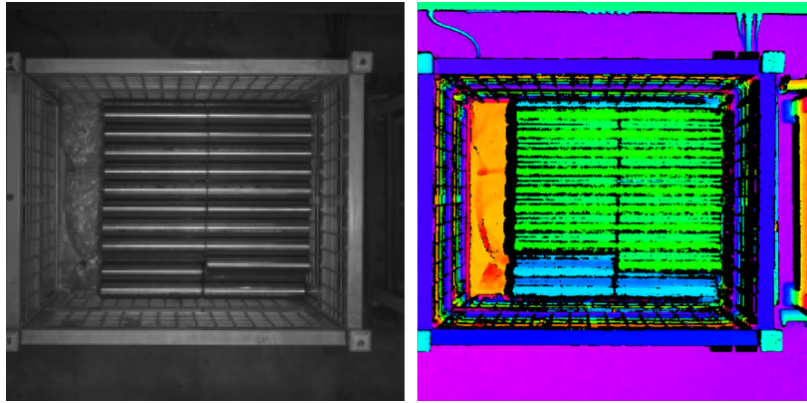
Click the dropdown arrow next to the Parameter Group on the right-hand side and select the **Typical neatly arranged cylindrical shaft loading**.



In addition to the default parameter group, Mech-Eye Viewer will also display parameter groups of other typical solutions.

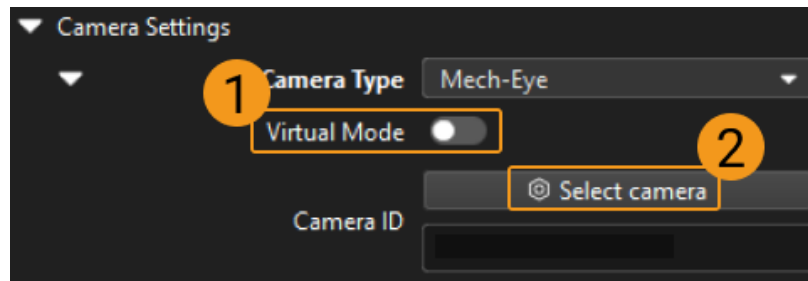
3. Capture images.



After the camera is successfully connected and the parameter group is set, you can start capturing the shaft images. Click the  button on the top to capture a single image. At this time, you can view the captured 2D image and point cloud of the shaft. Ensure that the 2D image is clear, the shaft point cloud is intact, and the edges are clear. The qualified 2D image and point cloud of the shaft are shown on the left and right in the figure below respectively.

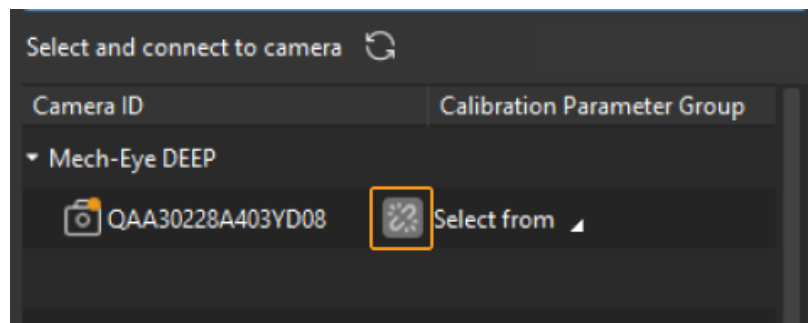


#### 4. Add a camera in Mech-Vision.

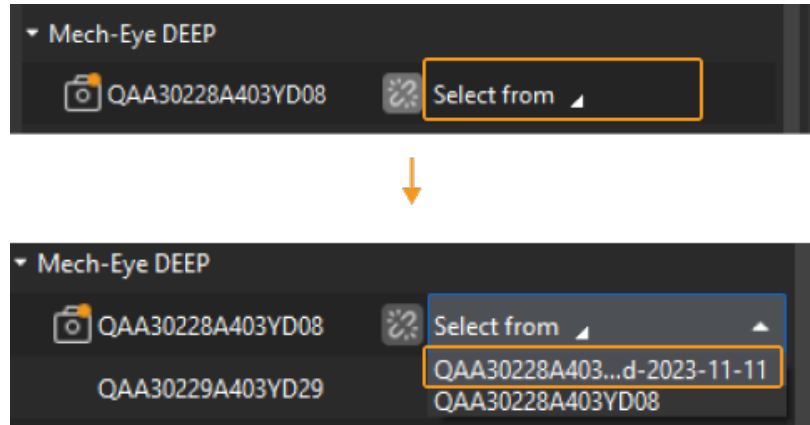
Select the **Capture Images from Camera** Step, disable the **Virtual Mode** option, and click **[ Select camera ]** in the Step Parameters panel.




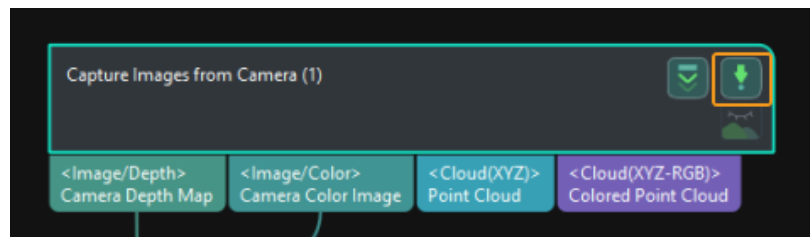
In the pop-up window, click the  button on the right of the Camera ID. When the button turns into , the camera is connected successfully.



After the camera is connected successfully, you can click **[ Select from ]** and select the corresponding camera calibration parameter group, as shown below.

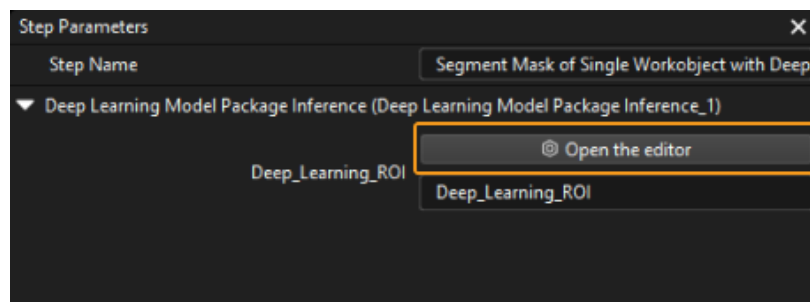


Once the above settings are complete, you can connect to a real camera. Other parameters can remain at their default values. Click the  button on the right of the “Capture Images from Camera” Step to run this Step. If no error message occurs, the camera is connected successfully and images can be captured normally.

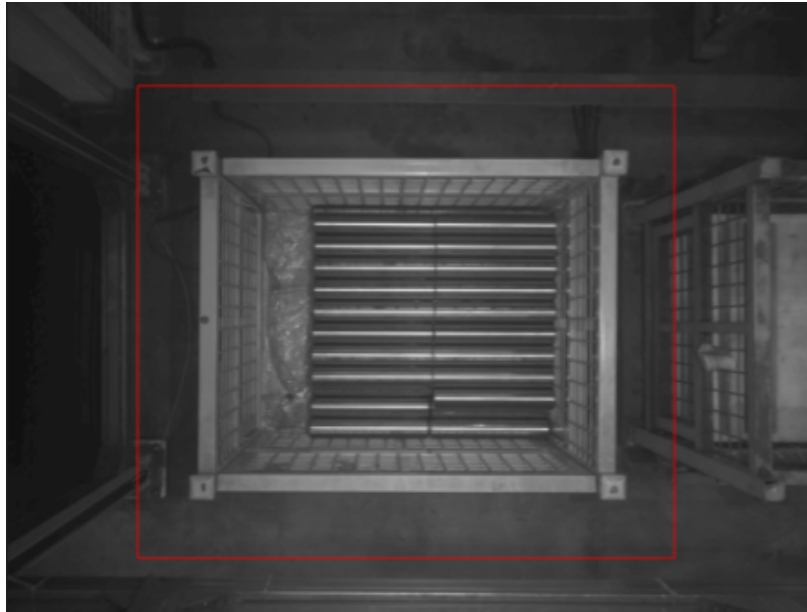


### Segment Individual Shafts

1. Select the **Segment Mask of Single Workobject with Deep Learning Procedure**, then click the [ **Open the editor** ] button in **Deep Learning ROI** in the Step Parameters panel to open the **Set ROI** window.



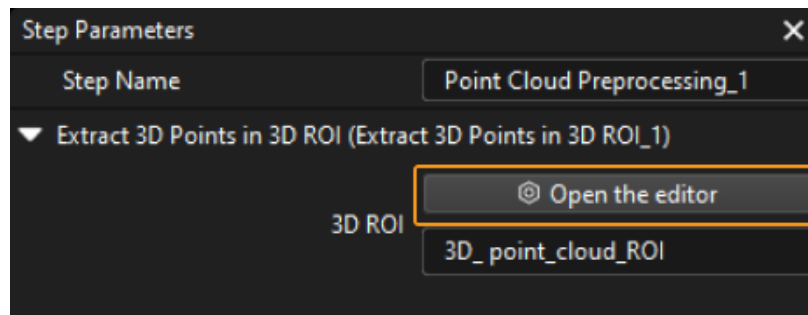
2. Set 2D RIO in the **Set ROI** window. The 2D ROI needs to cover the highest-layer shafts, leaving an appropriate margin of about one-third, as shown in the figure below.



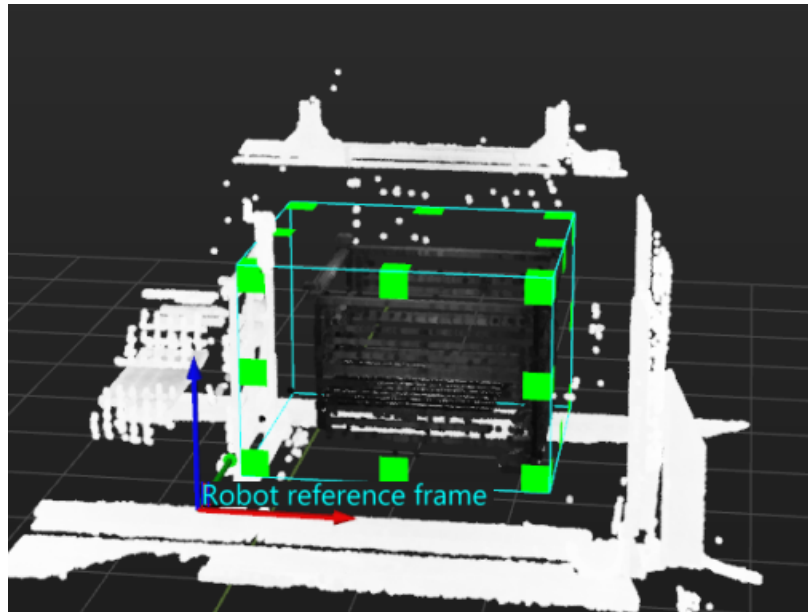
### Calculate Shaft Poses Using 3D Matching

#### Set 3D Region of Interest (ROI)

1. Select the **Point Cloud Preprocessing** Procedure, then click the [ **Open the editor** ] button in the Step Parameters panel to open the **Set 3D ROI** window.



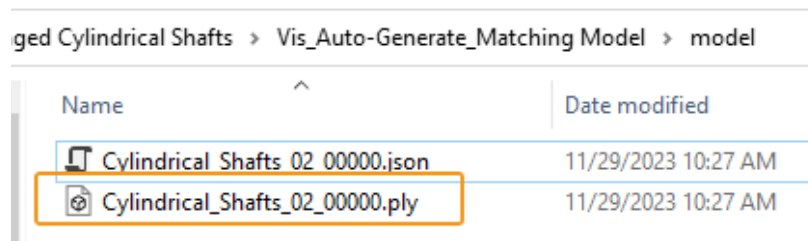
2. In the **Set 3D ROI** window, drag the default generated 3D ROI in the point cloud display area to a proper position. Make sure that the green box encompasses the whole bin with a certain margin at the same time, and that the green box does not contain other interfering point clouds, as shown in the following figure.



### Make the Shaft Point Cloud Model

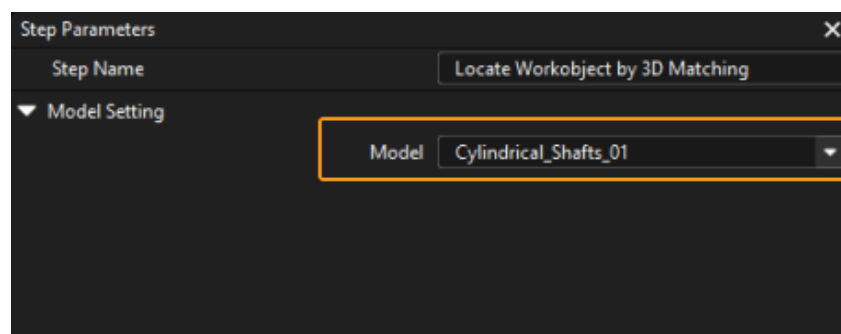
The `Vis_Auto-Generate_Matching_Model` Project in the neatly arranged cylindrical shaft loading solution is used to make shaft point cloud models and save them. Please follow the steps below to make them.

1. Run `Vis_Auto-Generate_MatchingVis_Auto-Generate_Matching_Model` project, and then automatically make the shaft point cloud models.
2. Check `model` folder in the `Vis_Auto-Generate_Matching_Model` project folder. After this running, the created shaft point cloud models (.ply files) will be automatically saved in the `model` folder.



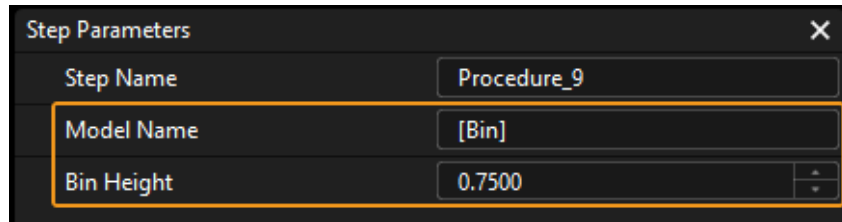
### Select Point Cloud Model

Select the **Locate Workobject by 3D Matching** Procedure, and then select the shaft point cloud model in the drop-down menu of **Model** in the Step Parameters panel.



## Bin Recognition

Select the **Recognize Bin Procedure**, and then enter the actual bin name and height in the **Model Name** and **Bin Height** parameters (Unit: m).

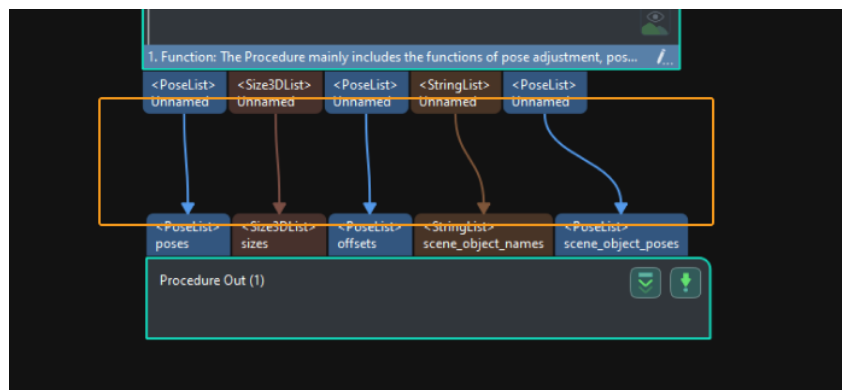


## Adjust Shaft Poses

The Procedure is used to transform shaft poses from the camera reference frame to the robot reference frame, adjust pose orientations, sort poses, and filter unqualified poses. There is no need to set parameters for this Procedure.

## Output Shaft Poses

The **Procedure Out** is used to output the poses of shafts and bins. Click the data stream to view the relevant data.



So far, you have learned how to get started with shaft locating.

## Path Planning

After the shaft recognition is complete, you can use Mech-Viz for path planning. The process of path planning is shown in the figure below.



The Standard Interface communication is used for path planning in the neatly arranged cylindrical shaft loading solution. For more information on the path planning under the Master-Control communication, please download the [Viz\\_Shaft\\_Picking.zip](#).

## Configure Scene Objects

Scene objects are introduced to make the scene in the software closer to the real scenario, which facilitates the robot path planning. For specific operations, please refer to [Configure Scene Objects](#).

## Configure the Tool

The end tool should be imported and configured so that its model can be displayed in the 3D simulation area and used for collision detection. For specific operations, please refer to [Configure the Tool](#).

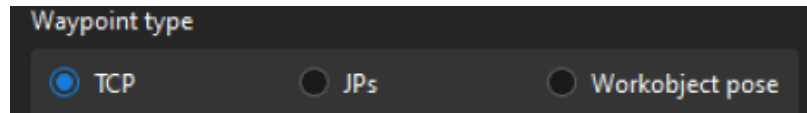
## Adjust the Workflow

The workflow refers to the robot motion control program created in Mech-Viz in the form of a flowchart. After the scene objects and end tools are configured, you can adjust the workflow.

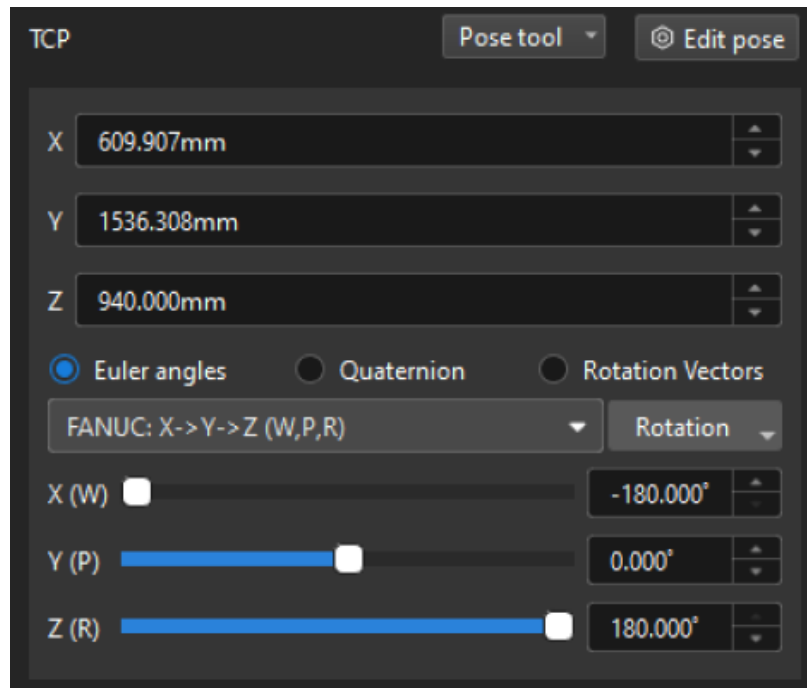
In the introductory stage, you only need to adjust the **Above-Bin Fixed Waypoint before Picking** and **Above-Bin Fixed Waypoint after Picking** Steps in the workflow, and there is no need to set parameters for other Steps.

### Adjust “Above-Bin Fixed Waypoint before Picking”

1. Select the **Above-Bin Fixed Waypoint before Picking** Step in the Workflow panel, and then set the **Waypoint type** to TCP on the right-hand side.

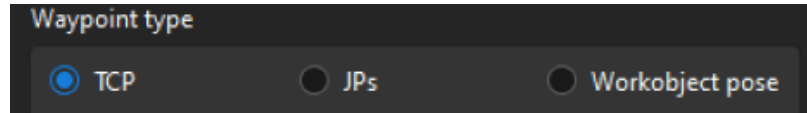


2. Enter the tool pose when the robot arrives above the bin before picking according to actual situation.

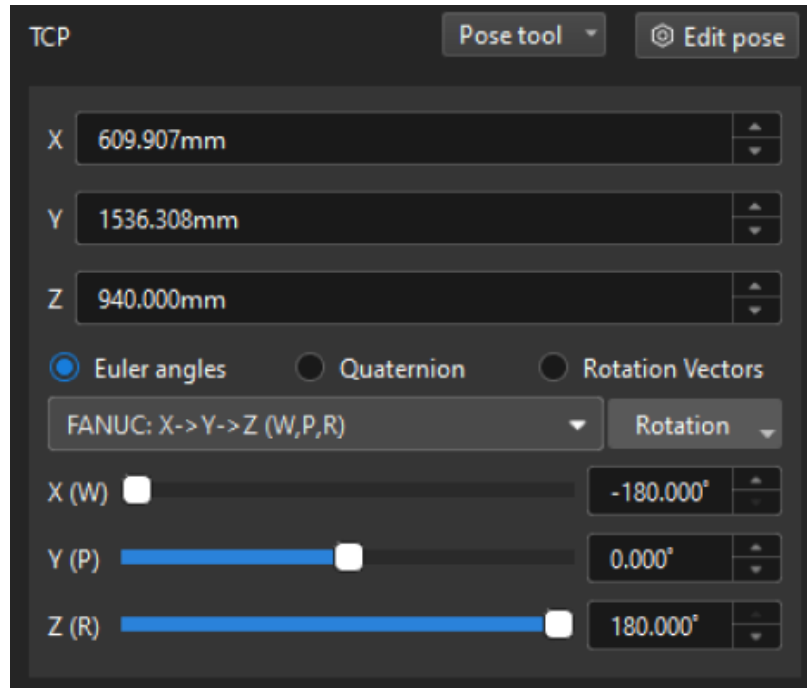


### Adjust “Above-Bin Fixed Waypoint after Picking”

1. Select the **Above-Bin Fixed Waypoint after Picking** Step in the Workflow panel, and then set the **Waypoint type** to TCP on the right-hand side.

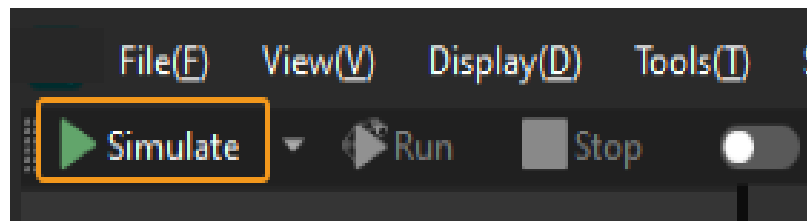


2. Enter the tool pose when the robot arrives above the bin after picking according to actual situation.



### Simulate and Run the Project

1. Click the [ Simulate ] button on the toolbar to simulate the Mech-Viz project.



2. If the simulation performance meets expectations, a Standard Interface program can be used to run the real robot.

Please refer to the picking example program and interface commands in [Standard Interface communication](#) to learn how to write the robot program.



It is recommended that the robot should move at a low speed and that you pay attention to the robot motion trajectory. In an emergency, press the emergency stop key on the teach pendant.

So far, you have learned how to get started with the path planning.

### 2.1.3. Troubleshooting

This section introduces the common problems, possible causes, and solutions for the neatly

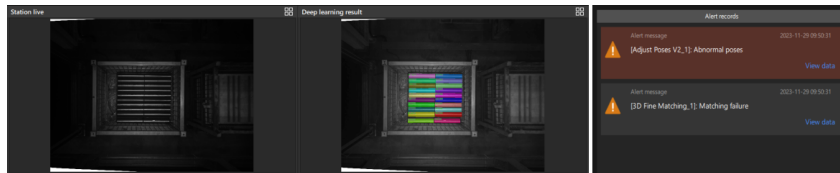


arranged cylindrical shaft loading solution.

### Problem 1: 3D Matching Failure with Abnormal Output Poses.

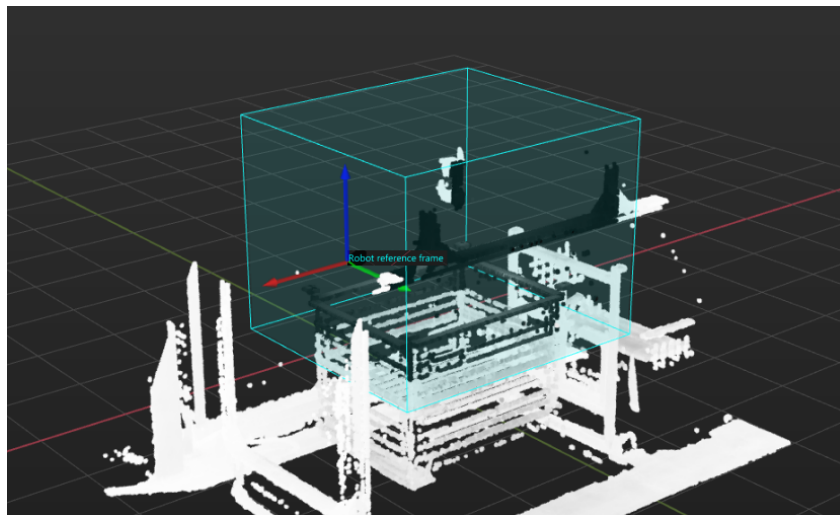
#### Symptom

The “Station live” in the production interface showed that there were workobjects, and the “Deep learning result” was normal (as shown in the left figure below), but Mech-Vision project did not output recognition results, resulting in an alarm message saying matching failure and abnormal poses (as shown in the right figure below).



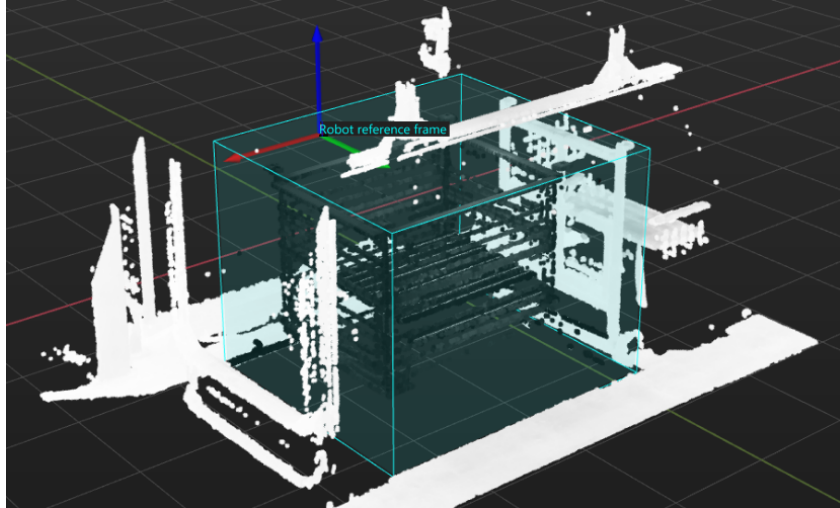
#### Possible Cause

The 3D ROI setting in the Point Cloud Preprocessing Procedure was incorrect as it did not cover the entire bin.



#### Solution

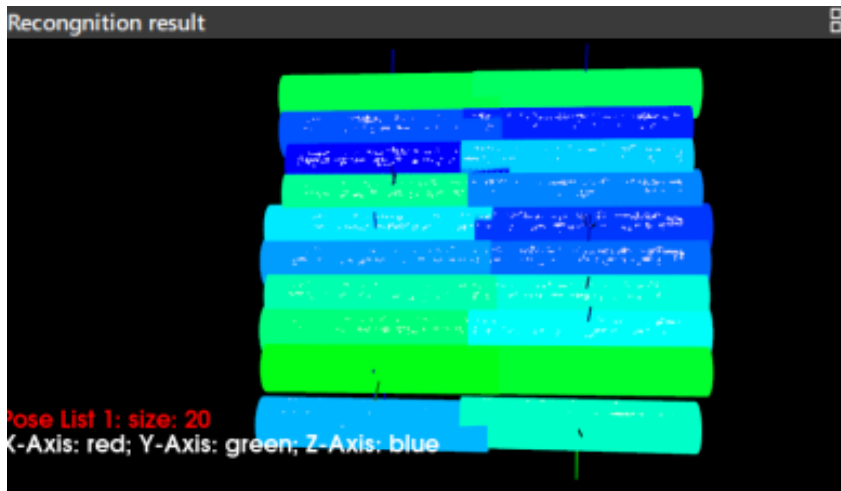
Reset 3D ROI according to actual situation. Make sure that the green box encompasses the whole bin with a certain margin, and that the green box does not contain other interfering point clouds.



### Problem 2: Abnormal Vision Recognition Results

#### Symptom

The “Recognition result” in the production interface showed overlapping workpieces and a mismatch between the sizes of the color point cloud model and the white workpiece point cloud.



#### Possible Cause







Incorrect production recipe was used in the production interface. For example, the current workobject model should use production recipe 1, but production recipe 2 was applied in actual use.

Production recipes							
Recipe ID	Recipe name	Status	Source	Last production time	Creator	Last modified	Operation
1	Cylindrical_Shfts_01	Idle	New workpiece	2023-11-16 10:43:47.200	none	2023-11-14 15:45:25.806	
2	Cylindrical_Shfts_02	Applied	New workpiece	2023-11-28 11:44:58.440	none	2023-11-14 15:45:45.974	

#### Solution

Make certain of the currently used workobject model, and then apply correct production recipe. For example, the currently used workobject model is model 1, then you should apply production recipe

1 that corresponds to workobject model 1.

Production recipes							
Recipe ID	Recipe name	Status	Source	Last production time	Creator	Last modified	Operation
1	Cylindrical_Shfts_01	Applied	New workpiece	2023-11-28 11:45:03.968	none	2023-11-14 15:45:25.806	  
2	Cylindrical_Shfts_02	Idle	New workpiece	2023-11-28 11:44:58.440	none	2023-11-14 15:45:45.974	  

### Problem 3: Abnormal Masks Obtained from Deep Learning

#### Symptom

The “Deep learning result” in the Production Interface showed mask abnormalities.



#### Possible Causes

- The setting of deep learning recognition region (2D ROI) was incorrect.



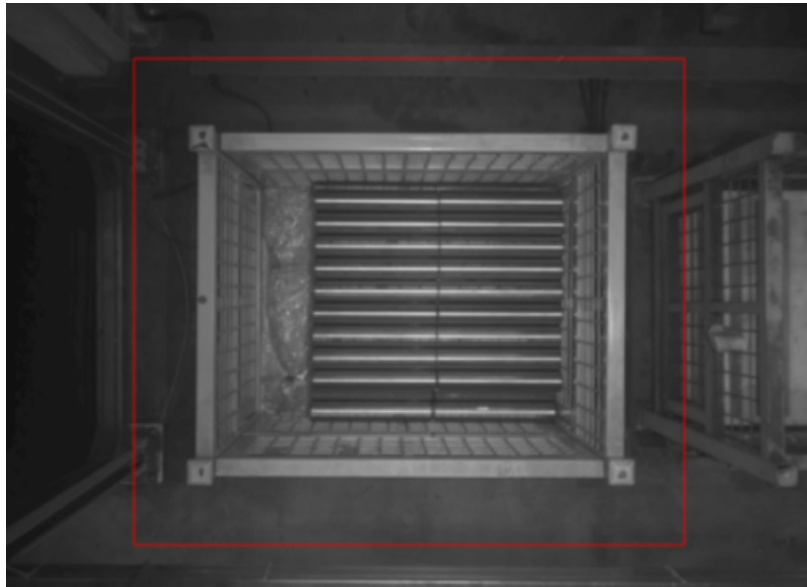
- When acquiring a 2D image, the exposure time was not set properly, resulting in the 2D image being too bright or too dark.



- A stable recognition of the current workobject using the deep learning model was not available.

### Solutions

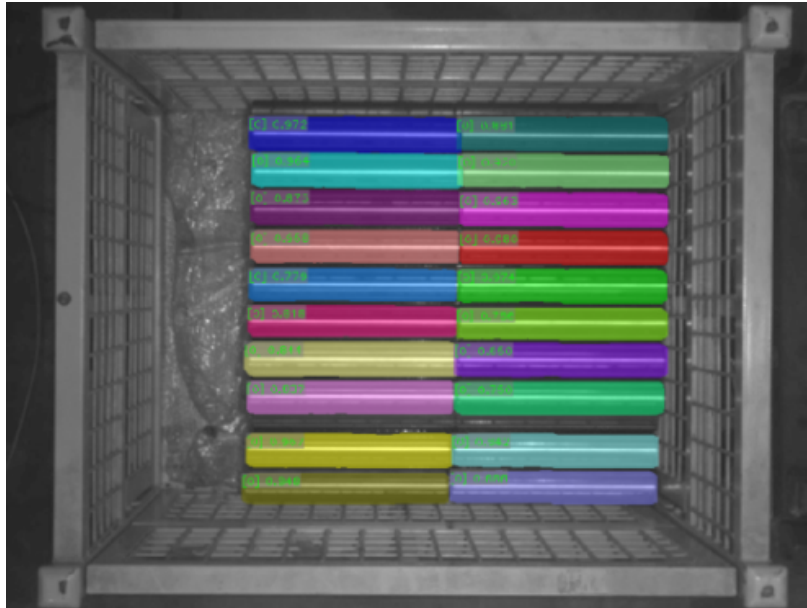
- Reset 2D ROI. Ensure that the set ROI enclose the entire upper surface of the bin and there are as few interfering points in the ROI as possible.



- Adjust the exposure time of the camera to ensure that the acquired 2D images are normal.



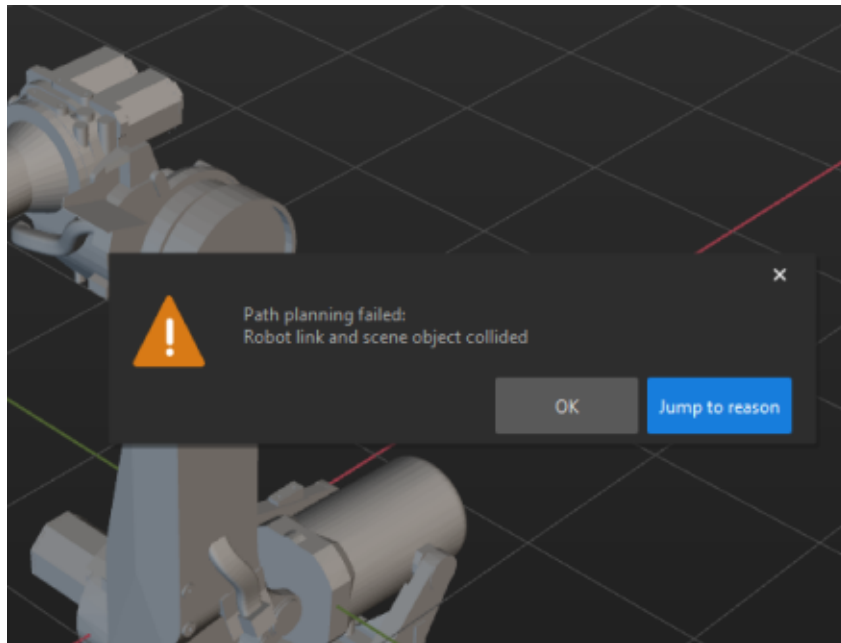
- Acquire shaft image data to iterate your deep learning model. A normal deep learning recognition is shown in the figure below.



#### Problem 4: Path Planning Failure Resulting in Robot Colliding with Scene Object

##### Symptom

When using Mech-Viz to run the project, you were informed that “the path planning fails, and there is a collision with the scene object.”



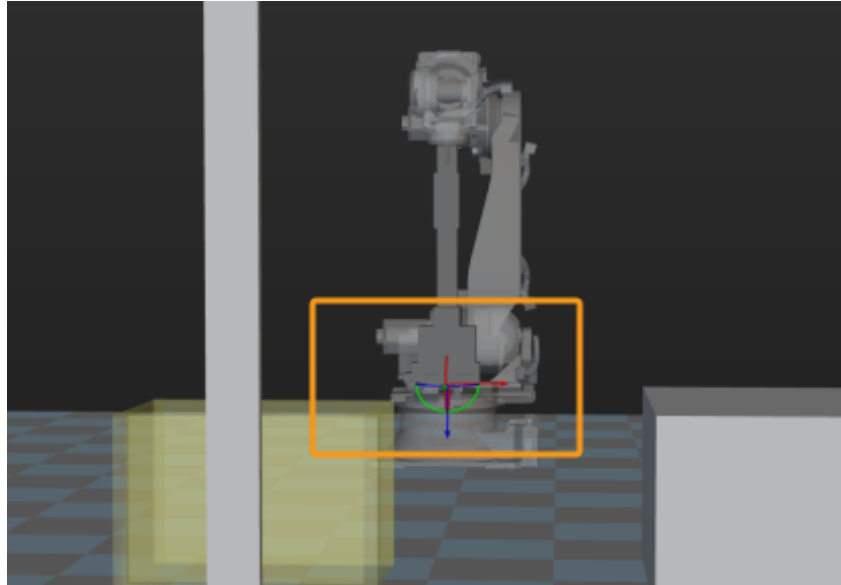
##### Possible Cause

The waypoints were not set up properly.

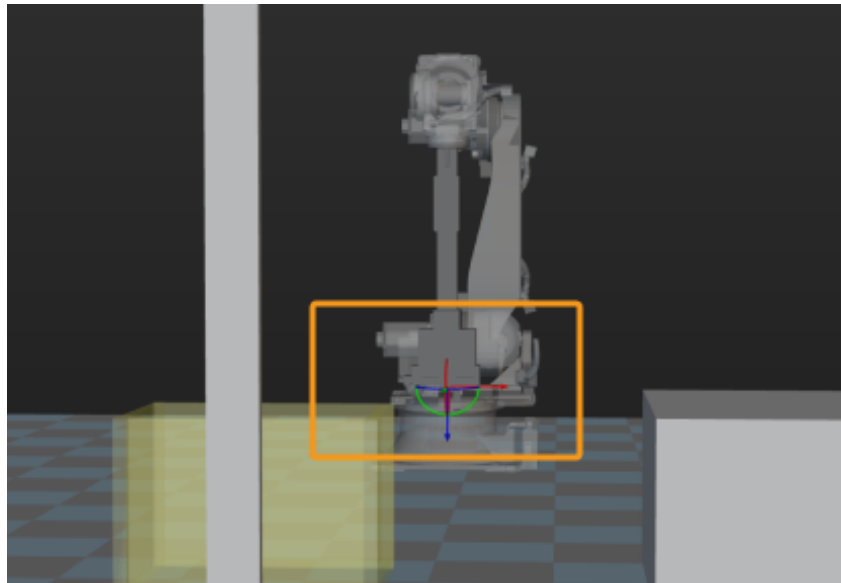
## Solution

Review the plan history to check at which Step the collision occurred and then adjust the waypoints according to the site layout.

For example, in the **Above-Bin Fixed Waypoint after Picking** Step, the robot collides with the bin, as shown in the following figure.



Then you should adjust the **Above-Bin Fixed Waypoint after Picking** Step to set the corresponding waypoints above the bin, as shown in the following figure.



## 3. Palletizing & Depalletizing

### 3.1. Single-Case Carton Depalletizing

#### Overview

Single-case carton depalletizing solution refers to the depalletizing of a single type of cartons on a pallet. The cartons used are regular cartons with a standard rectangular upper surface.

This solution is suitable for single-case carton depalletizing. It uses deep learning to identify the center of the highest layer carton and segment the individual carton mask, and then calculates and outputs the carton poses and dimensions.



#### Reading Guide

Check the contents below to learn about the basics of the single-case carton depalletizing solution as well as learn how to get started and troubleshoot.

No.	Section	Description
1	<a href="#">Basics</a>	The applicability, unsupported functions and technical specifications of the single-case carton depalletizing solution.
2	<a href="#">Getting Started</a>	Entry-level instructions for the single-case carton depalletizing solution.
3	<a href="#">Troubleshooting</a>	Common problems and corresponding solutions for the single-case carton depalletizing solution.

#### 3.1.1. Basics

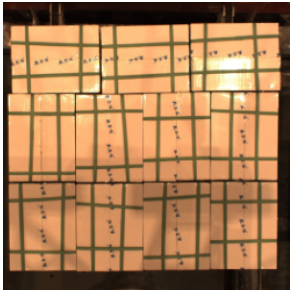

This section introduces the basic information about the single-case carton depalletizing solution, including the application scope, unsupported functions, and technical specifications.

#### Application Scope

This section introduces the application scope of the single-case carton depalletizing solution from the aspects of carton types, project requirements, carton surface features, etc.





### Carton Types

The table below illustrates the solution’s applicability to carton types.

In Scope	Illustration	Out of Scope	Illustration
Regular cartons with a standard rectangular upper surface		Flattened irregularly rectangular cardboards, waste cartons, etc.	

### Project Requirements



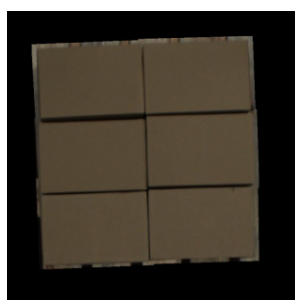

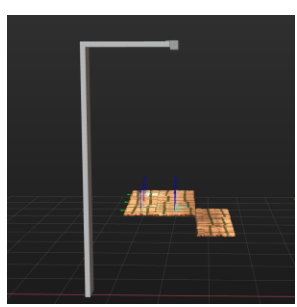
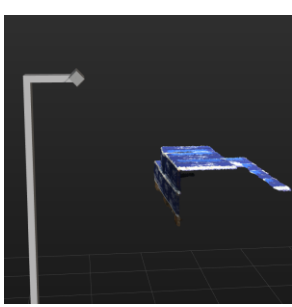
The table below illustrates the solution’s applicability to project requirements.

In Scope	Illustration	Out of Scope	Illustration
Single-case carton depalletizing		Mixed-case carton depalletizing	
Single-case carton palletizing		Mixed-case carton palletizing	

### Carton Surface Features



The table below illustrates the solution’s applicability to carton surface features.



In Scope	Illustration	Out of Scope	Illustration
<p>Carton edges are clear. The carton's surface color can be monochromatic or plain, and the surface can have patterns, texts, strapping, or tapes.</p> <p><b>Carton Placement</b></p> <p>The table below illustrates the solution's applicability to carton placement.</p>		<p>It is challenging to clearly distinguish whether there is only one carton or there are multiple cartons. For example, the cases when the carton is divided by distinct patterns or stripes, or when the cartons are closely placed together.</p>	
In Scope	Illustration	Out of Scope	Illustration
<p>Individual cartons are of moderate size, namely that each carton occupies an appropriate proportion in the camera's field of view.</p>		<p>The size of individual cartons is too large, occupying the entire field of view of the camera, which may impact the effectiveness of recognition based on deep learning.</p>	
<p>The camera is horizontally placed within the camera's field of view, and the angle between the carton and the camera ranges from 0° to 45°.</p>		<p>The camera is inclined within the camera's field of view, and the angle between the carton and the camera is greater than 45°. This may lead to wrong deep learning-based recognition results.</p>	

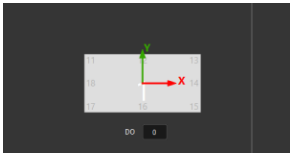


### Workobject Carriers

The table below illustrates the solution's applicability to object carriers.

In Scope	Illustration	Out of Scope	Illustration
Cartons are placed on a pallet.		Cartons are placed in four-wall bins, containers, or turnover boxes, or there are other obstructions around the carton pallet.	

### Vacuum Gripper Design

The table below illustrates the solution’s applicability to vacuum gripper design.

In Scope	Illustration	Out of Scope	Illustration
Single-section vacuum gripper		Multi-section vacuum gripper for picking objects in multiple rows	
Multi-section vacuum gripper for picking objects in a row			

### Dimensions

The table below illustrates the solution’s applicability to carton dimensions.

In Scope	Out of Scope
Cartons with known dimensions as accurate and real data need to be input into the software	Cartons with unknown dimensions

### Unsupported Functions

The single-case carton depalletizing solution does not support the following functions:

- Identification of the carton’s orientation. When the difference between the length and width of the carton is less than 20 mm, this solution does not support the identification of the carton’s orientation.
- Identification of the carton’s dimensions. When the carton is deformed, the vision recognition accuracy will be affected. Generally, the dimensions of a carton are recognized by scanning equipment.
- Detection of damage on the carton surface. This solution does not support the defect detection function.

### Technical Specifications

The technical specifications for the single-case carton depalletizing solution are as follows.

- Positioning accuracy:  $\pm 5$  mm
- Recognition success rate: more than 99%
- Execution time of vision system: within 4 s

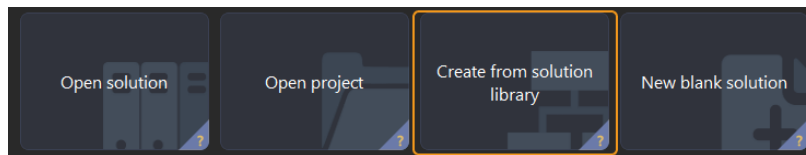
### 3.1.2. Getting Started

This section will introduce how to easily depalletize single-case cartons from a beginner’s perspective. The overall process is shown in the figure below.

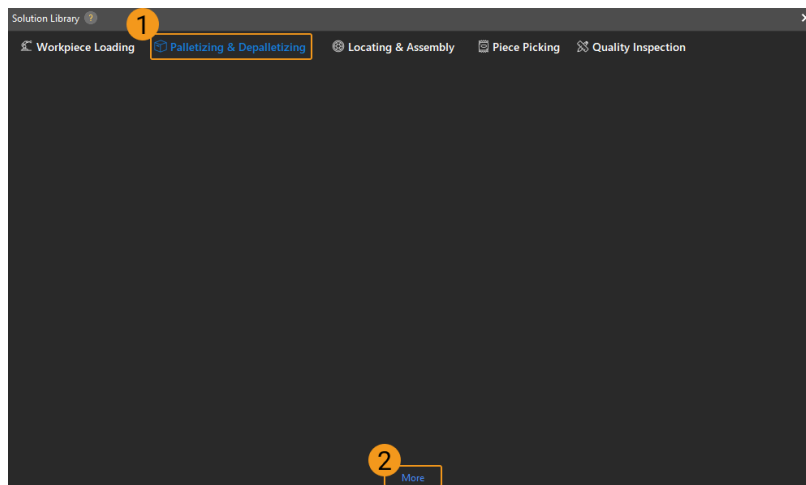


#### Acquire the Solution

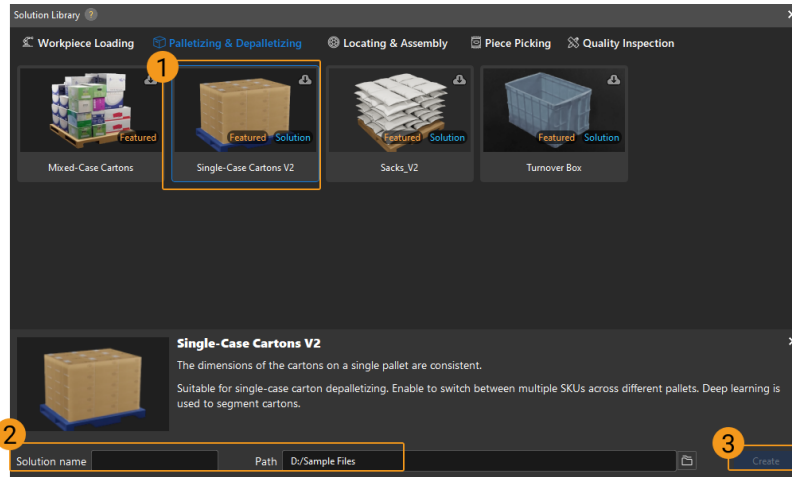
1. Open Mech-Vision.
2. In the Welcome interface of Mech-Vision, click [ **Create from solution library** ] to open the Solution Library.



3. Click Palletizing & Depalletizing in the Solution Library, then click on [ **More** ] at the bottom, and click [ **Yes** ] in the pop-up window.



4. After acquiring the solution resources, select **Single-Case Cartons V2**. Then, fill in the Solution name and Path at the bottom, and finally click [ **Create** ] to download the Single-Case Cartons V2 depalletizing solution.



Once the solution is downloaded, it will be automatically opened in Mech-Vision.

### Set up Communication

When deploying a Mech-Mind vision solution, you need to set up the communication between the Mech-Mind Vision System and the robot side (robot, PLC or host computer).

The Single-Case Carton depalletizing solution uses **Standard Interface Communication**. For specific operations, please refer to [Standard Interface Communication Configuration](#).

### Hand-Eye Calibration

Hand-eye calibration establishes the transformation relationship between the camera and robot reference frames. With this relationship, the object pose determined by the vision system can be transformed into that in the robot reference frame, which guides the robot to perform its tasks.

Please refer to [Hand-Eye Calibration Guide](#) to complete hand-eye calibration.



Every time the camera is mounted, or the relative position of the camera and the robot changes after calibration, it is necessary to perform hand-eye calibration again.

### Locate Cartons

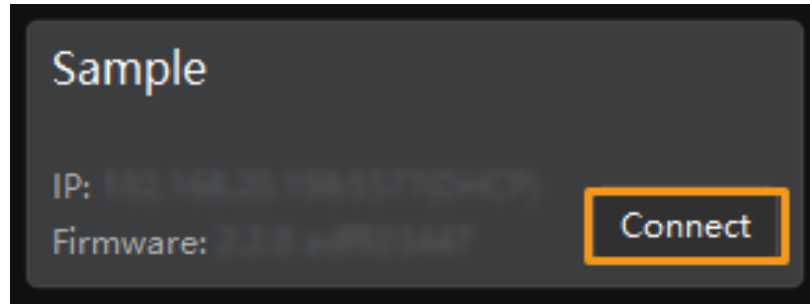
After completing the communication setup and hand-eye calibration, you can use Mech-Vision to locate cartons. The process for carton locating is shown in the figure below.



### Connect to the Camera and Capture Images

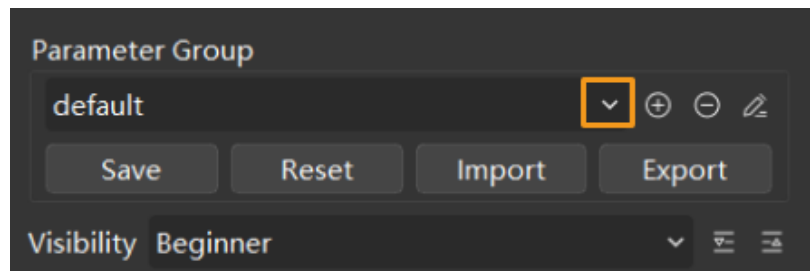
1. Connect to the camera.

Run Mech-Eye Viewer, find the camera to be connected, and then click [ **Connect** ].




2. Set parameter group.

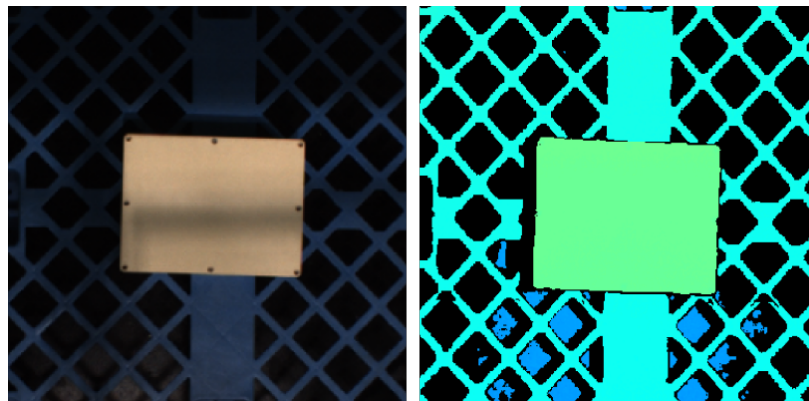
Click the dropdown arrow next to the Parameter Group on the right-hand side and select the Typical carton depalletizing.



In addition to the default parameter group, Mech-Eye Viewer will also display parameter groups of other typical solutions.

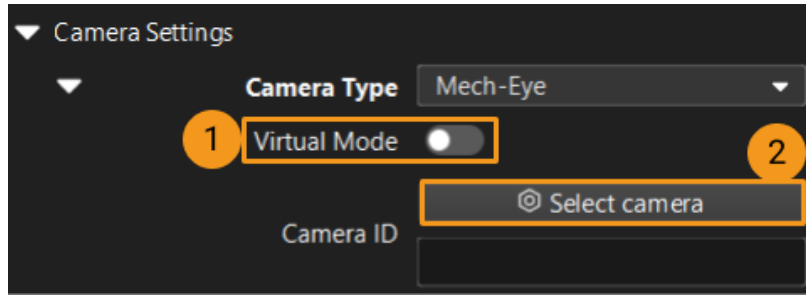
3. Capture image data.



After the camera is successfully connected and the parameter group is set, you can start to capture carton images. Click the  button on the top to capture a single image. At this time, you can view the captured 2D image and point cloud of the carton. Ensure that the 2D image is clear, the carton point cloud is intact, and the edges are clear. The qualified 2D image and point cloud of the carton are shown on the left and right in the figure below respectively.

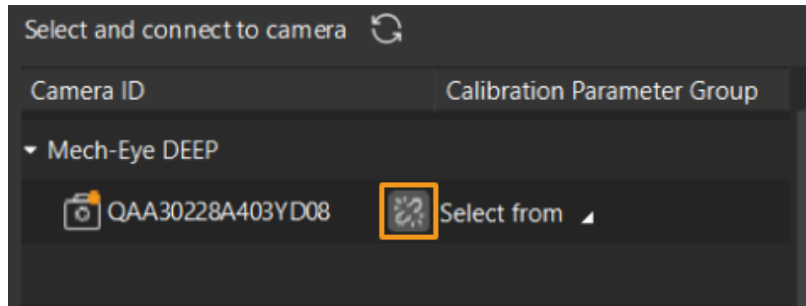


4. Add a camera in Mech-Vision.

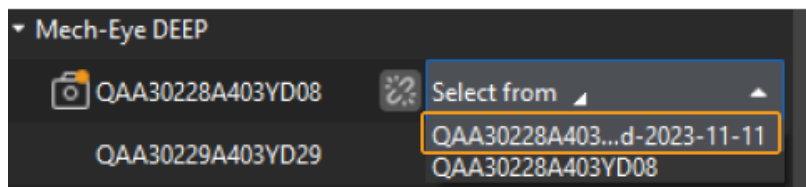
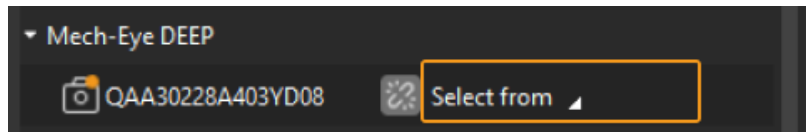
Click the **Capture Images from Camera** Step, disable the **Virtual Mode** option in the Step parameters tab, which is located in the lower right corner of the interface, and then click **[ Select camera ]**.




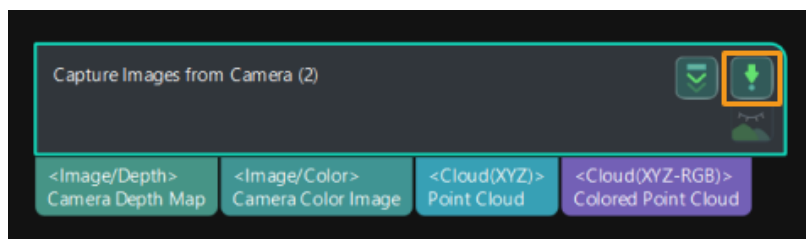
In the pop-up window, click the  button on the right of the camera serial number. When the button turns into , the camera is connected successfully.



After that, you can click [ **Select from** ] and select the corresponding camera calibration parameter group, as shown below.



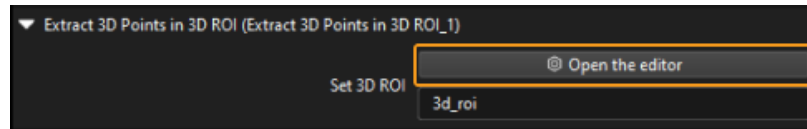
Once the above settings are complete, you can connect to a real camera. Other parameters can remain at their default values. Click the  button on the right of the “Capture Images from Camera” Step to run this Step. If no error message occurs, the camera is connected successfully and images can be captured normally.



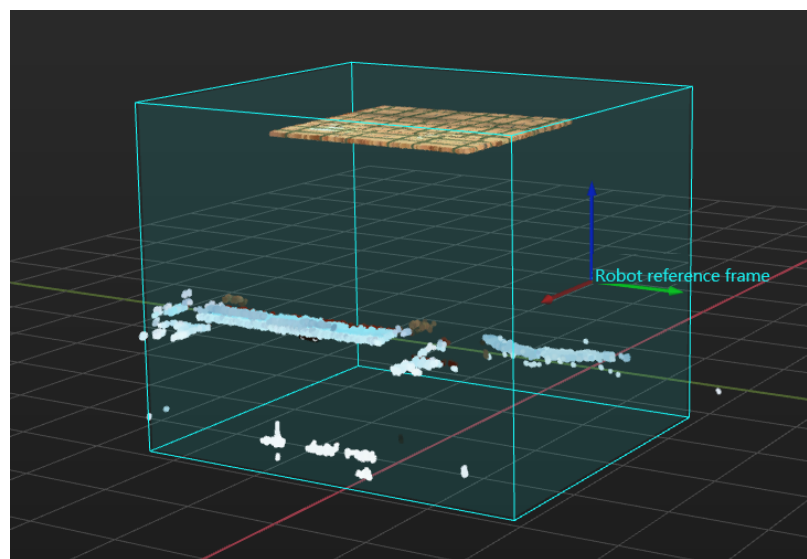
## Get Highest-Layer Cartons

### Set 3D Region of Interest (ROI)

1. Select the Procedure(Point Cloud Preprocessing & Get the Mask of the Highest Layer), then click the [ Open the editor ] button in the "Step Parameters" tab to open the Set 3D ROI window.

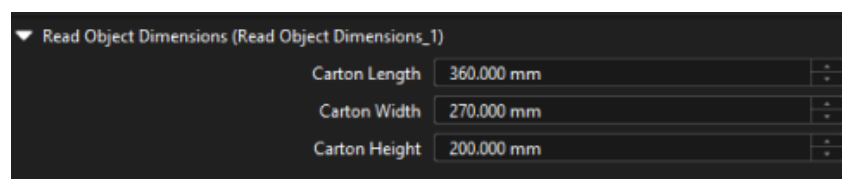


2. In the "Set 3D ROI" window, drag the default generated 3D ROI in the point cloud display area to a proper position. Make sure that the highest and lowest areas of the carton stack are within the green box at the same time, and that the green box does not contain other interfering point clouds, as shown in the following figure.



### Set Box Size

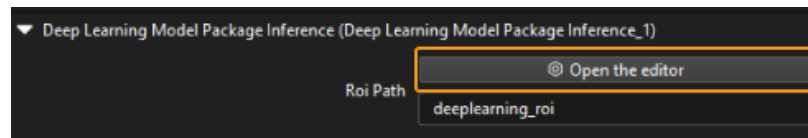
Select the Point Cloud Preprocessing & Get the Mask of the Highest Layer Procedure, then fill in the Box Length, Box Width, Box Height in sequence.



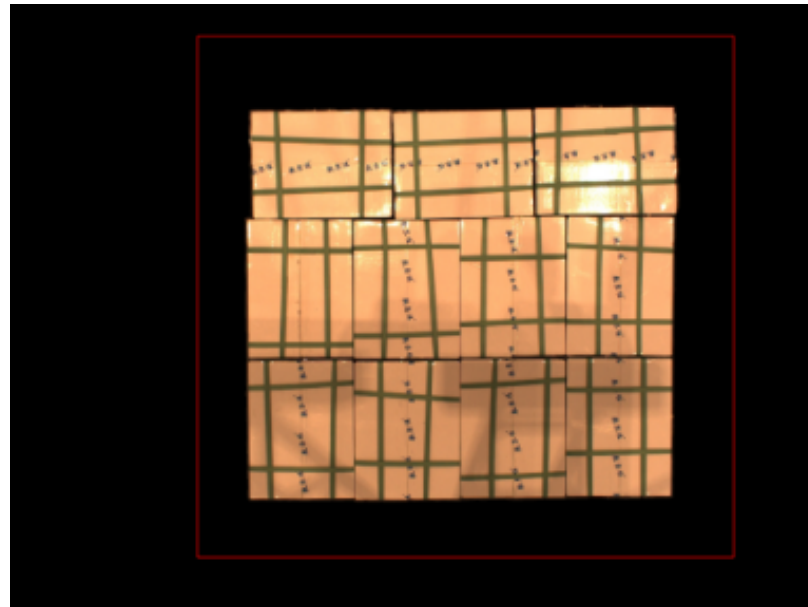
This Procedure extracts the point clouds of the highest layer cartons according to the height of these cartons. If the **Box Height** you set is greater than that, it will lead to an error in the point cloud extraction of the highest layer cartons.

### Segment Individual Cartons

1. Select the Segment Masks of Individual Cartons Using Deep Learning Procedure, then click the [ Open the editor ] button next to ROI Path to open the Set ROI window.



- Set the 2D ROI on the "Set ROI" panel. The 2D ROI needs to cover the highest-layer cartons, leaving an appropriate margin of about one-third, as shown in the figure below.



### Calculate Carton Poses and Dimensions

The **Calculate Carton Poses** Procedure is used to calculate the poses and dimensions of cartons. There is no need to set parameters for this Procedure.

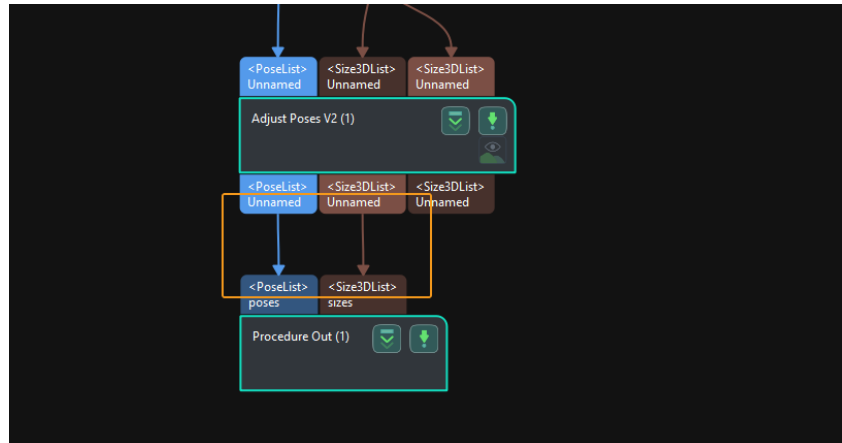
### Adjust Carton Poses

The **Adjust Poses V2** Step is used to transform carton poses from the camera reference frame to the robot reference frame, adjust pose orientations, sort poses, and filter unqualified poses. There is no need to set parameters for this Procedure.

### Output Carton Poses

The **Procedure Out** Step is used to output carton poses and dimensions. Click the data flow to view the relevant data.

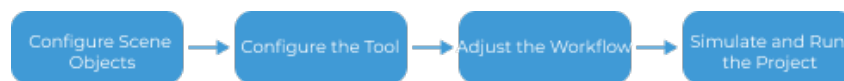




So far, you have learned how to get started with carton locating.

## Path Planning

After the carton locating is complete, you can use Mech-Viz for path planning. The process of path planning is shown in the figure below.



The Standard Interface communication is used for path planning in the single-case carton depalletizing solution. For more information about the path planning under the Master-Control communication, please download the [Viz\\_Single\\_Case\\_Cartons.zip](#).

### Configure Scene Objects

Scene objects are introduced to make the scene in the software closer to the real scenario, which facilitates the robot path planning. For specific operations, please refer to [Configure Scene Objects](#).

### Configure the Tool

The end tool should be configured so that its model can be displayed in the 3D simulation area and used for collision detection. For specific operations, please refer to [Configure the Tool](#).

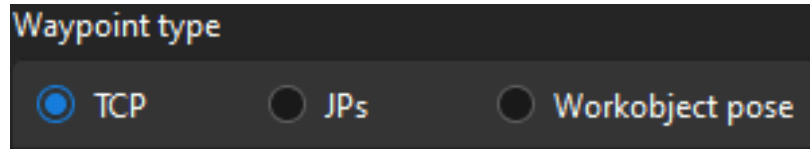
### Adjust the Workflow

The workflow refers to the robot motion control program created in Mech-Viz in the form of a flowchart. After the scene objects and end tools are configured, you can adjust the workflow.

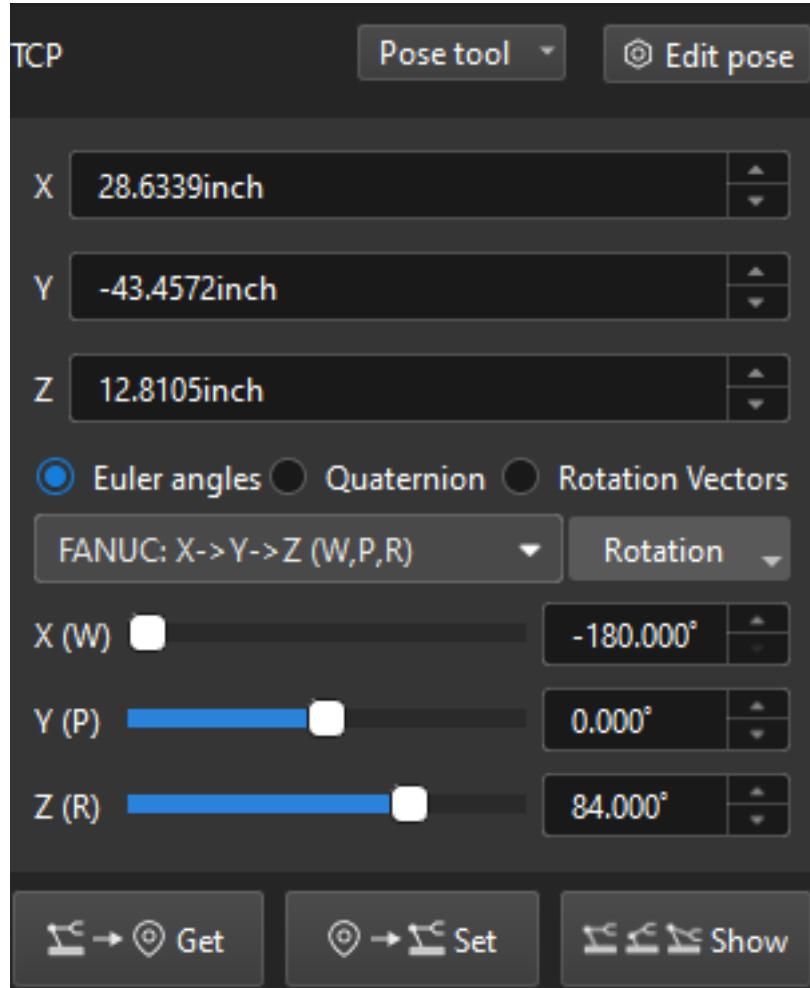
In the introductory stage, you only need to adjust the **Home Point** Step in the workflow, and there is no need to set parameters for other Steps.

### Set the Robot Home Position

1. Select the **Home Point** Step in the workflow panel, set the **Waypoint type** to TCP on the right-hand side.

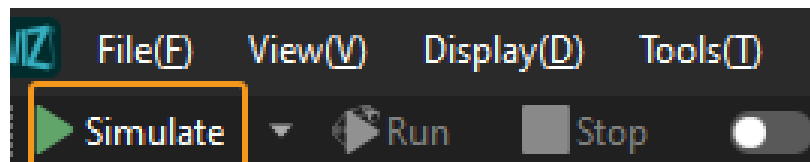


- Set the TCP according to the actual situation.



### Simulate and Run the Project

- Click the [ **Simulate** ] button on the toolbar to simulate the Mech-Viz project.



- If the simulation performance meets expectations, a Standard Interface program can be used to run the real robot.

Please refer to the picking example program and interface commands in [Standard Interface communication](#) to learn how to write the robot program.



It is recommended that the robot should move at a low speed and that you pay attention to the robot motion trajectory. In an emergency, press the emergency stop key on the teach

pendant.

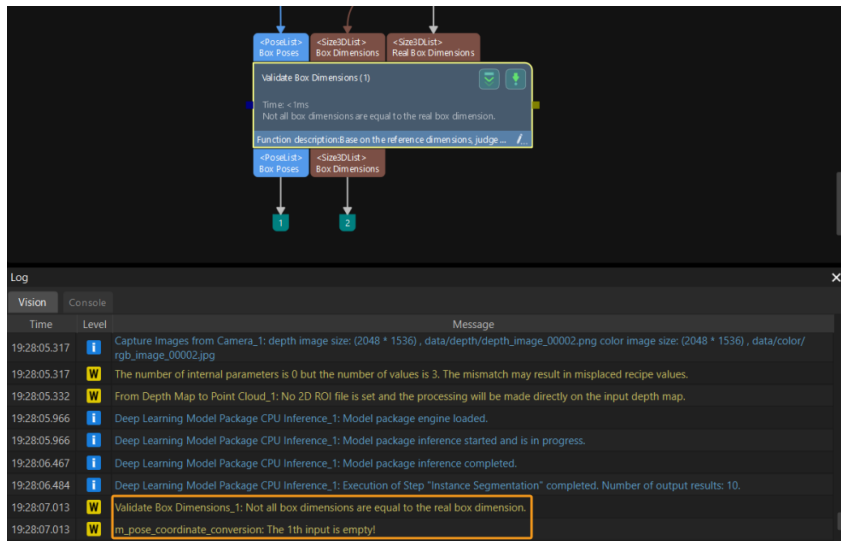
So far, you have learned how to get started with the path planning.

### 3.1.3. Troubleshooting

#### Problem 1: Failure to Locate the Cartons, Resulting in No Output from the Mech-Vision Project

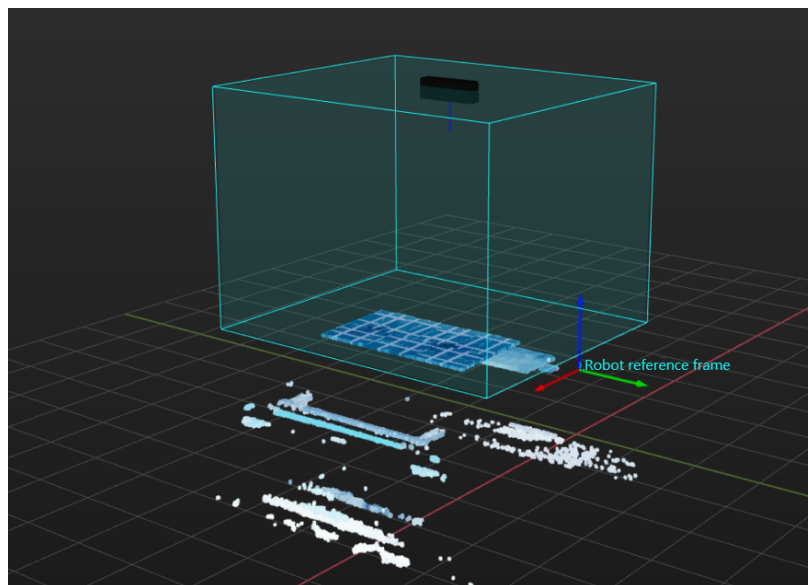
##### Symptom

The cartons are not located successfully, and there is no output from the Mech-Vision project, resulting in unpicked cartons on site.

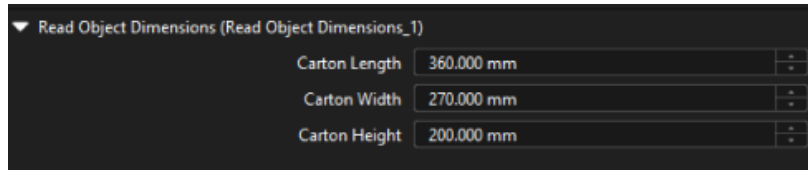


##### Possible Causes

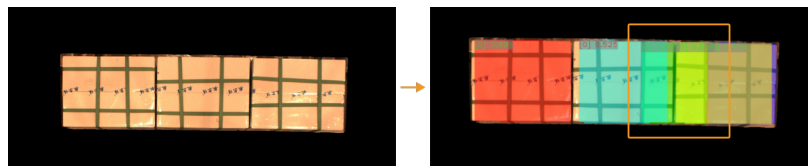
- Due to incorrect setting of 3D ROI, the carton(s) is beyond the 3D ROI. Hence, no result can be output from the Mech-Vision project.



- In the **Point Cloud Preprocessing & Get the Mask of the Highest Layer** Procedure, the carton dimensions entered in the Step Parameters panel differ significantly from the recognized carton dimensions, making dimension validation impossible and resulting in failure to locate the carton.

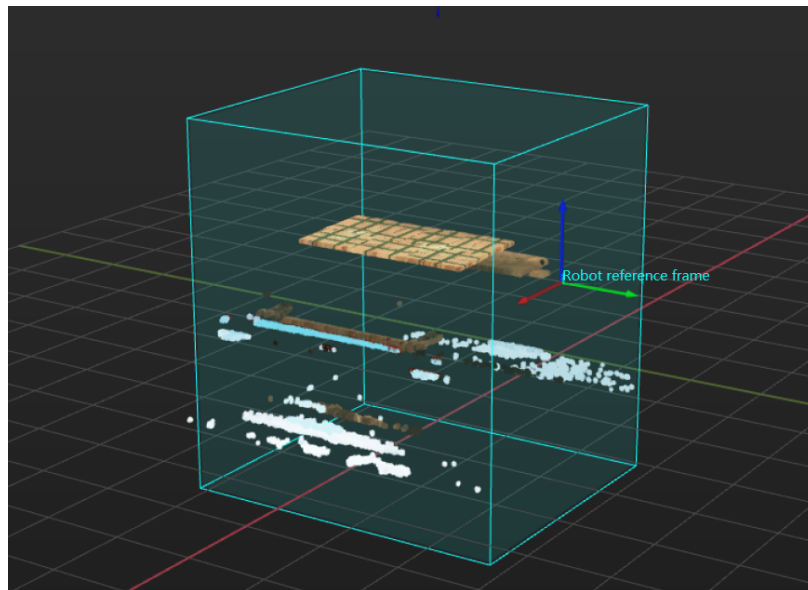


- Deep learning failed to correctly segment masks of individual cartons, making dimension validation impossible in the subsequent processing and resulting in failure to locate the carton.

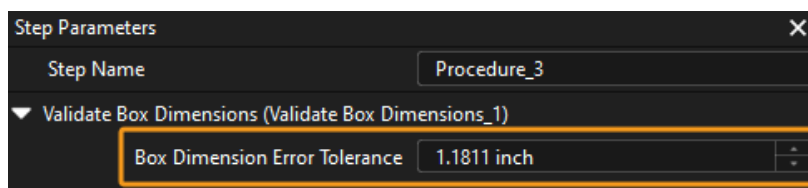


### Solutions

- Reset 3D ROI based on workstation layout and pallet pattern dimensions, so that the cartons will be within the ROI.



- Measure the carton dimensions and compare to the entered dimensions. If the difference is huge, you can adjust the parameters under **Read Object Dimensions** in the Step Parameters panel of the **Point Cloud Preprocessing & Get the Mask of the Highest Layer** Procedure to reset the carton dimensions. If the difference is small, you can appropriately increase the value of the **Box Dimension Error Tolerance** parameter in the **Calculate Carton Poses** Procedure.



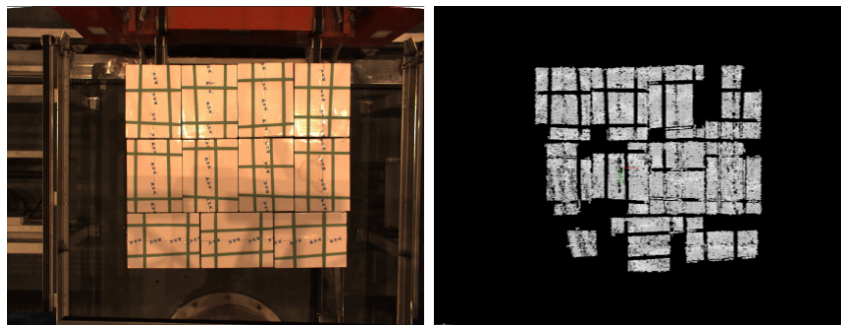
- Double-click the **Segment Masks of Individual Cartons Using Deep Learning Procedure**, check the visualized output of the **Deep Learning Model Package Inference Step**, and ensure that the visualized output is normal, as shown in the figure below. If the visual output results are abnormal, please refer to [Problem 3](#).



## Problem 2: Poor Quality of Carton Point Cloud

### Symptom

The obtained carton point cloud was in poor quality. As shown below, the image on the left is the 2D image captured by the camera, and the image on the right is the point cloud of the carton in poor quality.



### Possible Causes

- The ambient light on site was too strong.
- The setting of camera 3D exposure parameter was not proper.

### Solutions

- When the ambient light is too strong, it is recommended to use longer exposure time to enhance the image quality. When the ambient light is too strong and it is not effective to increase the exposure time, you can consider shading the station so that the ambient light intensity at the station remains constant.
- As the captured image tends to be too bright when the carton is white, it is recommended to use shorter exposure time; as the captured image tends to be too dark when the carton is

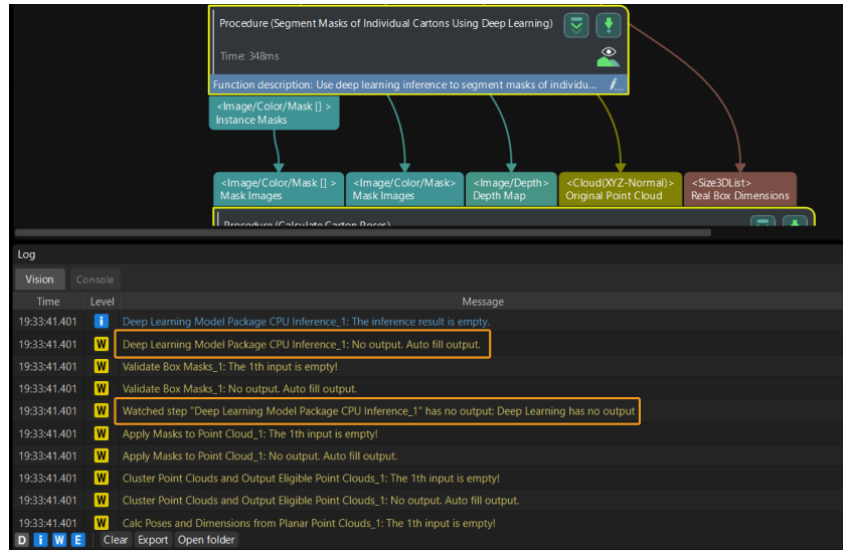
black, it is recommended to use longer exposure time.

- When there are cartons with different colors, it is recommended to capture images using the method of combining shorter exposure time and longer exposure time.

### Problem 3: Poor Quality of Recognition Result from Deep Learning

#### Symptom

The performance of deep learning recognition was poor, resulting in no output from the “Segment Masks of Individual Cartons Using Deep Learning” Procedure.

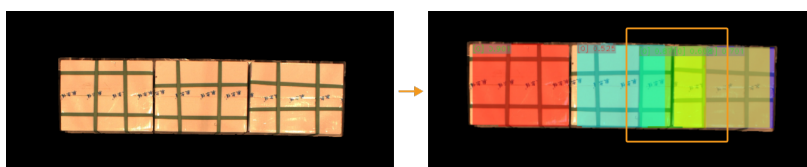


#### Possible Causes

- When capturing 2D images, the camera exposure time and white balance settings were not proper. As shown below, the image on the left is captured when the camera exposure time is normal, and the image on the right is captured when that is abnormal.



- The deep learning recognition region (2D ROI) was not set.
- Masks of individual cartons obtained by using deep learning are abnormal. In this case, you need to iterate your deep learning model.



### Solutions

- First, you need to confirm whether the 2D image has problems such as overexposure, underexposure, shadows, abnormal white balance, etc. If the above problems exist, you need to adjust the camera exposure time and white balance to ensure that the captured 2D image is normal. After ensuring that the 2D image is normal, if the recognition performance is still poor, please refer to the next part.
- Reset 2D ROI.
- Acquire carton image data to iterate your deep learning model.

### Problem 4: Dresspack Wrapping and Excessive Rotation During Path Planning

#### Symptom

When using Mech-Viz for path planning, the robot encounters problems such as dresspack wrapping and excessive rotation.

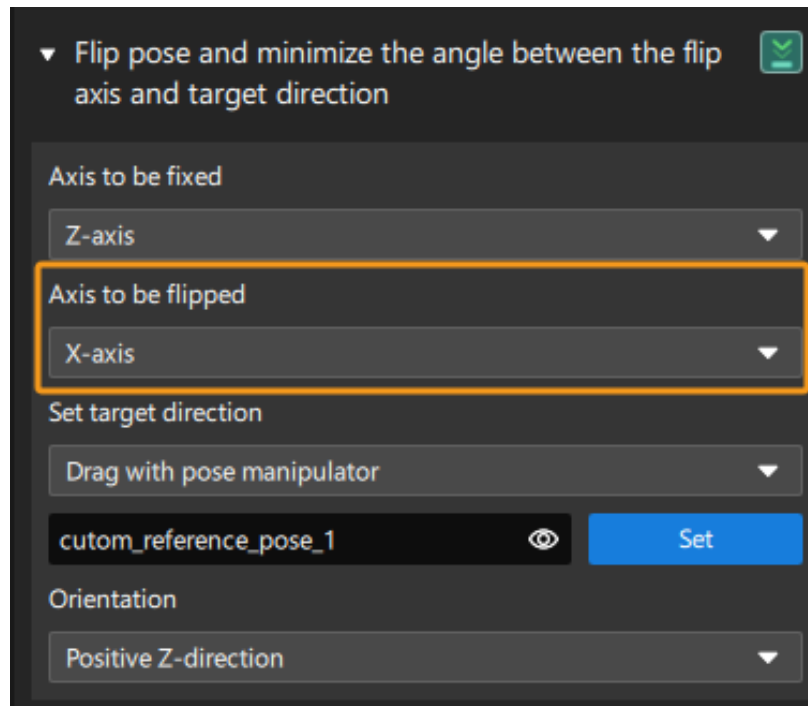
#### Possible Cause

The orientation of the carton poses output by Mech-Vision project was not proper.

### Solutions

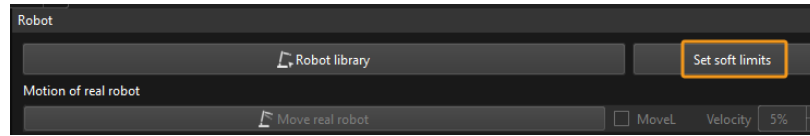
- Adjust the Z-axis of the carton poses to a specific orientation in the Mech-Vision project.

In the Custom mode of the Pose Adjustment Tool, add the **Flip pose and minimize the angle between the flip axis and target direction** option. This allows flipping the X or Y-axis of the pose to the target direction, so as to control the rotation angle of the gripper within the range of 0 to 90°.

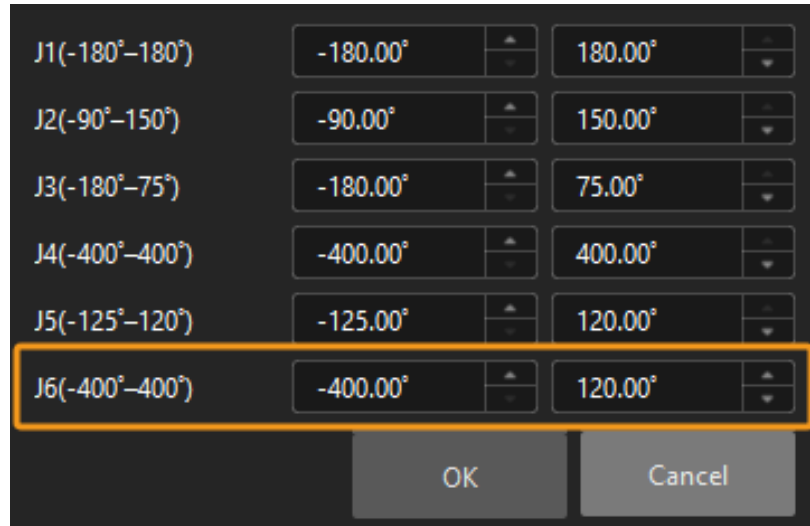


- Set soft limits.

Click [ Set soft limits ] in the Robot Functional Panel of Mech-Viz.



Manually rotate the sixth axis of the real robot, test the limit rotation angle of the sixth axis in the positive and negative directions, and then set the appropriate soft limits with reference to the limit rotation angle of the sixth axis.

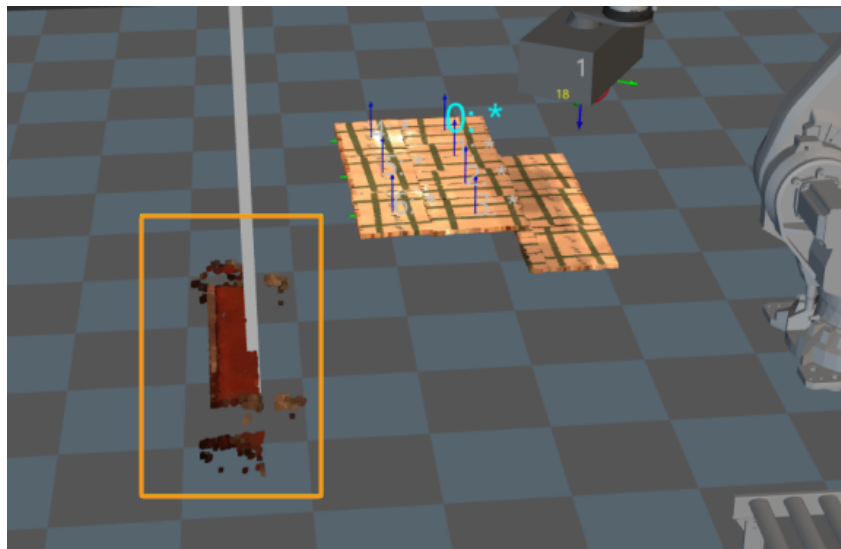


After finishing the above operations, the picking path for the robot is shown as below.

### Problem 5: Too Much Point Cloud Noises in Mech-Viz or Presence of Scene Point Cloud Unrelated to Picking

#### Symptom

When using Mech-Viz for path planning, there are too much point cloud noises or unnecessary scene point clouds in the 3D simulation area of Mech-Viz.



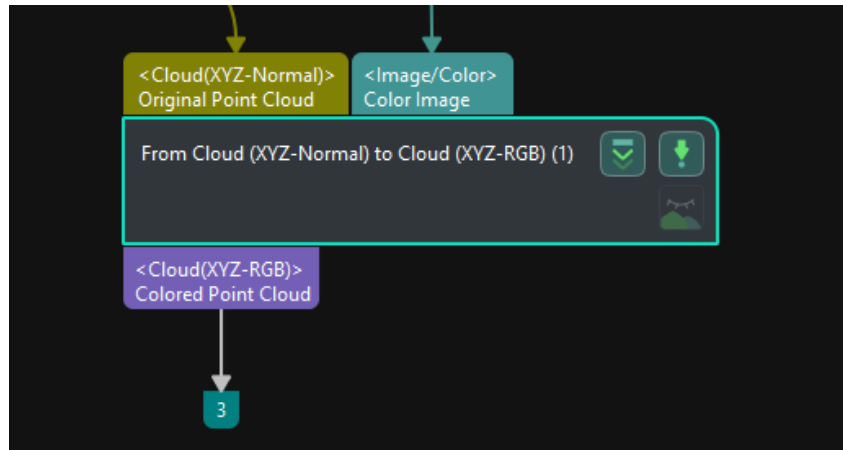


### Possible Cause

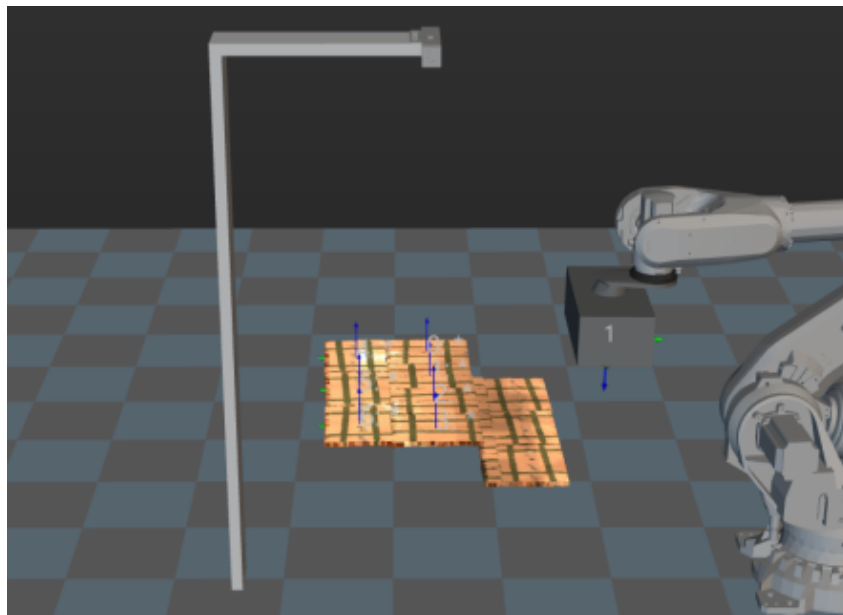
Point cloud preprocessing was not applied in the point clouds sent to Mech-Viz.

### Solution

In the **From Cloud (XYZ-Normal) to Cloud (XYZ-RGB)** Step, the preprocessed point cloud is input into the first input port. Then connect the **Send Point Cloud to External Service** Step to send the preprocessed point cloud to Mech-Viz.



After the point cloud preprocessing, the point cloud in the Mech-Viz 3D simulation area is shown in the figure below. The scene point cloud that is unrelated to picking is removed.

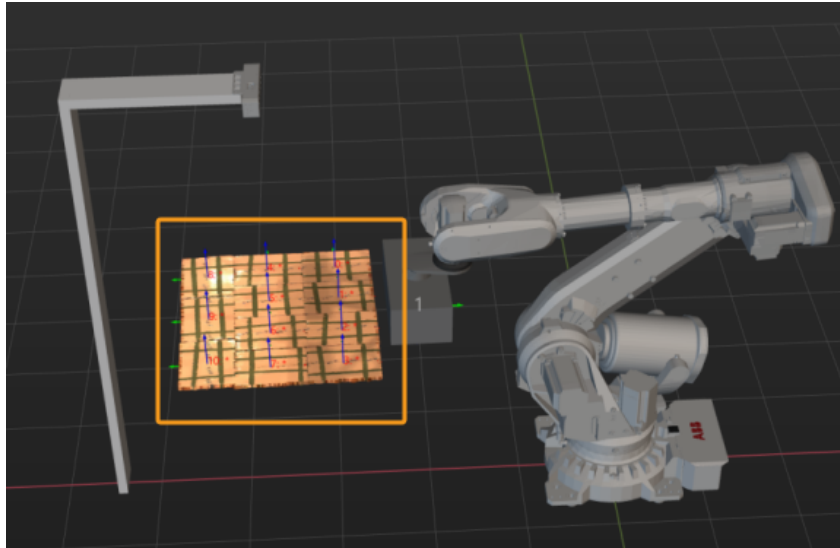


### Problem 6: Path Planning Failed Due to Abnormal Waypoints

#### Symptom

When using Mech-Viz for path planning, the waypoints (carton poses) were abnormal, and the path planning failed.

Take the following figure as an example. The pose numbers in deep red indicate that the waypoints are abnormal, leading to the path planning failure.



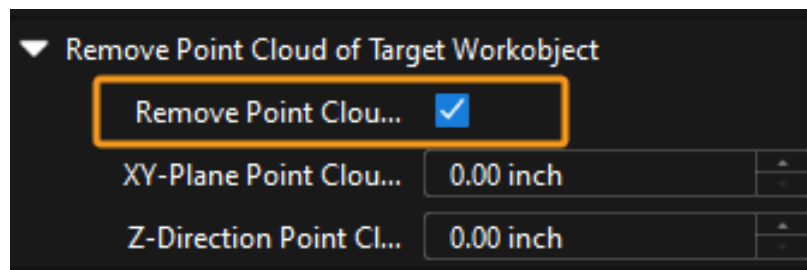
### Possible Causes

It could result from a collision, an unreachable waypoint, or other factors.

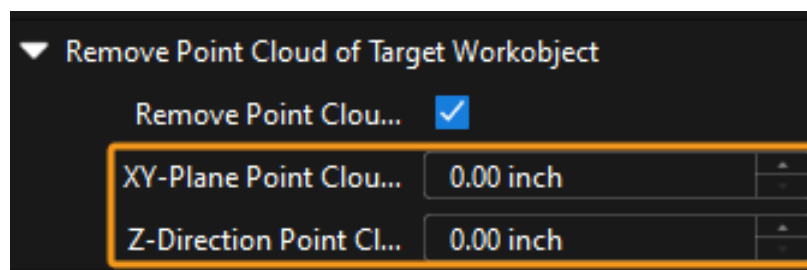
If all the poses turn red at the same time, it is most likely due to a point cloud collision.

### Solutions

- In the **Vision Move Step**, make sure to select the box of **Remove Point Cloud of Target Workobject** in the **Remove Point Cloud of Target Workobject** parameter group.



- In the **Vision Move Step**, check whether the parameter values of **XY-Plane Point Cloud Removal Range Expansion** and **Z-Direction Point Cloud Removal Range Expansion** are too small in the **Remove Point Cloud of Target Workobject** parameter group. If the parameter values are too small, increase the parameter values appropriately.

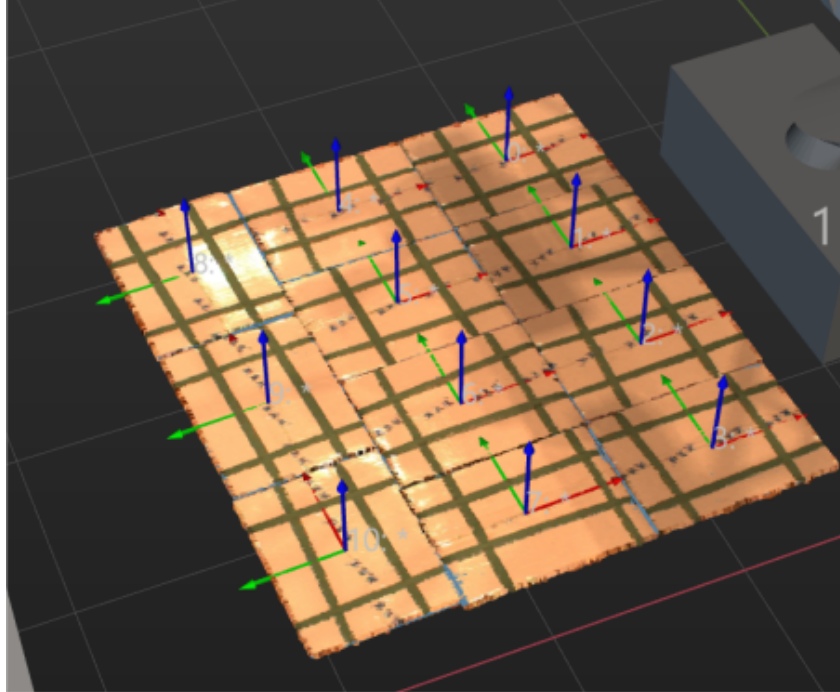


### Problem 7: Failure to Plan the Picking Path for the Robot

## Symptom

When using Mech-Viz for path planning, it fails to plan the picking path for the robot.

Take the following figure as an example. The carton pose numbers in grey indicate that the waypoints have not been planned in the motion path.

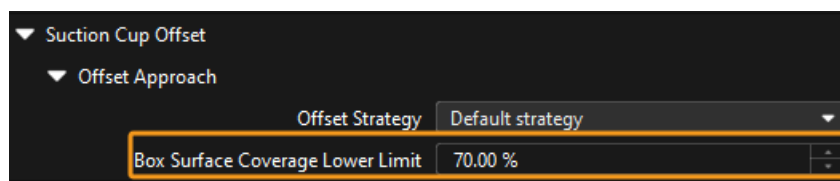


## Possible Cause

It may be caused by the incorrect setting of the **Vision Move Step**. If the **Box Surface Coverage Lower Limit** parameter is set incorrectly, that is, the vacuum gripper surface is smaller than that of the carton, it cannot cover the entire upper surface of the carton.

## Solution

Based on the ratio between the vacuum gripper surface area to carton surface area on-site, adjust the **Box Surface Coverage Lower Limit** parameter in the **Vision Move Step**.



## 3.2. Single-Case Sack Depalletizing

### Overview

Single-case sack depalletizing refers to the depalletizing of a single type of sacks on a pallet. In general, these sacks are neatly arranged woven bags, gunnysacks, paper bags, etc. They should have a nearly rectangular upper surface.

This solution is applicable to all kinds of regular sacks and has no special restrictions on the size,

color, and surface pattern of the sacks. In addition, deep learning algorithms are employed to recognize the size and center positions of the highest-layer sacks.



## Reading Guide

Check the contents below to learn about the basics of the single-case sack depalletizing solution as well as learn how to get started and troubleshoot.

No.	Section	Description
1	<a href="#">Basics</a>	The applicability, unsupported functions and technical specifications of the single-case sack depalletizing solution.
2	<a href="#">Getting Started</a>	Entry-level instructions for the single-case sack depalletizing solution.
3	<a href="#">Troubleshooting</a>	Common problems and corresponding solutions for the single-case sack depalletizing solution.

### 3.2.1. Basics



This section introduces the basic information about the single-case sack depalletizing solution, including the applicability, unsupported functions, and technical specifications.

#### Applicability

The applicability of the single-case sack depalletizing solution can be described from the aspects of sack types, project requirements, sack surface features, etc.

#### Sack Types

The table below illustrates the solution's applicability to sack types.

Feasible	Illustration	Not feasible	Illustration
<p>Neatly arranged woven bags, sacks, paper bags, etc. These sacks should have a nearly rectangular upper surface as in the case of ordinary plastic woven bags and kraft paper bags.</p>		<p>Randomly stacked, transparent, or overly small bags, such as snack bags and saline bags.</p>	



### Project Requirements



The table below illustrates the solution’s applicability to project requirements.

Feasible	Illustration	Not feasible	Illustration
<p>Single-case sack depalletizing</p>		<p>Multi-case sack depalletizing</p>	

### Sack Surface Features


The table below illustrates the solution’s applicability to sack surface features.

Feasible	Illustration	Not feasible	Illustration
<p>The edges of the sacks are clear so that they can be distinguished by deep learning. The sacks can be colored or monochromatic or have patterns or texts on their surface.</p> <p><b>Sack Placement</b></p> <p>The table below illustrates the solution's applicability to sack placement.</p>		<p>The edges of the sacks are not clear so they cannot be distinguished by deep learning. The sacks have complex surface patterns or are closely placed or stacked together, which may lead to unstable recognition performance.</p>	

Feasible	Illustration	Not feasible	Illustration
<p>The sack is placed horizontally in the camera's field of view, with a tilt angle of 0° to 45°.</p>		<p>The sack is placed at an angle of greater than 45° in the camera's field of view. This may lead to wrong deep learning-based recognition results.</p>	

### Workobject Carriers

The table below illustrates the solution's applicability to workobject carriers.

Feasible	Illustration	Not feasible	Illustration
<p>Sacks placed on a pallet</p>		<p>Sacks placed in a stack rack</p>	

### Dimensions

The table below illustrates the solution's applicability to sack dimensions.

Feasible	Not feasible
Because Mech-Vision requires the actual dimensions of the sacks to be input, only sacks with known dimensions can be recognized.	Because Mech-Vision requires actual sack dimensions to prevent incorrect recognition by deep learning, sacks with unknown dimensions are not suitable for recognition.

## Unsupported Functions

The single-case sack depalletizing solution does not support the following functions:

- Recognition of sack fronts and backs, sack orientations, and sack models. If you need to implement this function, there should be noticeable differences between the front and back features and differences in diverse orientation features and model features of the sacks. On this basis, it is necessary to obtain the color image of a single sack first and then use the object detection model to distinguish between the front and back of the sack and recognize the orientation of the sack mouth and the model of the sack.
- Recognition and grasping of the pallet. In addition to this solution, you need to build a pallet recognition project so as to achieve this purpose.
- Capturing a single image to achieve the picking of multiple objects with a dual gripper. For this function, it is essential to first recognize all the topmost sacks, perform a specific sorting of sack poses, and then send all the sack poses to the robot.
- Recognition of sack pallet patterns. For this function, it is necessary to identify all sacks in the top layer and define the possible pallet patterns beforehand. Then the pallet pattern can be determined according to the poses of the topmost sacks.
- Recognition of sack specifications. Sacks can hardly have a fixed shape, which may affect the vision recognition accuracy.

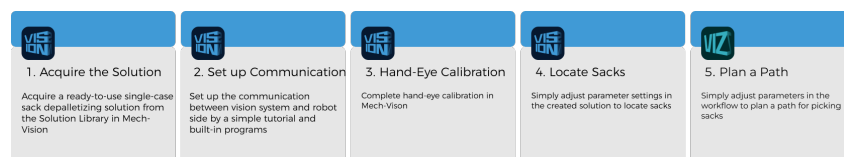
## Technical Specifications

The technical specifications for the single-case sack depalletizing solution are as follows.

- Positioning accuracy:  $\pm 20$  mm
- Recognition success rate: more than 99%
- Execution time of vision system: within 4 s

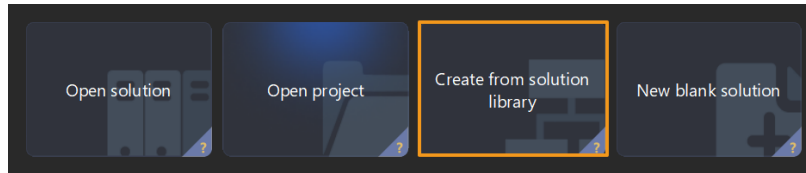
### 3.2.2. Getting Started

This section will introduce how to easily depalletize single-case sacks from a beginner's perspective. The overall process is shown in the figure below.

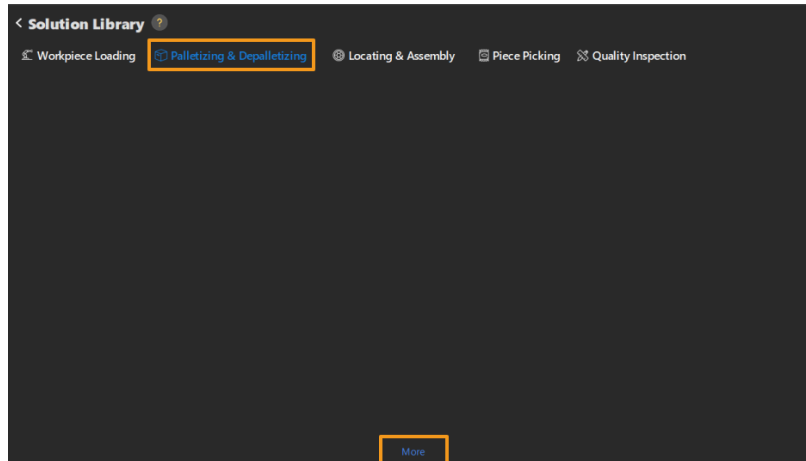


## Acquire the Solution

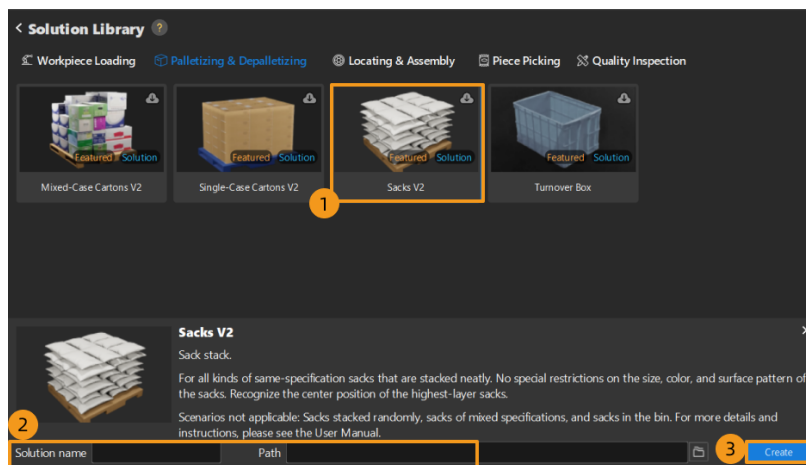
1. Open Mech-Vision.
2. In the welcome interface of Mech-Vision, click [ **Create from solution library** ] to open the **Solution Library**.



3. In the **Palletizing & Depalletizing** category, click [ **More** ] at the bottom, and then click [ **Yes** ] in the pop-up window.



4. After acquiring the solution resources, select **Sacks V2**. Then, enter the solution name and path at the bottom, and finally click [ **Create** ] to download the single-case sack depalletizing solution.



Once the solution is downloaded, it will be automatically opened in Mech-Vision.

### Set up Communication

When deploying a vision solution provided by Mech-Mind, you need to set up the communication between Mech-Mind Vision System and robot side (robot, PLC, or host computer).

The single-case sack depalletizing solution uses **Standard Interface** communication. For specific operations, please refer to [Set up Standard Interface Communication](#).



## Hand-Eye Calibration

Hand-eye calibration establishes the transformation relationship between the camera and robot reference frames. With this relationship, the object pose determined by the vision system can be transformed into that in the robot reference frame, which guides the robot to perform its tasks.

Please refer to [Hand-Eye Calibration Guide](#) to complete hand-eye calibration.



Every time the camera is mounted, or the relative position of the camera and the robot changes after calibration, it is necessary to perform hand-eye calibration again.

## Locate Sacks

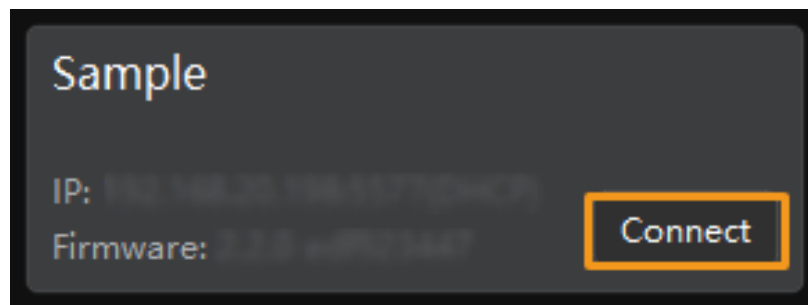
After communication setup and hand-eye calibration, you can use Mech-Vision to locate sacks. The workflow is shown in the figure below.



### Connect to the Camera and Capture Images

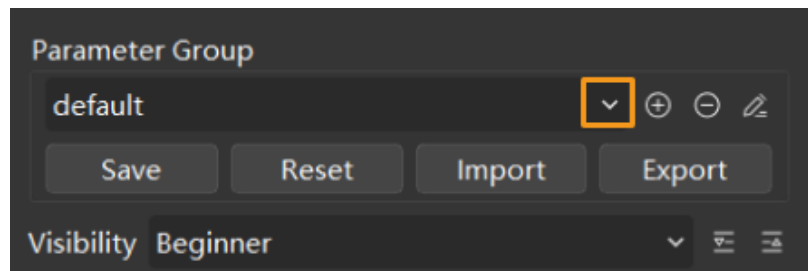
1. Connect to the camera.

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




2. Set the parameter group.

Select **Sack depalletizing** from the drop-down list under **Parameter Group**.

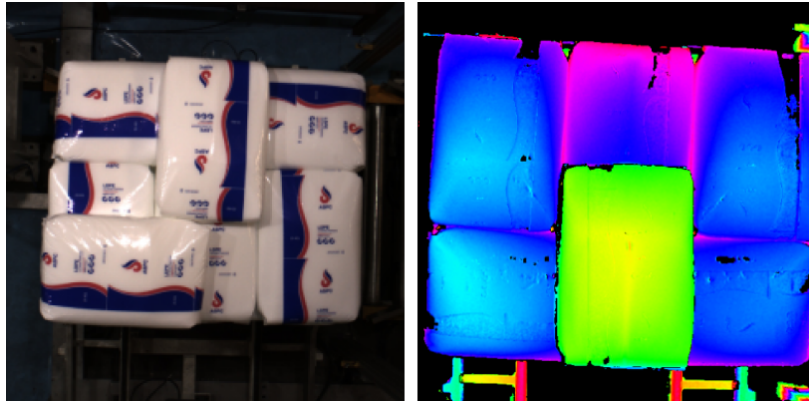


In addition to the default parameter group, Mech-Eye Viewer will also display parameter groups of other typical solutions.

3. Capture images.

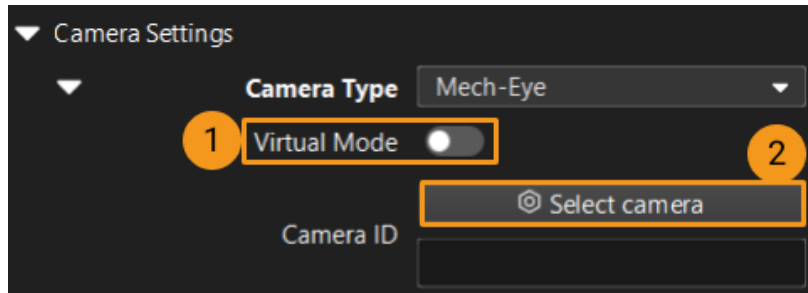
After the camera is successfully connected, and the parameter group is set, you can start capturing sack images. Click the  button on the interface top to capture an image. At this time, you can view the captured 2D image and point cloud of the sacks. Ensure that the 2D image is clear and that no points missing from the sack point cloud, and the edges are clear.



The qualified 2D image and point cloud of sacks are shown on the left and right in the figure below, respectively.

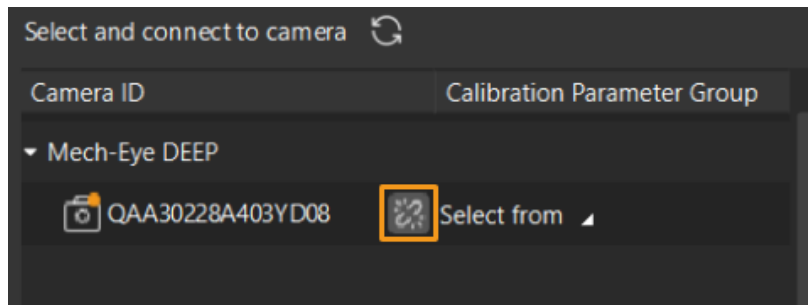


4. Add the camera in Mech-Vision.

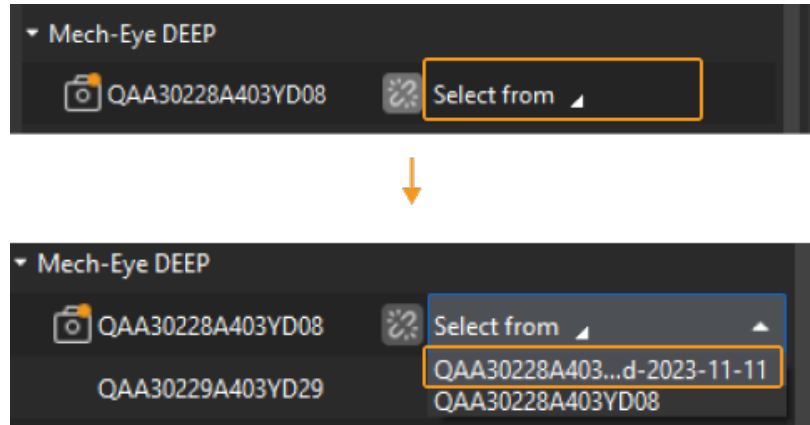
Click the **Capture Images from Camera** Step, then disable the **Virtual Mode** option from the Step Parameters panel, and click [ **Select camera** ].




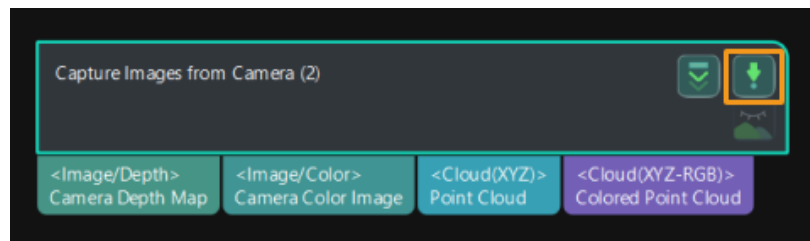
In the pop-up window, click the  button on the right of the camera serial number. When the button turns into , the camera is connected successfully.



After that, you can click [ **Select from** ] and select the corresponding calibration parameter group, as shown below.



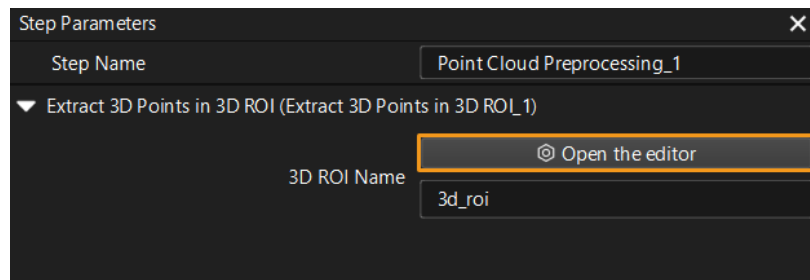
Once the above settings are complete, you can connect to a real camera. Other parameters can remain at their default values. Click the  button on the right of the “Capture Images from Camera” Step to run this Step. If no error message occurs, the camera is connected successfully and images can be captured normally.



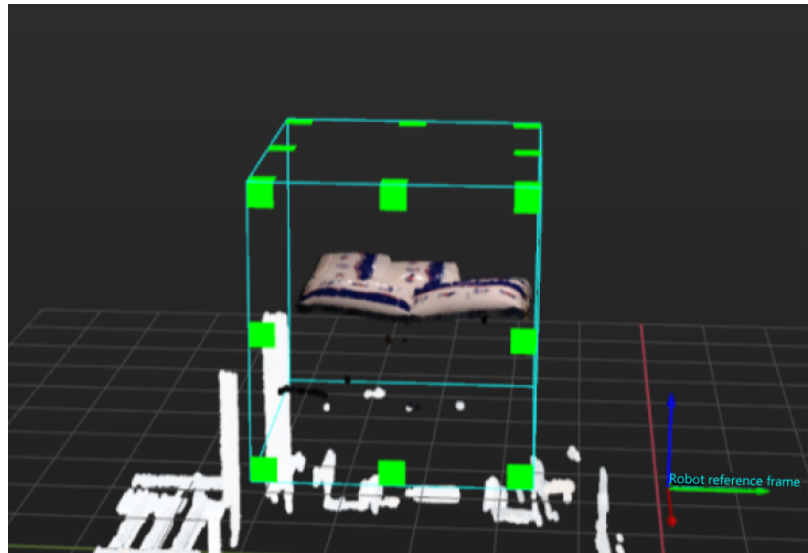
## Obtain Sack Point Cloud

### Set 3D ROI

1. Select the **Point Cloud Preprocessing** Procedure, then click the [ **Open the editor** ] button in the **Step Parameters** panel to open the **Set 3D ROI** window.

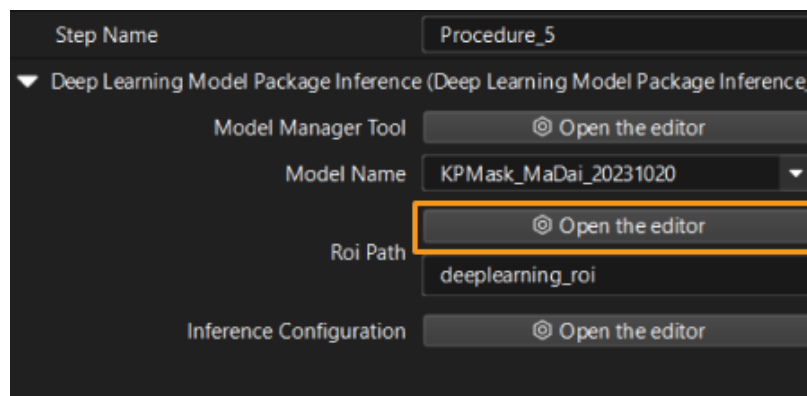


2. In the **Set 3D ROI** window, drag the default 3D ROI in the point cloud display area to a proper position. Make sure that the highest and lowest areas of the sack stack are within the green box and that the green box does not contain any other interfering point clouds, as shown in the following figure.



### Segment Individual Sacks

1. Select the **Segment Masks of Individual Sacks Using Deep Learning Procedure** and then click [ **Open the editor** ] button next to **Roi Path** to open the window of **Set ROI**.

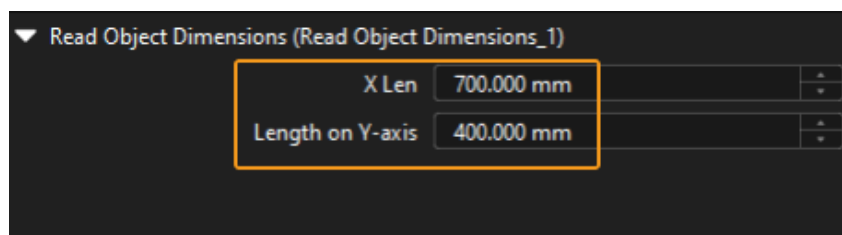


2. Set the 2D ROI in the **Set ROI** window. The 2D ROI needs to cover the highest-layer sacks, leaving an appropriate margin of about one-third, as shown in the figure below.



### Calculate the Pose of Individual Sacks

Select the **Recognize Center Poses of Sacks** Procedure and input the **Sack Length**, **Sack Width**, and **Sack Height** in the Step Parameters panel.

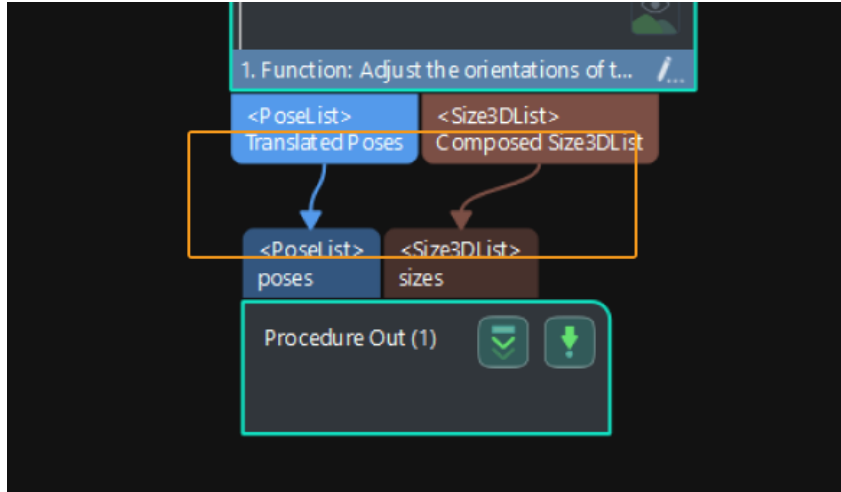


### Adjust Sack Poses

The **Adjust Poses** Procedure is used to transform sack poses from the camera reference frame to the robot reference frame, adjust pose orientations, sort poses, and filter out unqualified poses. There is no need to set parameters for this Procedure.

### Output Sack Poses

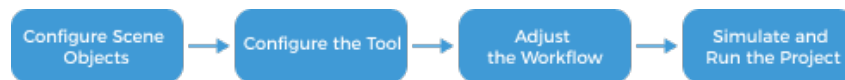
The **Procedure Out** Step is used to output sack poses and dimensions. Click the data flow to view the relevant data.



So far, you have learned how to get started with sack locating.

## Plan a Path

Given that the sacks have been located, you can use Mech-Viz for path planning. The process of path planning is shown in the figure below.



The Standard Interface communication is used for path planning in the single-case sack depalletizing solution. For more information on path planning under the Master-Control communication, please download the [Viz\\_Single\\_Case\\_Sacks.zip](#).

## Configure Scene Objects

Scene objects are introduced to make the scene in the software closer to the real scenario, which facilitates the robot path planning. For specific operations, please refer to [Configure Scene Objects](#).

## Configure the Tool

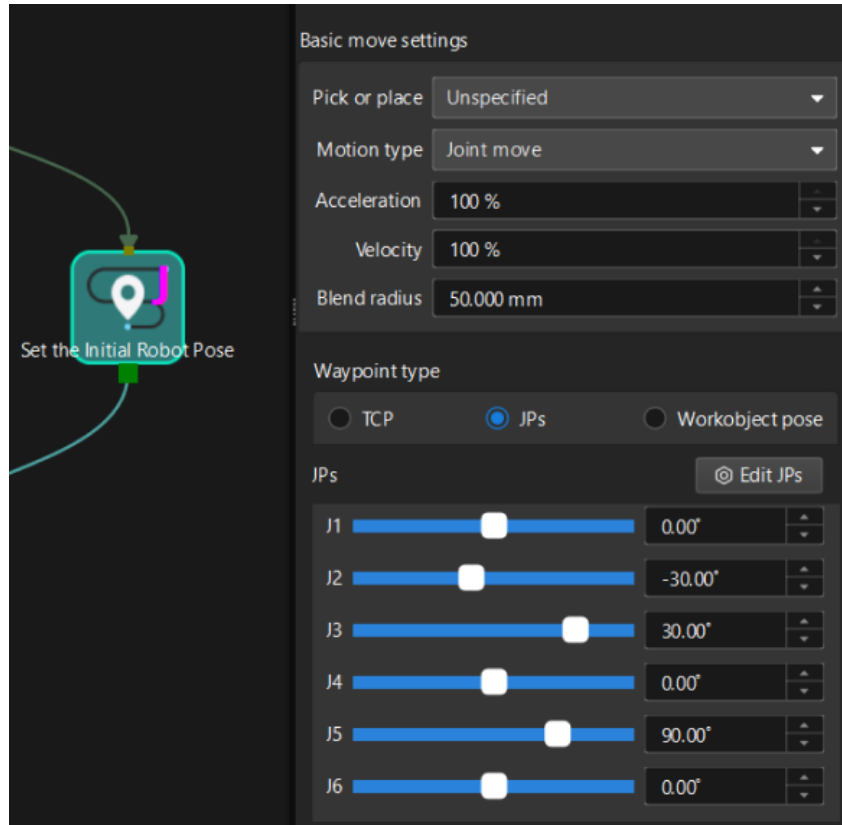
The tool should be imported and configured so that its model can be displayed in the 3D simulation area and used for collision detection. For specific operations, please refer to [Configure the Tool](#).

## Adjust the Workflow

The workflow refers to the robot motion control program created in Mech-Viz, taking the form of a flowchart. You can adjust the workflow upon the configuration of scene objects and the tool.

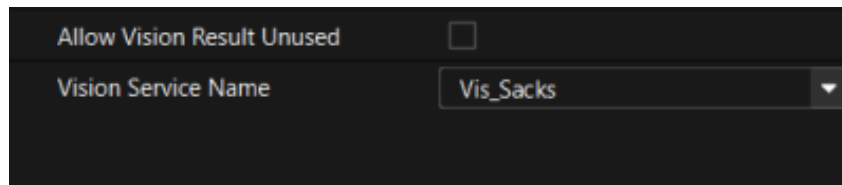
## Set the Initial Robot Pose

Move the robot to approach the object picking area. When the robot does not block the camera's FOV, set the JPs of the robot in the software according to those displayed on the robot teach pendant.



### Set Vision Service Name

Click the **Vision Look\_1** Step and select the corresponding vision project **Vis\_Sacks** in the drop-down list of **Vision Service Name**.



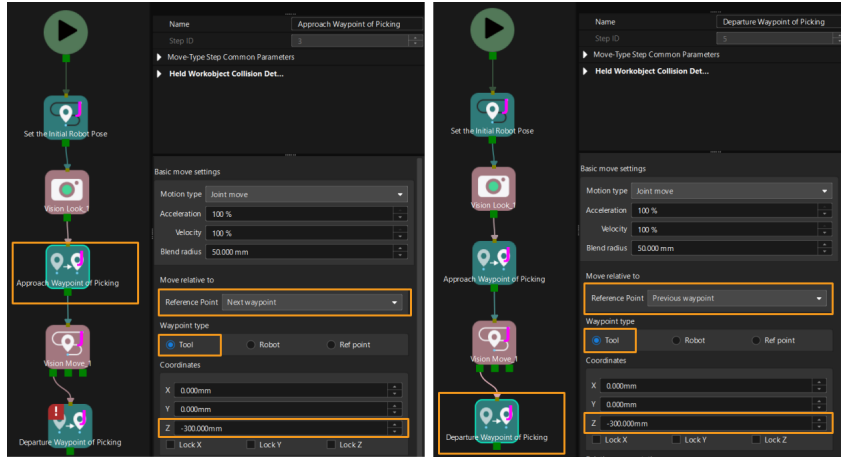
### Set Approach Waypoint and Departure Waypoint of Picking

Click the **Approach Waypoint of Picking** Step. Then, set the **Reference Point** under **Move Relative** to **Next** waypoint, the **Waypoint type** to **Tool**, and **Z** under **Coordinates** to **-300**.



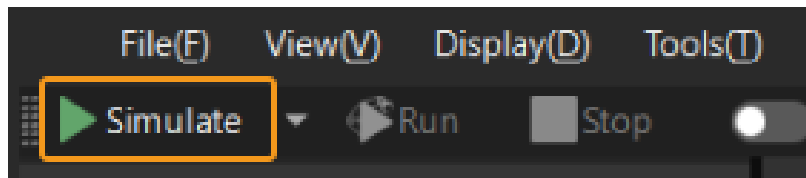
The Z value should be set according to actual situation, whose value, in general, is slightly greater than the actual thickness of sacks. In addition, the Z value should be highly consistent with the height of the **Approach Waypoint of Picking** in the robot program.

Similarly, click the **Departure Waypoint of Picking** Step. Then, set the **Reference Point** under **Move Relative** to **Previous** waypoint, the **Waypoint type** to **Tool**, and **Z** under **Coordinates** to **-300**.



### Simulate and Run the Project

1. Click the [ Simulate ] button on the toolbar to simulate the Mech-Viz project.



2. If the simulation performance meets expectations, a Standard Interface program can be used to run the real robot.

Please refer to the picking example program and interface commands in [Standard Interface communication](#) to learn how to write the robot program.



It is recommended that the robot should move at a low speed and that you pay close attention to the robot motion trajectory. In an emergency, press the emergency stop key on the teach pendant.

So far, you have learned how to get started with path planning.

### 3.2.3. Troubleshooting

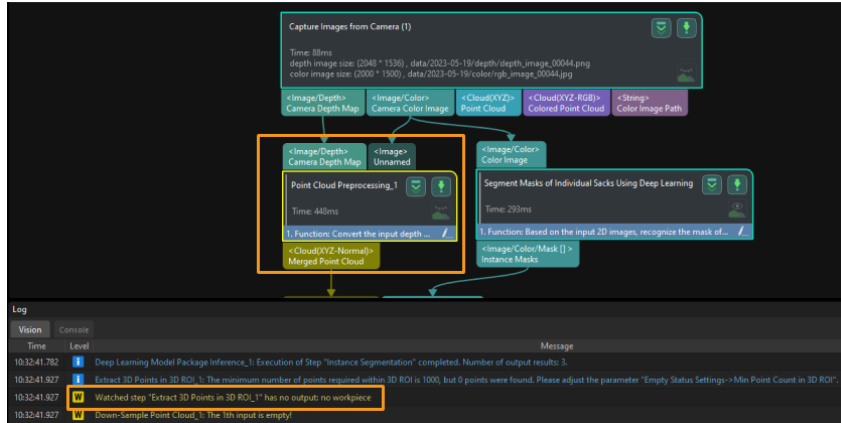
This section shows the common problems that might occur in the implementation of the single-case sack depalletizing solution and the corresponding causes and solutions.

#### Problem 1: No Workpiece in 3D ROI

##### Symptoms

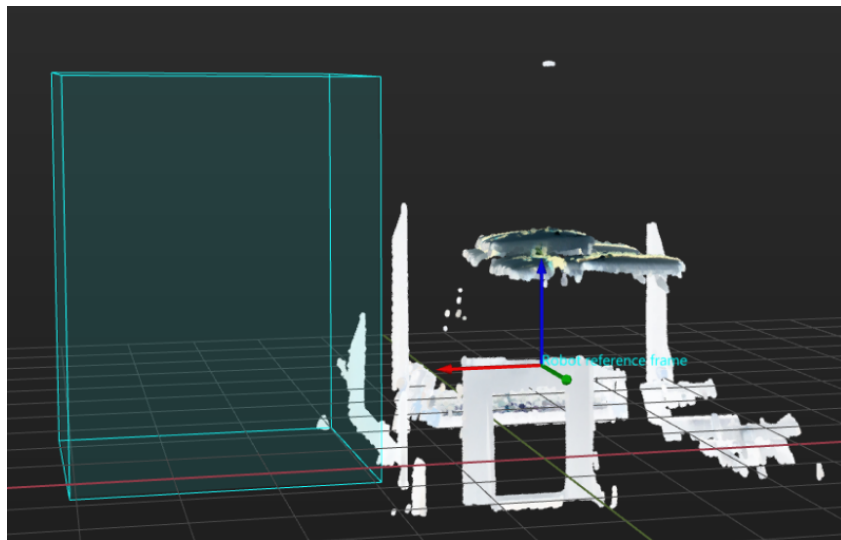
The **Point Cloud Preprocessing** Procedure encountered a failure during execution, and the log panel of Mech-Vision displayed an error message of “Watched step ‘Extract 3D Points in 3D ROI\_1’ has no output: no workpiece.”





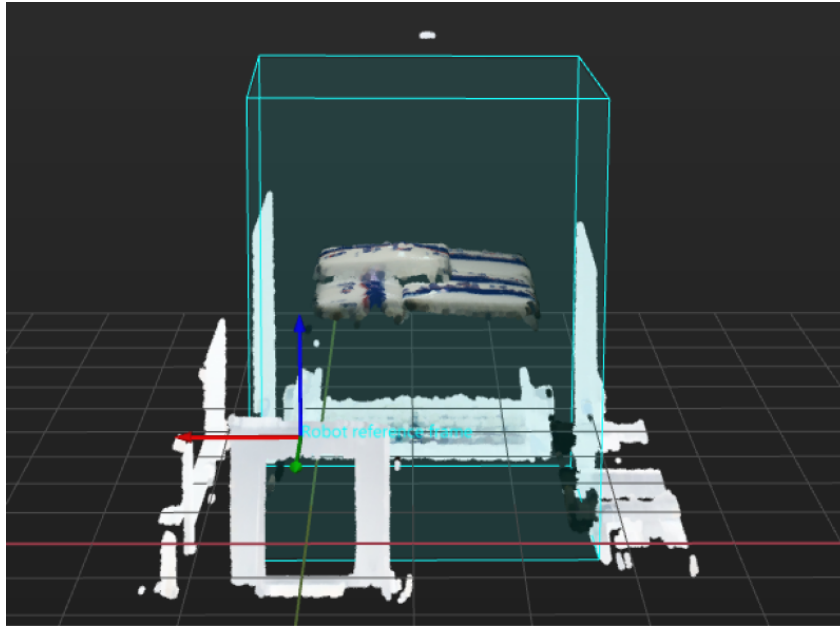
### Possible Cause

Due to incorrect setting of 3D ROI, the sack pallet is beyond the 3D ROI. Hence, no result can be output from the Mech-Vision project.



### Solution

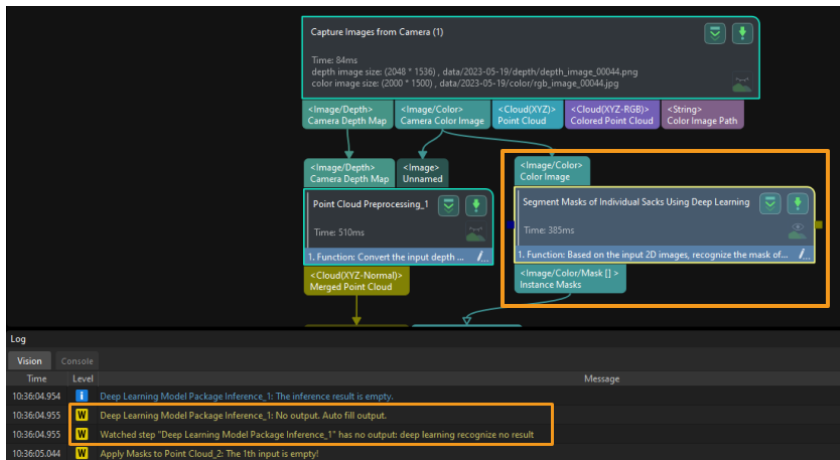
Reset 3D ROI according to workstation layout and pallet pattern dimensions to ensure the sack pallet is within the ROI.



## Problem 2: No Output from “Deep Learning Model Package Inference” Step

### Symptoms

The Segment Masks of Individual Sacks Using Deep Learning Procedure encountered a failure during execution, and the log panel of Mech-Vision displayed a warning message of “Watched step ‘Deep Learning Model Package Inference\_1’ has no output.”



### Possible Causes

- Inappropriate exposure time was set for the capture of 2D images. As shown below, the images from left to right are captured in cases where the exposure time is too long, the exposure time is appropriate, and the exposure time is too short, respectively.



- The adjusted white balance was not appropriate for the capture of 2D images. As shown below, the image on the left was captured under incorrect white balance, while the image on the right was captured under correct white balance.



- The setting of deep learning recognition region (2D ROI) was inappropriate.



- Deep learning models demonstrated poor performance for single-case sacks. Therefore, the deep learning models should be improved first.

## Solutions

- Adjust the exposure time of the camera to ensure that the acquired 2D images are normal.
- Adjust the white balance of the camera. See the documentation of [Adjust White Balance](#).
- Reset 2D ROI. Make sure that the entire upper surface of the stack are within the 2D ROI that is slightly larger than the full stack, and that the ROI should better not contain any other

interfering point clouds.



- Acquire image data of sacks to iterate deep learning models.

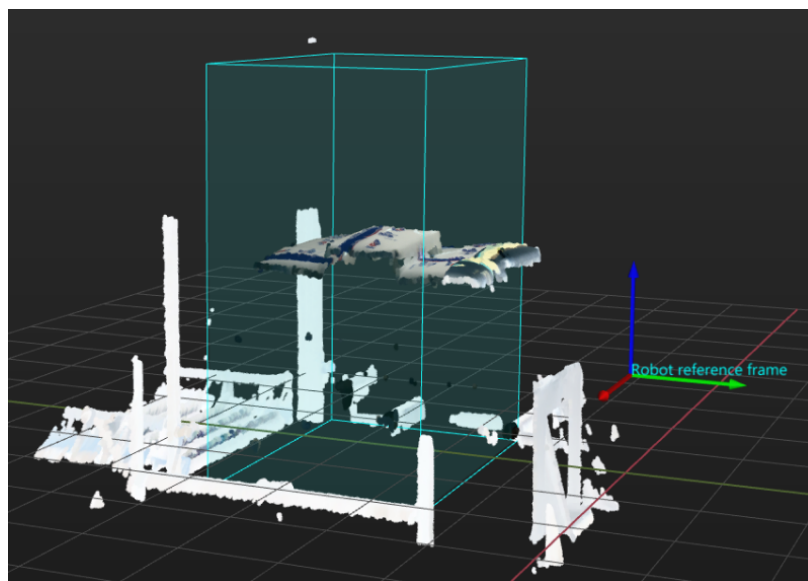
### Problem 3: Abnormal Output after Pose Adjustment

#### Symptoms

The **Adjust Poses** Procedure encountered a failure during execution, and the log panel of Mech-Vision displayed a message of "Watched step 'Adjust Poses V2\_1' has no output: pose abnormal."

#### Possible Causes

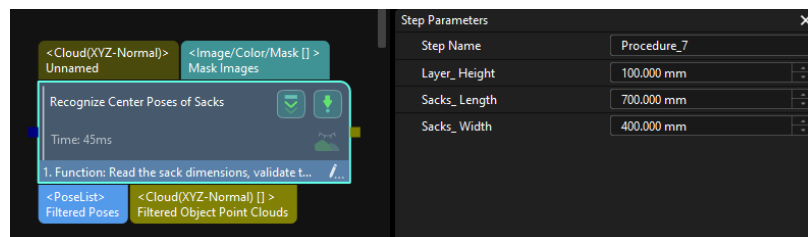
- The 3D ROI didn't cover complete sacks. As a result, the dimensions of the sacks could not be verified in subsequent operations, and no output was obtained from Mech-Vision.



- Deep learning models failed to correctly segment masks of individual sacks. As a result, the dimensions of the sacks could not be verified in subsequent operations, and no output was obtained from Mech-Vision.




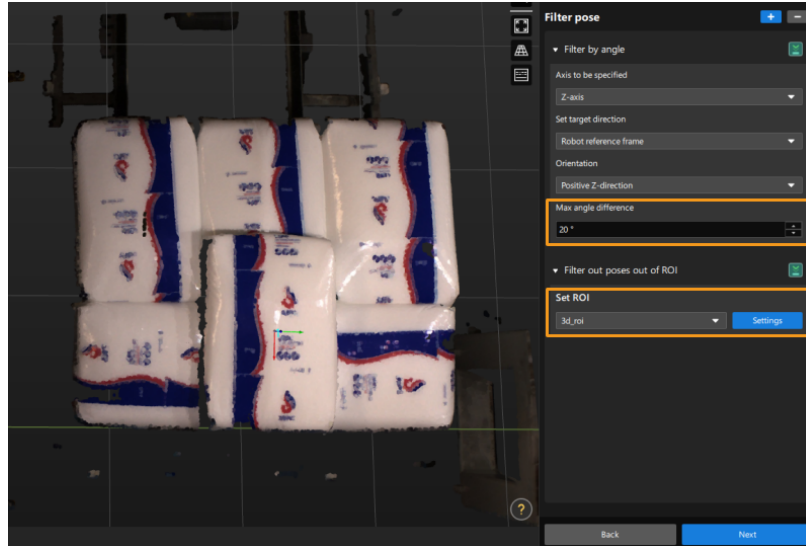
- The dimensions input in the **Recognize Center Poses of Sacks** Procedure differed greatly from recognized ones. Thus, the dimensions of the sacks could not be verified, and no output was obtained from Mech-Vision.



- Correct poses of sacks were removed, and thus no output could be obtained from Mech-Vision.

## Solutions

- Reset 3D ROI according to workstation layout and pallet pattern dimensions to ensure the sacks are within the ROI.
- Double-click the **Segment Masks of Individual Sacks Using Deep Learning** Procedure to view the visualized output from the **Deep Learning Model Package Inference** Step. If the visualized output demonstrates incomplete sacks or misses some sacks, please refer to **Problem 2** for resolution.
- Measure the sack dimensions and compare them with the input ones. If the difference is huge, you can adjust the parameters of the **Read Object Dimensions** Step in the **Recognize Center Poses of Sacks** Procedure to reset the sack dimensions.
- Select the **Adjust Poses** Procedure and click [ **Open the editor** ] in the **Step Parameters** panel to adjust poses. Then, click [ **Next** ] in the lower-right corner. Check whether there is any output from the **Filter out poses out of ROI** Step. (Click  and check whether the sack poses are output in the visualization area on the left.) If the output is correct, then check whether there is any output from the **Filter by angle** Step. If sacks are significantly tilted but the poses are correct, you can increase the **Max angle difference** to a certain extent.



### Problem 4: Path Planing Failure Resulting in Collision with Scene Objects

#### Symptoms

The alert “Path planning failed: End tool and scene object collided” popped up when Mech-Viz was used to run a project.

In the figure below, the air compressed cable extends from the gripper, and the pallet is close to the fence. When the robot attempted to pick sacks near the fence, collisions between the air compressed cable and the fence were often detected, and thus the sacks could not be picked.



#### Possible Cause

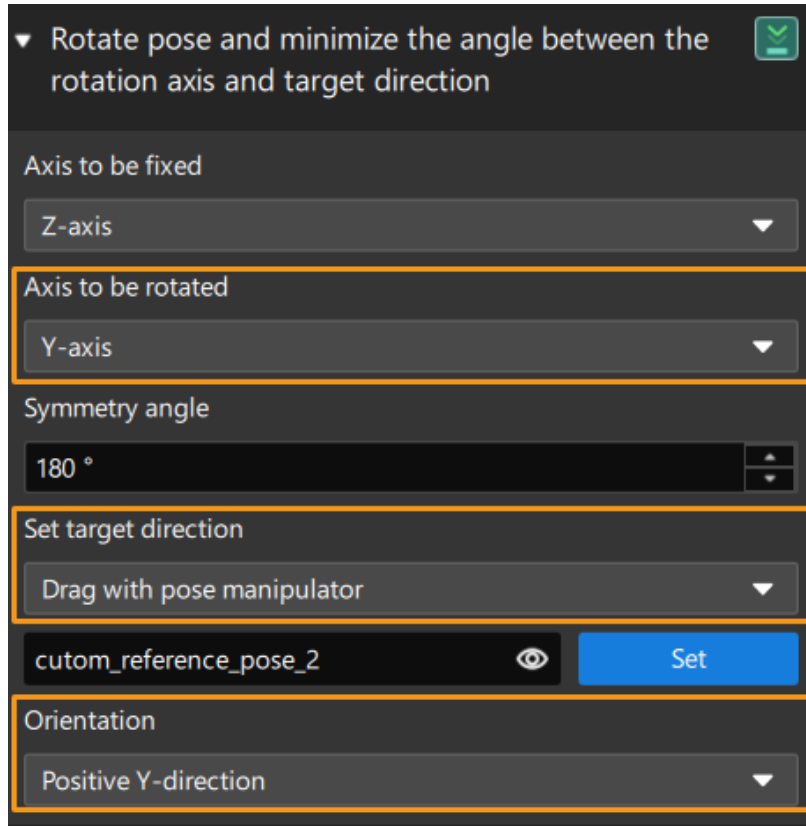
The Z-axis orientation of sacks output from Mech-Vision is incorrect.

#### Solutions

- If the gripper is more protruding in the Y-axis of the TCP, for the sack near the fence, the Y-axis of its pose should be adjusted to point to the pallet center. The instructions are as follows:

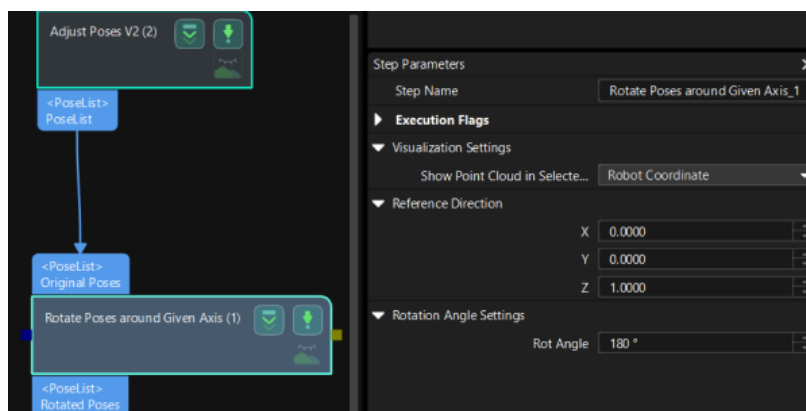
Select the **Adjust Poses** Procedure and click [ **Open the editor** ] in the **Step Parameters** panel to adjust poses. In the default predefined mode, set **Orientation** to **Point to/away from pallet**

center (depalletizing) and the Application scenario to Point away from, and then set Axis to be rotated to Y-axis. After that, use the manipulator to set the pallet center so that the Y-axis of the sack pose can point to the pallet center.



- If the gripper is more protruding in the X-axis of the TCP, for the sack near the fence, the X-axis of its pose should be adjusted to point to the pallet center. The instructions are as follows:

Select the **Adjust Poses** Procedure and click [ **Open the editor** ] in the **Step Parameters** panel to adjust poses. In the default predefined mode, set **Orientation** to **Point to/away from pallet center (depalletizing)** and the **Application scenario** to **Point to**, and then set **Axis to be rotated** to **X-axis**. After that, use the manipulator to set the pallet center so that the X-axis of the sack pose can point to the pallet center.



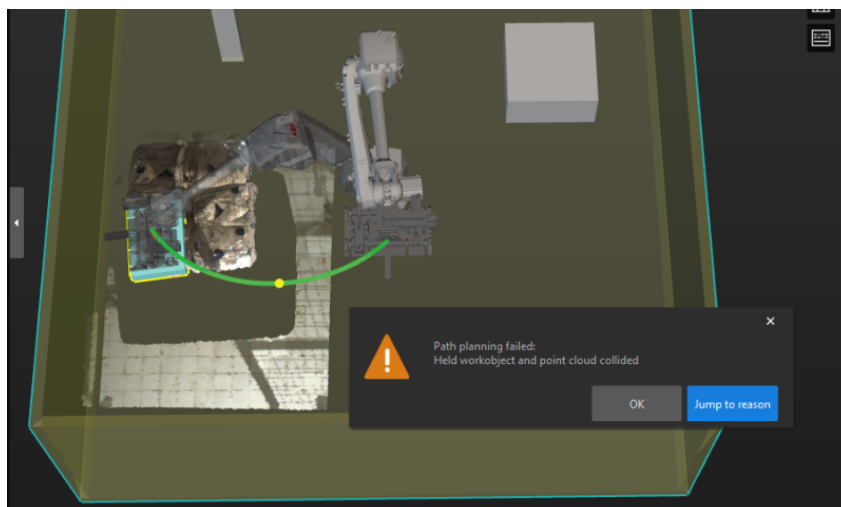
After the above operations are completed, the X-axis or Y-axis of the sack pose will point to the pallet center.



### Problem 5: Path Planing Failure Due to Collision between Held Workobject and Point Cloud

#### Symptoms

Mech-Viz failed to plan a path, and the alert of “Path planning failed: Held workobject and point cloud collided” popped up.



#### Possible Cause

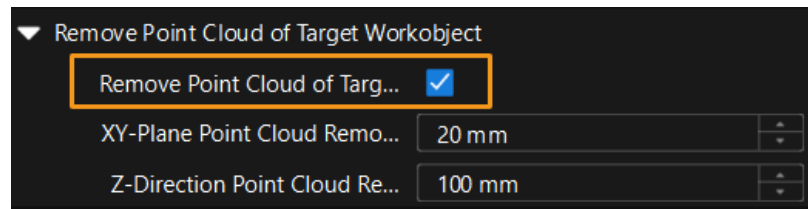
The problem may be caused by collision, an unreachable waypoint, etc.

If all the poses turn red at the same time, it is much possible that the problem was caused by a point cloud collision.

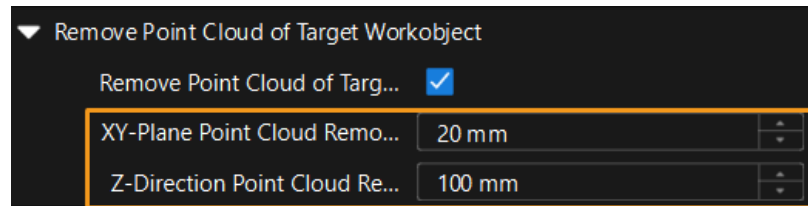
#### Solutions

- In the **Vision Move Step**, make sure to select the **Remove Point Cloud of Target Workobject** checkbox under **Remove Point Cloud of Target Workobject**.





- In the Vision Move Step, check whether the parameter values of **XY-Plane Point Cloud Removal Range Expansion** and **Z-Direction Point Cloud Removal Range Expansion** under **Remove Point Cloud of Target Workobject** are too small. If so, increase the parameter values appropriately.



## Problem 6: Dresspack Wrapping and Excessive Rotation During Path Planning

### Symptoms

During path planning in Mech-Viz, the robot encountered problems such as dresspack wrapping and excessive rotation.

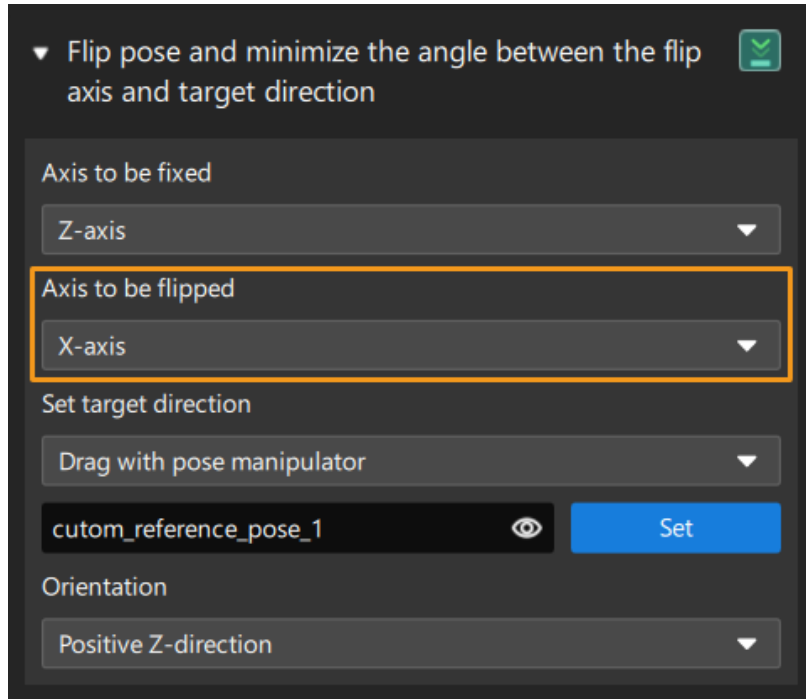
### Possible Cause

The Z-axis orientation of sacks output from Mech-Vision is incorrect.

### Solutions

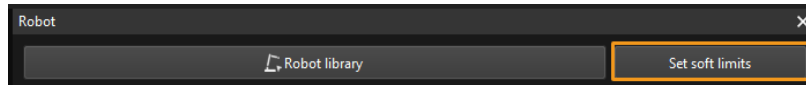
- Adjust the Z-axis of the sack poses to a uniform orientation in the Mech-Vision project.

In the custom mode of the pose adjustment tool, add the **Flip pose and minimize the angle between the flip axis and target direction** option if the sacks are placed transversely or longitudinally. This allows flipping the X or Y-axis of the pose to the target direction, so as to control the rotation angle of the gripper within the range of 0° to 90°.

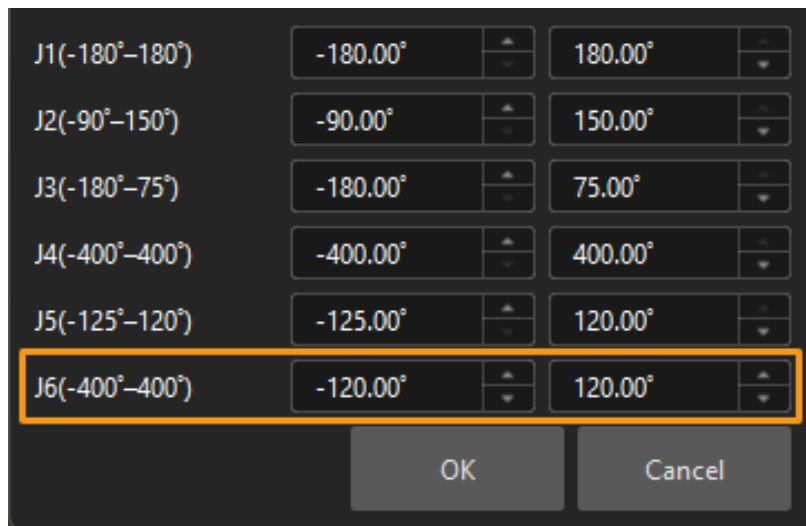


- Set soft limits of the robot.

Click [ Set Soft Limits ] in the Robot panel of Mech-Viz.



Manually rotate the sixth axis of the real robot, test the limit rotation angle of the sixth axis in the positive and negative directions, and then set the appropriate soft limits with reference to the limit rotation angle of the sixth axis.



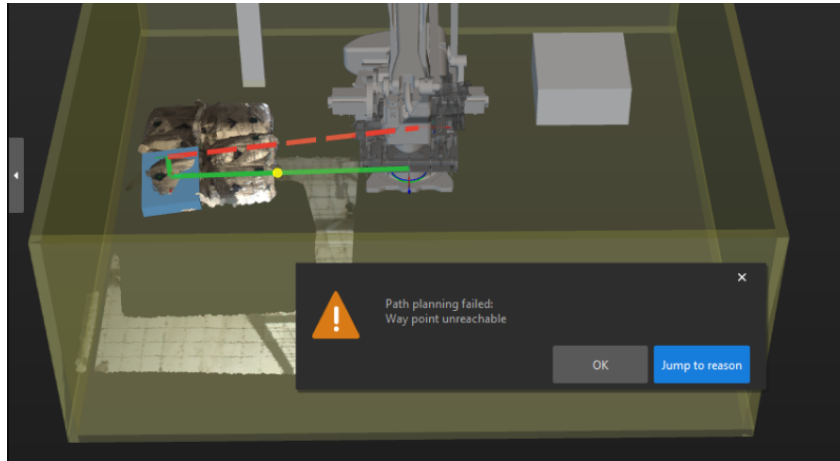
After the above operations, the planned robot picking path is shown as below.

### Problem 7: Path Planning Failed Due to Unreachable Waypoints

## Symptoms

Mech-Viz failed to plan a path, and the alert of “Path planning failed: Way point unreachable” popped up.

For example, when a four-axis robot is used for sack depalletizing, path planning failed due to unreachable waypoints. At this point, you can still manually control the robot to reach any point of the pallet pattern, and the Mech-Vision project can output vision result.



## Possible Cause

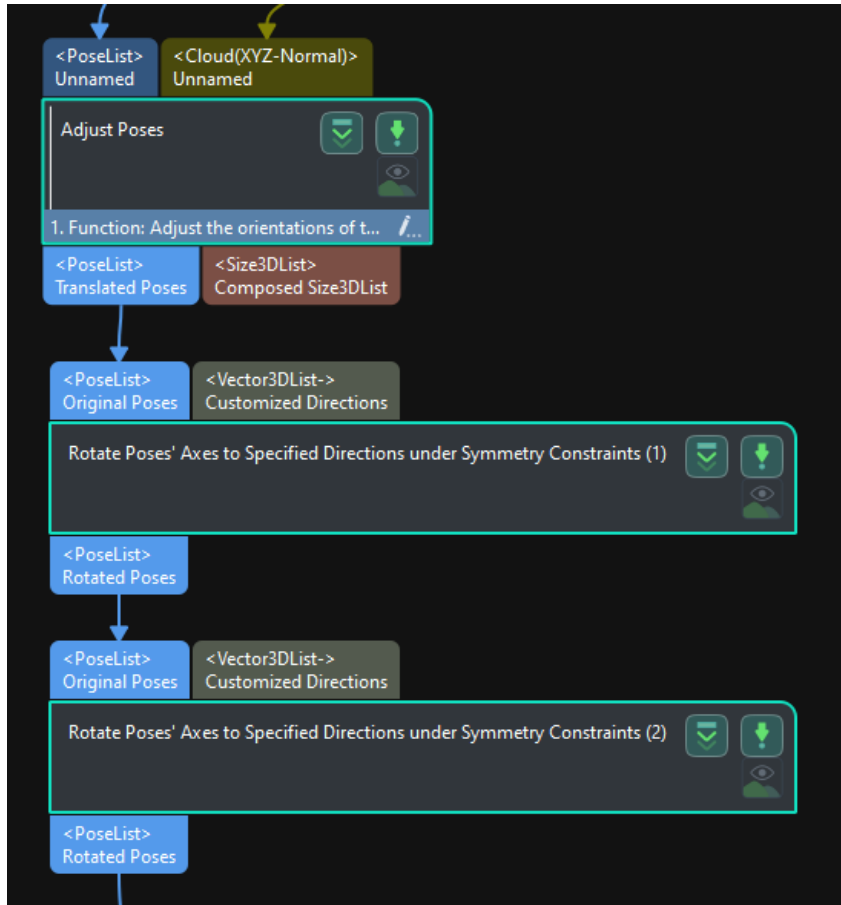
In most cases, when the incoming sacks are tilted, there may be an included angle between the Z-axis of the sack pose and the Z-axis of the robot reference frame in the X and Y-directions.

For the four-axis robot, its X, Y, and Z-axes can move linearly, and the Z-axis can rotate, i.e., the robot has four degrees of freedom (DOF). When the angle between the Z-axis of the sack pose and that of the robot reference frame is small, Mech-Viz will automatically rectify the Z-axis of the sack pose for picking path planning. When the included angle is large, however, an alert will be triggered, and thus path planning will encounter a failure.

## Solution

Rectify the Z-axis of the sack pose before any vision result is output from the Mech-Vision project. Note that before the rectification, judge whether the included angle between the Z-axis of the sack pose and that of the robot reference frame is within the acceptable range. For those sacks with a seriously tilt angle, an alert should be triggered, and the Z-axis of sack poses should not be rectified. Ways to rectify the Z-axis of sack poses are as follows.

1. Add two **Rotate Poses' Axes to Specified Directions** under **Symmetry Constraints** Steps after the **Adjust Poses** Procedure.
2. Set **Axis to Be Rotated** to Z and **Axis to Be Fixed** to X for the first **Rotate Poses' Axes to Specified Directions** under **Symmetry Constraints** Step.
3. Set **Axis to Be Rotated** to Z and **Axis to Be Fixed** to Y for the second **Rotate Poses' Axes to Specified Directions** under **Symmetry Constraints** Step.



Upon the above parameter setting, the Z-axis of the sack pose can be rectified to be upward in both X and Y-directions.

### Problem 8: Cannot Plan a Path for Depalletizing

#### Symptoms

Mech-Viz failed to plan a path, and the alert of "Cannot plan a path for depalletizing" popped up.



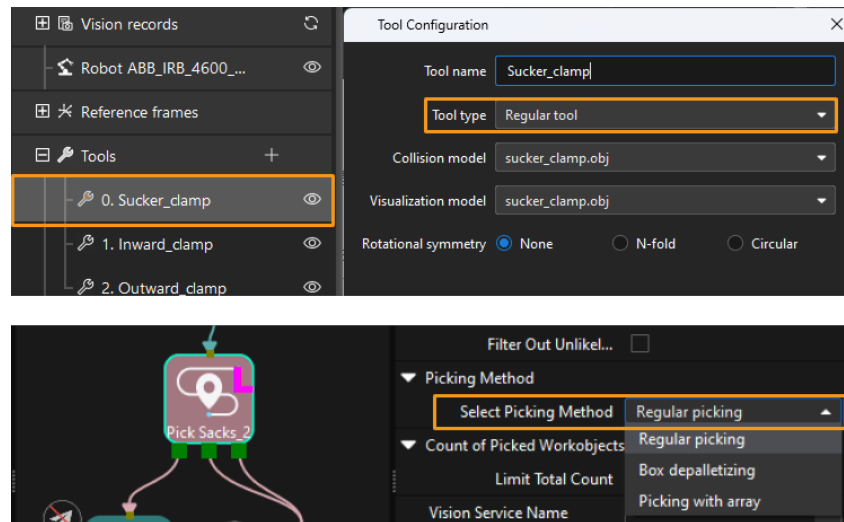
#### Possible Cause

The failure may be caused by incorrect parameter setting of the **Vision Move Step**; for example, the

incorrect setting of Tool type.

### Solution

During sack depalletizing, the robot can pick up only one sack at a time, and thus the **Tool type** should be set to **Regular tool** in the Tool Configuration window. Accordingly, in the **Picking Sacks** Step, the **Select Picking Method** should be **Regular picking**.



## 3.3. Turnover Box Depalletizing

### Overview

Turnover box depalletizing refers to depalletizing the same-specification opened turnover boxes that are stacked neatly. The turnover box is in the shape of a rectangular, and the material in the turnover box cannot go beyond the top edges of the turnover box.

This solution is used for same-specification turnover boxes that are stacked neatly. It is acceptable that a small quantity of points are missing in the point clouds or the boxes are placed close to each other.



### Reading Guide

You can check the following sections to learn about the basic information, getting started instructions, common problems and fixes of the turnover box depalletizing solution.

No.	Section	Description
1	<a href="#">Basics</a>	The applicability, unsupported functions and technical specifications of the turnover box depalletizing solution.
2	<a href="#">Getting Started</a>	Entry-level instructions for the turnover box depalletizing solution.
3	<a href="#">Troubleshooting</a>	Common problems and corresponding solutions for the turnover box depalletizing solution.

### 3.3.1. Basics


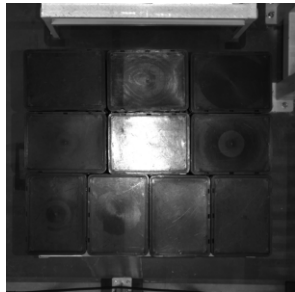
This section introduces the basics of the turnover box depalletizing solution, including the applicability, unsupported functions and technical specifications.

#### Applicability

This section introduces the applicability of the turnover box depalletizing solution from the aspects of turnover box types, project requirements, material status in the turnover box, etc.


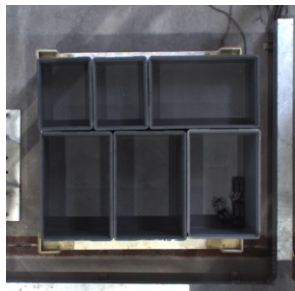
#### Turnover Box Types

The table below illustrates the solution's applicability to turnover box types.

Feasible	Illustration	Not feasible	Illustration
Common open-lid turnover boxes with rectangular-like shapes.		Closed turnover boxes.	

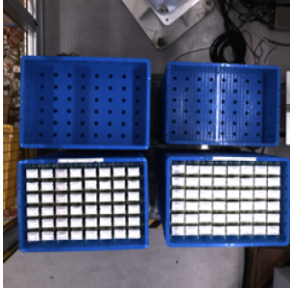



#### Project Requirements

The table below illustrates the solution's applicability to project requirements.

Feasible	Illustration	Not feasible	Illustration
Single-case turnover box depalletizing.		Mixed-case turnover box depalletizing.	

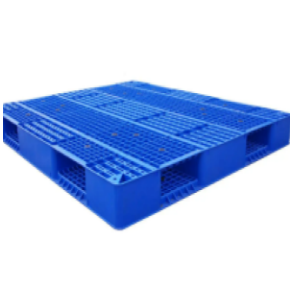

### Material Status in the Turnover Boxes

The table below illustrates the solution’s applicability to material status in the turnover boxes.

Feasible	Illustration	Not feasible	Illustration
The height of the materials inside the turnover box cannot exceed the top edge of the turnover box, and the camera needs to capture a relatively complete edge feature of the turnover box.		The height of the materials inside the turnover box exceeds the top edge of the turnover box, obscuring the edge feature of the turnover box.	
There is a significant gap between the materials in the turnover box and the top edge of the turnover box.		There are partitions among the materials in the turnover box. The partitions are flush with the top edge of the turnover box.	

### Turnover Box Carriers

The table below illustrates the solution’s applicability to turnover box carriers.

Feasible	Illustration	Not feasible	Illustration
Turnover boxes are placed on a pallet.		Turnover boxes are placed in four-wall bins, containers, or larger turnover boxes, or there are other obstructions around the turnover box stacks.	

### Unsupported Functions

The turnover box depalletizing solution does not support the following functions.

- Identify the dimensions of the turnover boxes. The turnover box depalletizing solution can only recognize the position of turnover boxes, and cannot accurately recognize the dimensions of turnover boxes. To recognize the dimensions of different turnover boxes, it is recommended to use deep learning to assist the recognition.
- Identify deformed turnover boxes. If the turnover boxes are deformed, it may affect the accuracy of vision recognition and even result in collisions during depalletizing. Before depalletizing, deformed turnover boxes should be removed to ensure production stability.

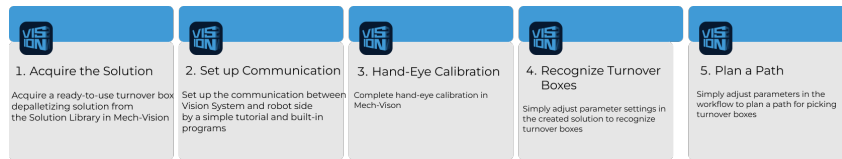
## Technical Specifications

The technical specifications for the turnover box depalletizing solution are as follows.

- Positioning accuracy:  $\pm 3$  mm
- Recognition success rate: more than 99%
- Execution time of vision system: within 4 s

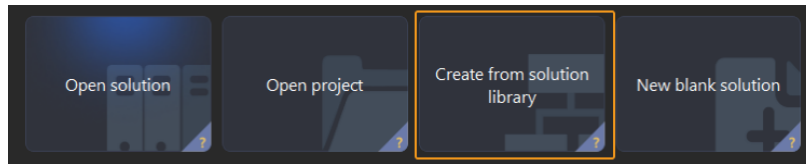
### 3.3.2. Getting Started

This section will introduce how to easily depalletize turnover boxes from a beginner's perspective. The overall process is shown in the figure below.

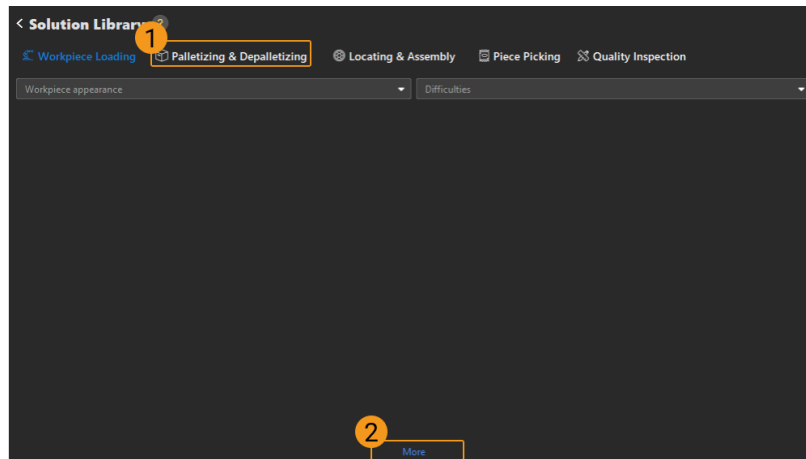


### Acquire the Solution

1. Open Mech-Vision.
2. In the Welcome interface of Mech-Vision, click [ **Create from Solution Library** ] to open the Solution Library.

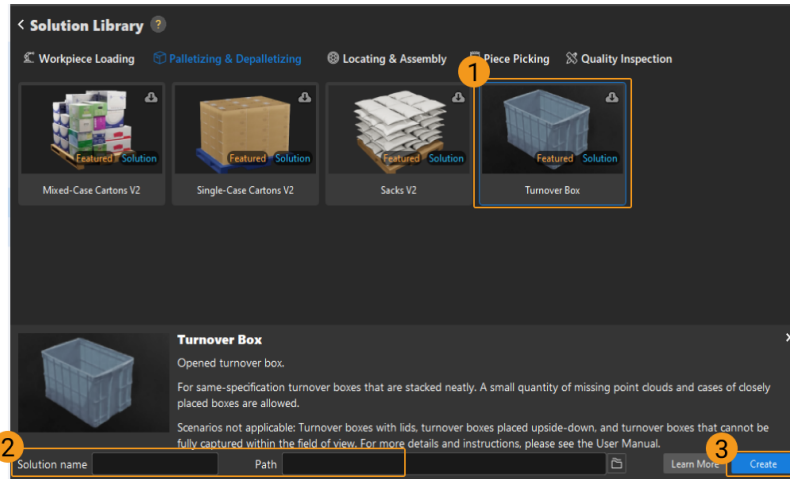


3. Click **Palletizing & Depalletizing** in the Solution Library, then click on [ **More** ] at the bottom, and click [ **Yes** ] in the pop-up window.



4. After acquiring the solution resources, select **Turnover Boxes (with Production Interface)**. Then, fill in the Solution name and Path at the bottom, and finally click [ **Create** ] to download the turnover box depalletizing solution.





Once the solution is downloaded, it will be automatically opened in Mech-Vision.

## Set up Communication

When deploying a Mech-Mind vision solution, you need to set up the communication between the Mech-Mind Vision System and the robot side (robot, PLC or host computer).

The turnover box depalletizing solution uses **Standard Interface communication**. For specific operations, please refer to [Standard Interface Communication Configuration](#).

## Hand-Eye Calibration

Hand-eye calibration establishes the transformation relationship between the camera and robot reference frames. With this relationship, the object pose determined by the vision system can be transformed into that in the robot reference frame, which guides the robot to perform its tasks.

Please refer to [Hand-Eye Calibration Guide](#) to complete hand-eye calibration.



Every time the camera is mounted, or the relative position of the camera and the robot changes after calibration, it is necessary to perform hand-eye calibration again.

## Locate Turnover Boxes

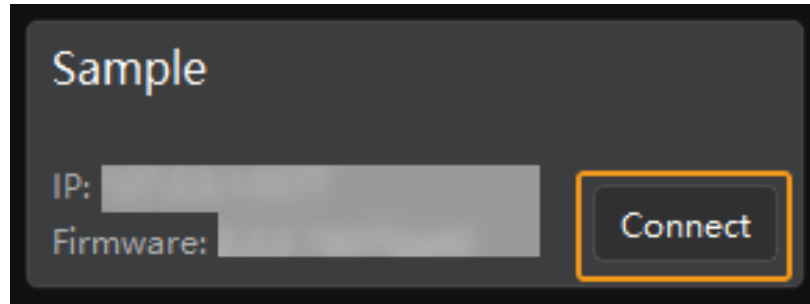
After completing the communication configuration and hand-eye calibration, you can use Mech-Vision to recognize turnover boxes. The process for turnover box recognition is shown in the figure below.



## Connect to the Camera and Capture Images

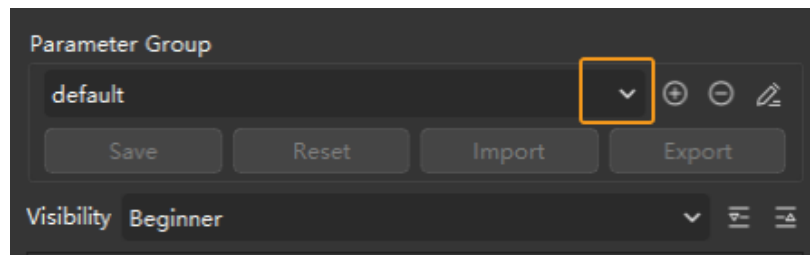
1. Connect to the camera.

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




2. Set the parameter group.

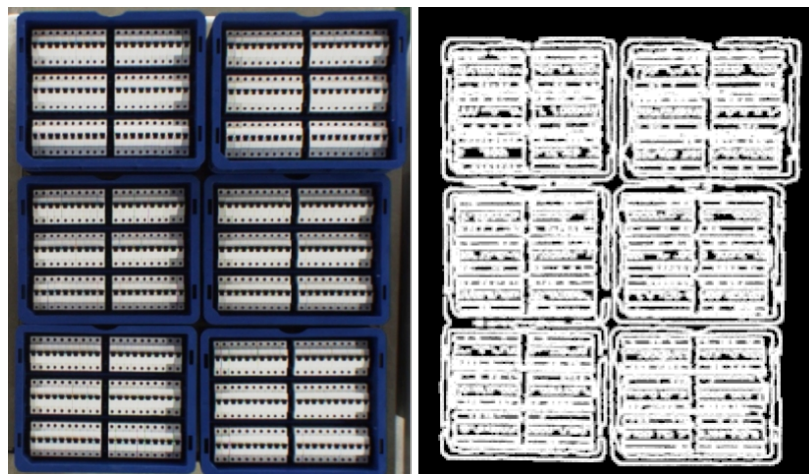
Click the dropdown arrow next to the Parameter Group on the right-hand side and select the Typical turnover box depalletizing.



In addition to the default parameter group, Mech-Eye Viewer will also display parameter groups of other typical solutions.

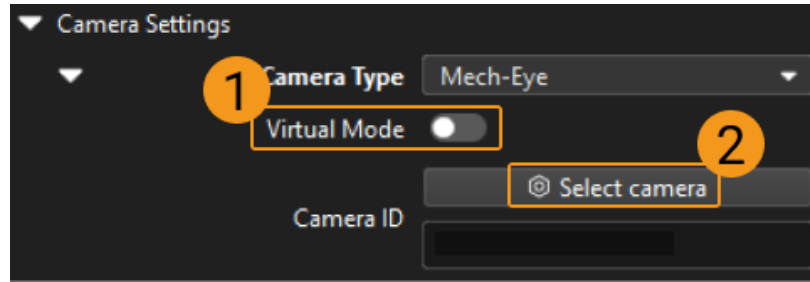
3. Capture Images.



After the camera is successfully connected and the parameter group is set, you can start capturing turnover box images. Click the  button on the top to capture a single image. At this time, you can view the captured 2D image and point cloud of the turnover box. Ensure that the 2D image is clear, the turnover box point cloud is intact, and the edges are clear. The qualified 2D image and point cloud of the turnover box are shown on the left and right in the figure below respectively.

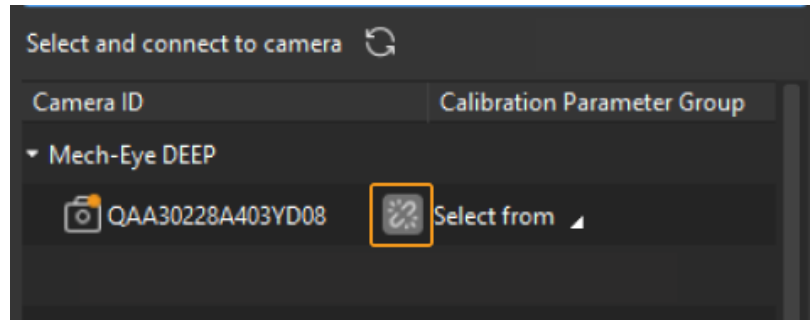


4. Add a camera in Mech-Vision.

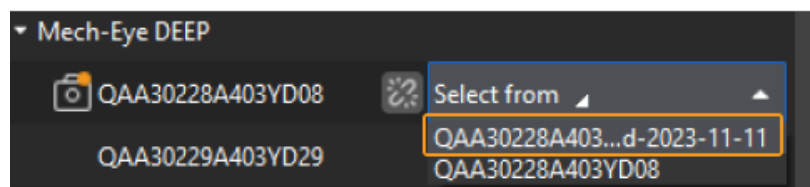
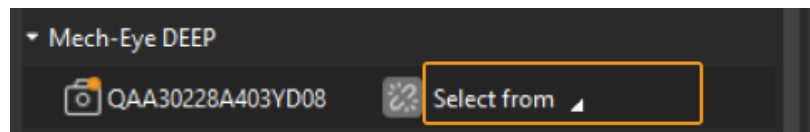
Select the **Capture Images from Camera Step**, disable the **Virtual Mode** option, and click **[ Select camera ]** on the Step Parameters tab.




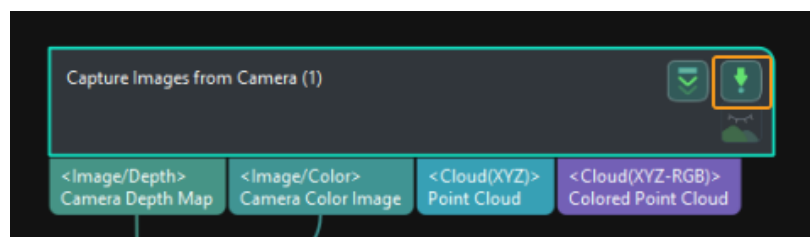
In the pop-up window, click the  button on the right of the Camera ID. When the button turns into , the camera is connected successfully.



After the camera is connected successfully, you can click [ **Select from** ] and select the corresponding camera calibration parameter group, as shown below.



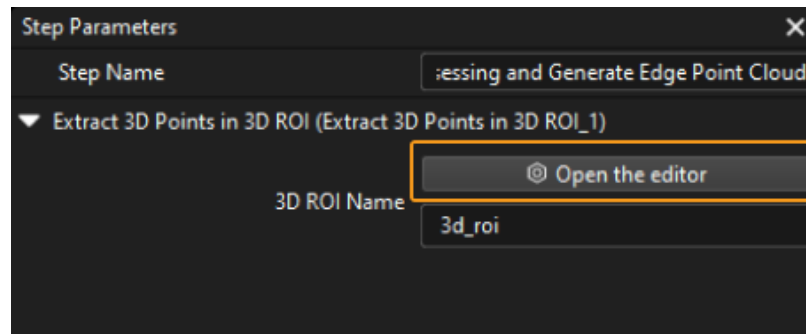
Once the above settings are complete, you can connect to a real camera. Other parameters can remain at their default values. Click the  button on the right of the “Capture Images from Camera” Step to run this Step. If no error message occurs, the camera is connected successfully and images can be captured normally.



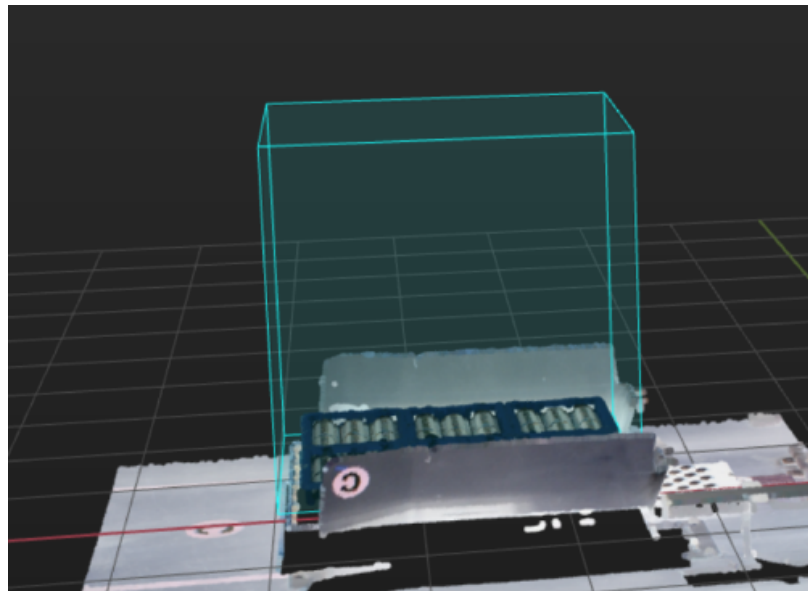
### Extract Point Cloud of Turnover Boxes

1. Select the **Point Cloud Preprocessing and Generate Edge Point Cloud** Procedure, then click

the [ Open the editor ] button on the Step Parameters tab to open the **Set 3D ROI** window.



2. In the **Set 3D ROI** window, drag the default generated 3D ROI in the point cloud display area to a proper position. Make sure that the highest and lowest areas of the turnover box stack are within the green box at the same time, and that the green box does not contain other interfering point clouds, as shown in the following figure.



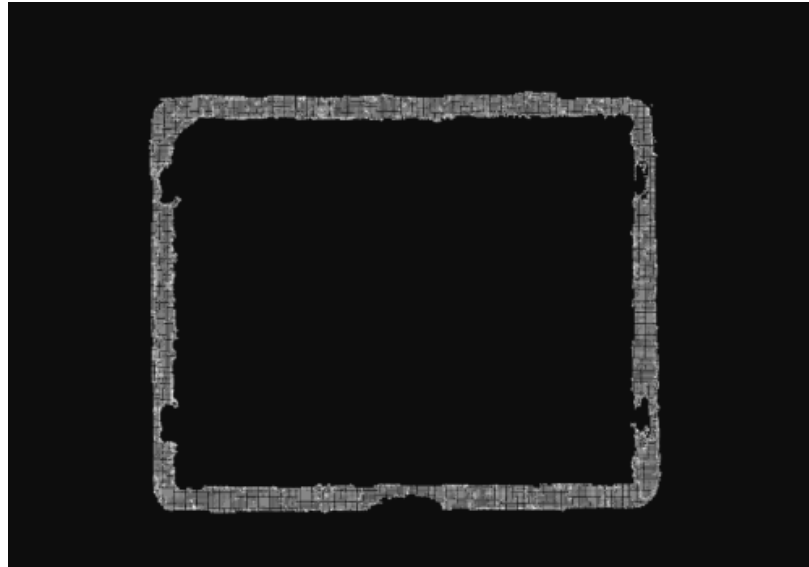
## Calculate Turnover Box Poses Using 3D Matching

### Make the Point Cloud Model

The specific methods for making surface point cloud models and edge point cloud models are as follows.


### Make Surface Point Cloud Model

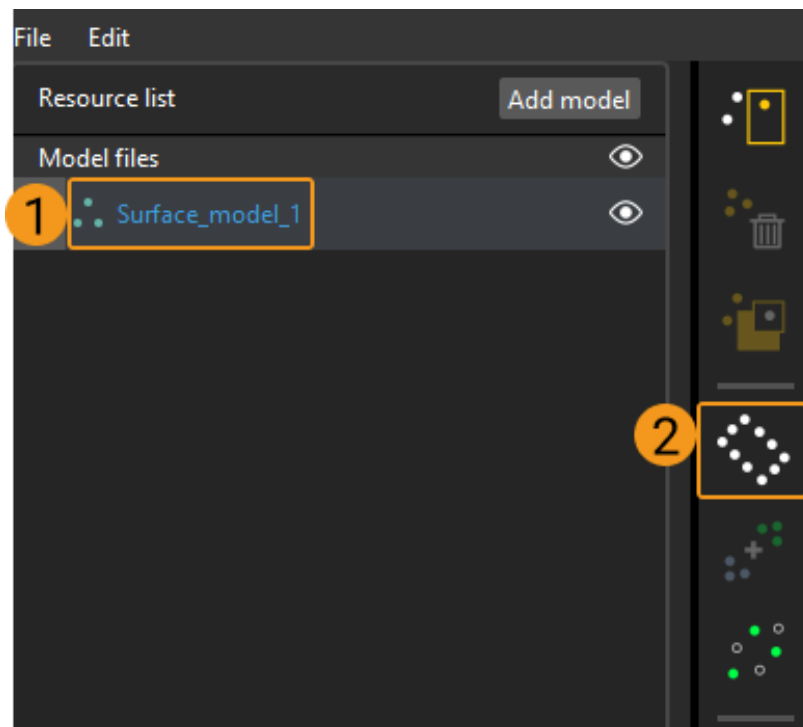
1. Generate point cloud model. This feature generates a point cloud from depth map(s) acquired by the camera. For specific operation, please refer to [Generate a Point Cloud Model from Image Acquired by the Camera](#).
2. Edit the point cloud model. Ensure that only one turnover box point cloud is left after the outliers and point cloud of other turnover boxes are removed. For specific operation, please refer to [Edit Point Cloud Model](#).



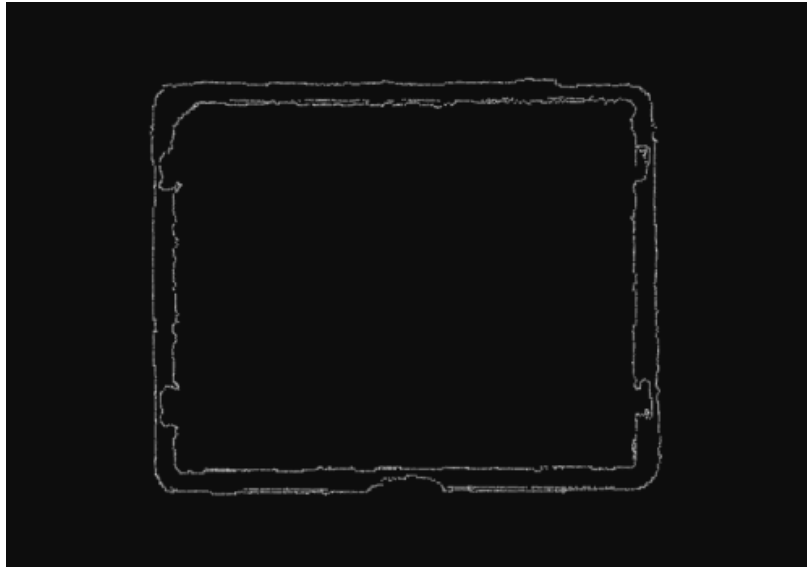
### Make Edge Point Cloud Model

After making the surface point cloud model, you can use this to create edge point cloud model.

1. Select surface model in the resource list, and then click . You can use the “Estimate point cloud edges by 3D methods” to generate turnover box edge model.




2. The generated edge point cloud model is as follows.

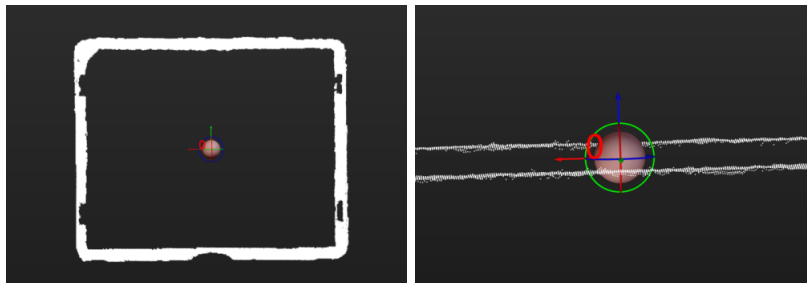


You can rename the point cloud model files by double-click them in the resource list. For example, you can rename them as Edge\_model\_1、Surface\_model\_1 for distinction.

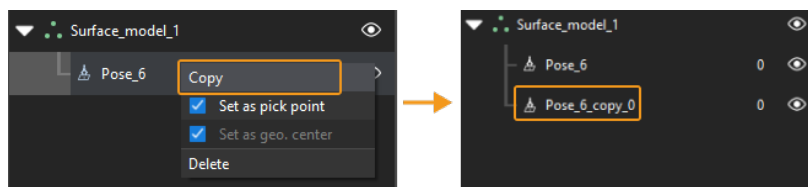
### Add Pick Point

After you finish making the point cloud model, you can add a pick point for it.

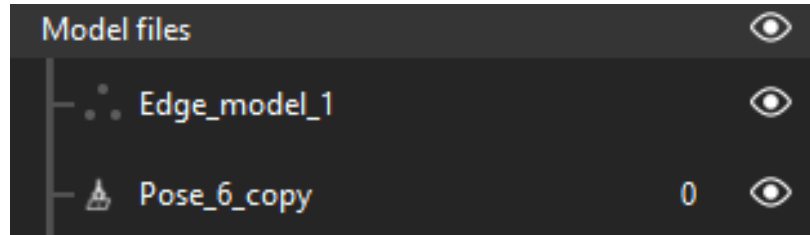
1. Select surface model in the resource list, click  to add pick point for surface point cloud model. The position and orientation of the pick point should then be adjusted to ensure that the pick point is as close as possible to the center of the surface point cloud model (as shown in the left figure below) and that the Z-axis is perpendicular to the surface of the model (as shown in the right figure below).



2. After adding the pick point of the surface point cloud model, right-click the pick point in the resource list, and then click [Copy].



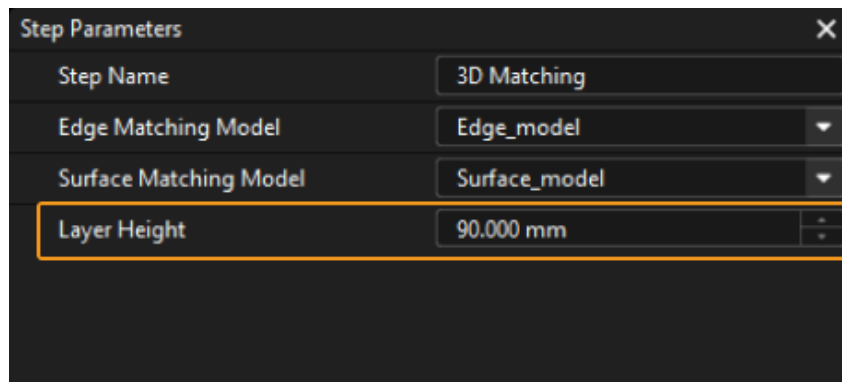
3. You can quickly add a pick point for an edge point cloud model by dragging the copied pick point below the edge point cloud model in the resource list.



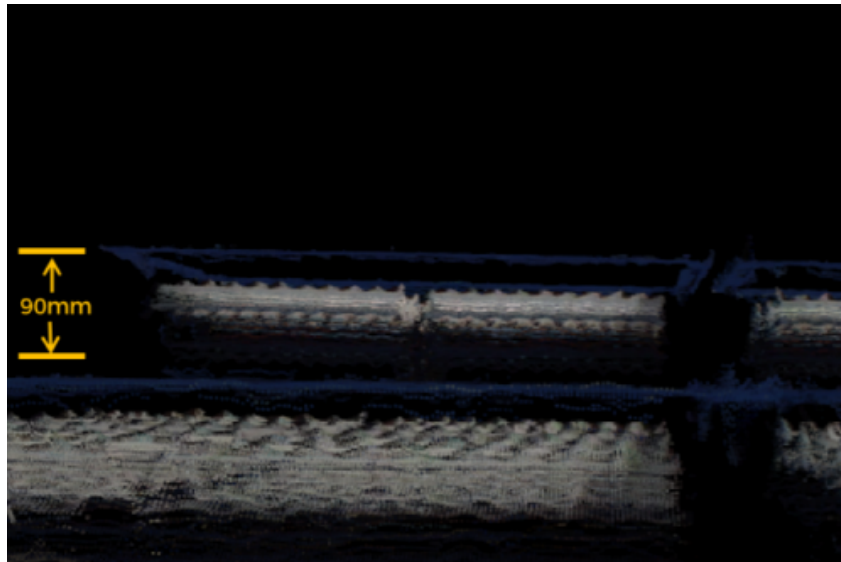
If you need to adjust the pick point later, you need to adjust the pick point of both the Edge Point Cloud Model and Surface Point Cloud Model.

### Set the Layer Height

The **Layer Height** Indicates the height range of the highest layer area. Once the height range of the objects on the highest layer in the north-to-south direction is set, the object poses within this height range will be output.



If there are object poses of other layers included in this range, you should adjust the value of **Layer Height** until there are only poses of objects on the highest layer within the range.

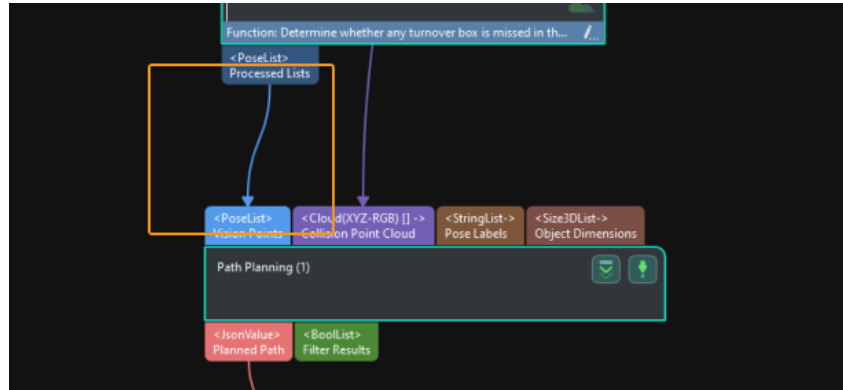


### Adjust Turnover Box Poses

The Procedure is used to transform turnover box poses from the camera reference frame to the robot reference frame, adjust pose orientations, sort poses, and filter unqualified poses. There is no need to set parameters for this Procedure.

### Output Turnover Box Poses

As **Path Planning** Step is used in the turnover box depalletizing solution for path planning, the turnover box poses are then input to the **Path Planning** Step. You can click the data flow to check relevant data.



So far, you have learned how to get started with turnover box locating.

### Path Planning

The **Path Planning Tool** under the **Path Planning** Step is used in the turnover box depalletizing solution for path planning. Click [**Open the editor**] in the Step Parameters of **Path Planning** to open **Path Planning Tool**.

The process of path planning is shown in the figure below.



#### Configure Scene Objects

Scene objects are introduced to make the scene in the software closer to the real scenario, which facilitates the robot path planning. For specific operations, please refer to [Configure Scene Objects](#).

#### Configure the Tool

The end tool should be configured so that its model can be displayed in the 3D simulation space and used for collision detection. For specific operations, please refer to [Configure the Tool](#).

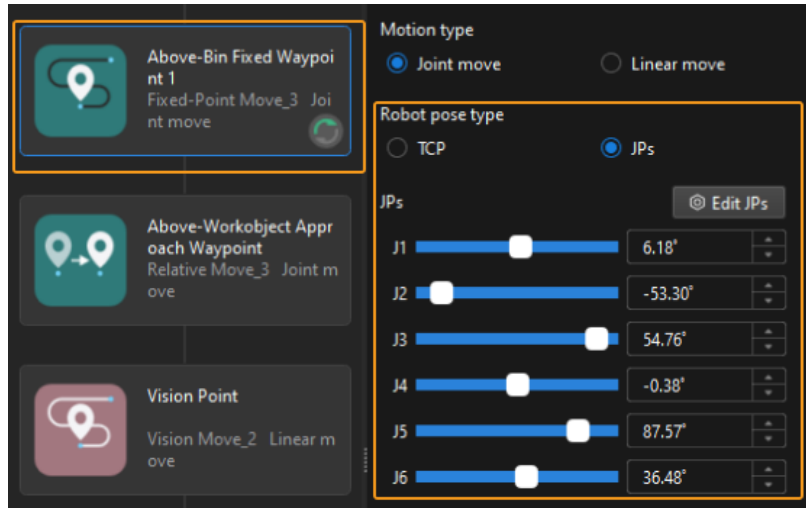
#### Adjust the Workflow

The workflow refers to the robot motion control program created in the form of a flowchart. After the scene objects and end tools are configured, you can adjust the workflow.

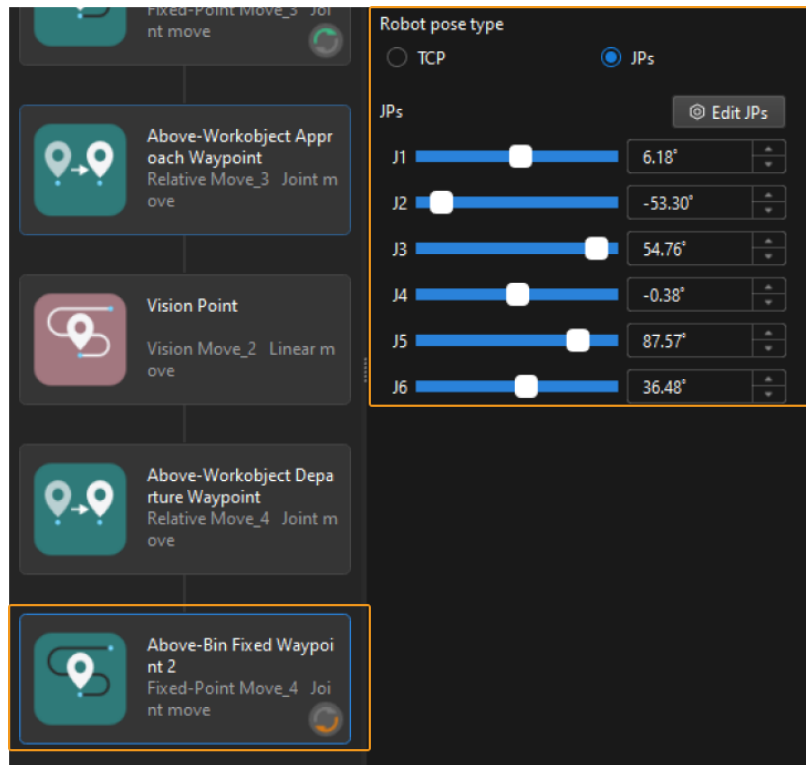
#### Adjust the Above-Bin Fixed Waypoint

1. Select the "Above-Bin Fixed Waypoint 1" Step, and then choose the "JPs" of the "Robot pose type" in the Step Parameters on the right. Then you can set the values of "JPs" according to the picking poses when the real robot is above the bin.





2. Select the "Above-Bin Fixed Waypoint 2" Step, and then choose the "JPs" of the "Robot pose type" in the Step Parameters on the right. Then you can set the values of "JPs" according to the picking poses when the real robot is above the bin.

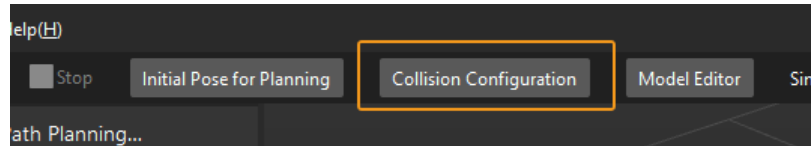


### Configure Collision Detection

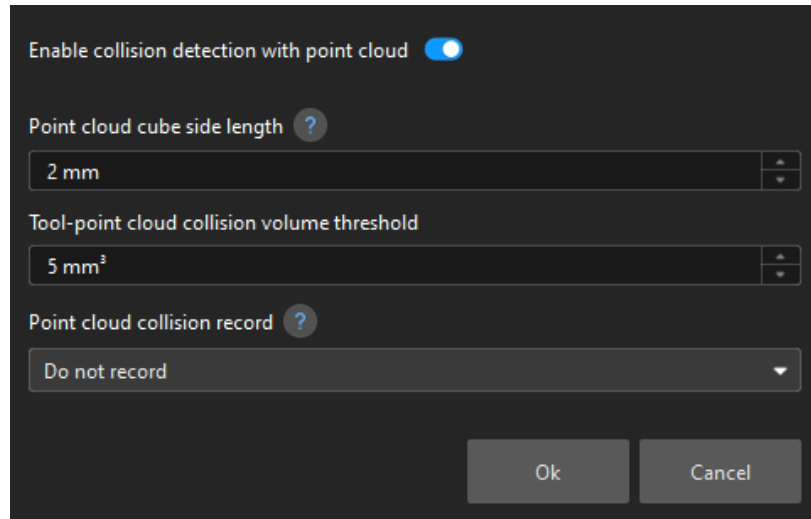
Collision configuration is used to detect and avoid possible collisions. By default, collisions between any two of the robot, tool, and scene objects will be detected. Once "Enable collision detection with point cloud" is enabled, the collision between the input point cloud and the tool will be detected.

### Configure Point Cloud Collision Detection

1. Click [ Collision Configuration ] on the toolbar to open the "Point Cloud Collision Detection Configuration" window.

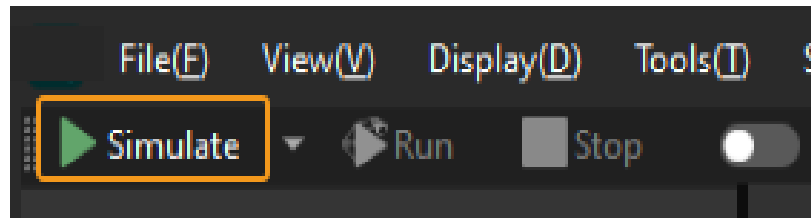


2. Enable collision detection with point cloud, and then set relevant parameters according to actual situation.



### Simulate and Run the Project

1. Click the [ Simulate ] button on the toolbar to simulate the Mech-Viz project.



2. If the simulation performance meets expectations, a Standard Interface program can be used to run the real robot.

Please refer to the picking example program and interface commands in [Standard Interface communication](#) to learn how to write the robot program.



It is recommended that the robot should move at a low speed and that you pay attention to the robot motion trajectory. In an emergency, press the emergency stop key on the teach pendant.

So far, you have learned how to get started with the path planning.

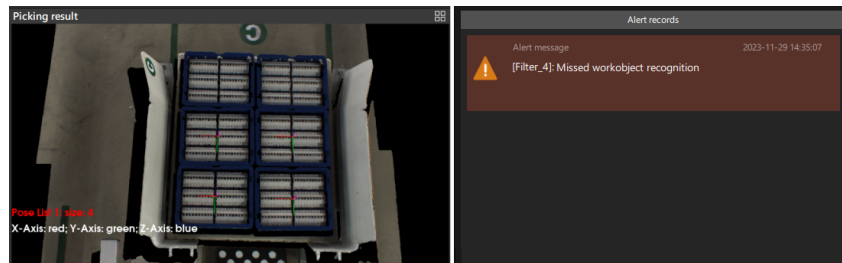
### 3.3.3. Troubleshooting

This section introduces the common problems, possible causes, and solutions for the turnover box depalletizing solution.

## Problem 1: 3D Matching Failure or Missed Turnover Box Recognition

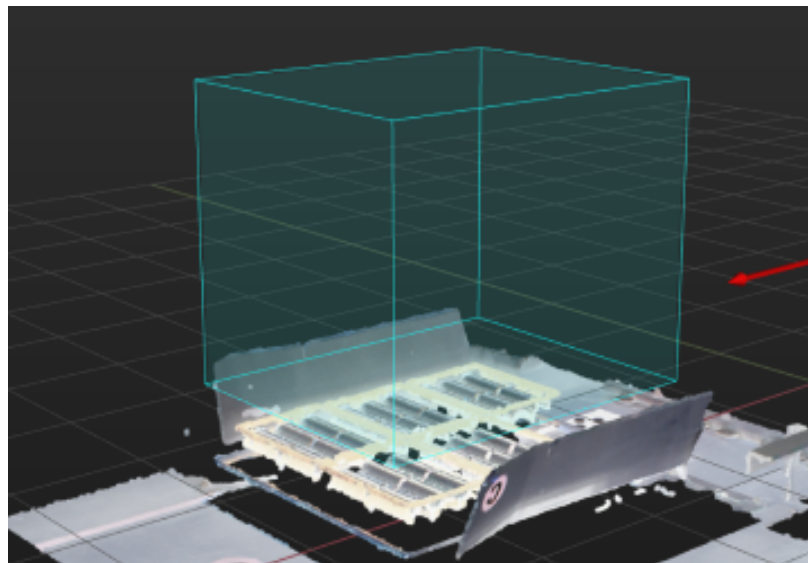
### Symptom

The “Picking sequence” area in the production interface displayed that the input image contained six turnover boxes, but only four turnover box poses were output (as shown in the left figure below), which triggered an alert saying that “Missed workobject recognition” (as shown in the right figure below) in the production interface.

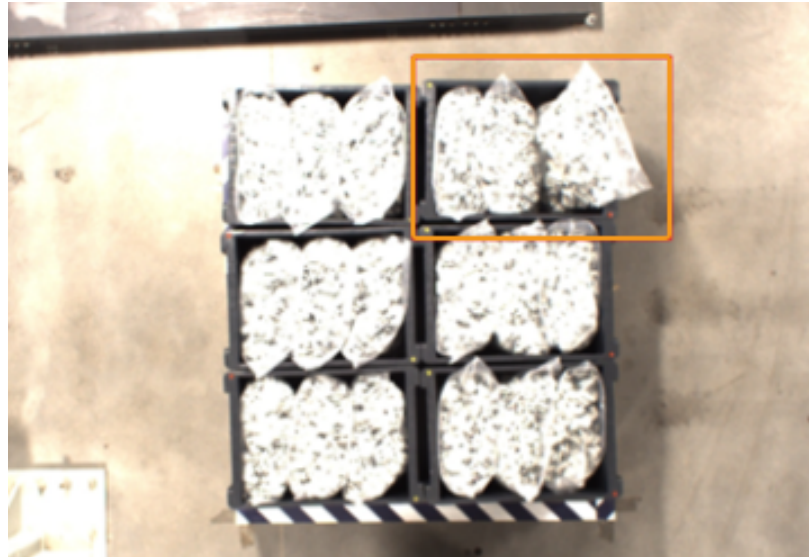


### Possible Causes

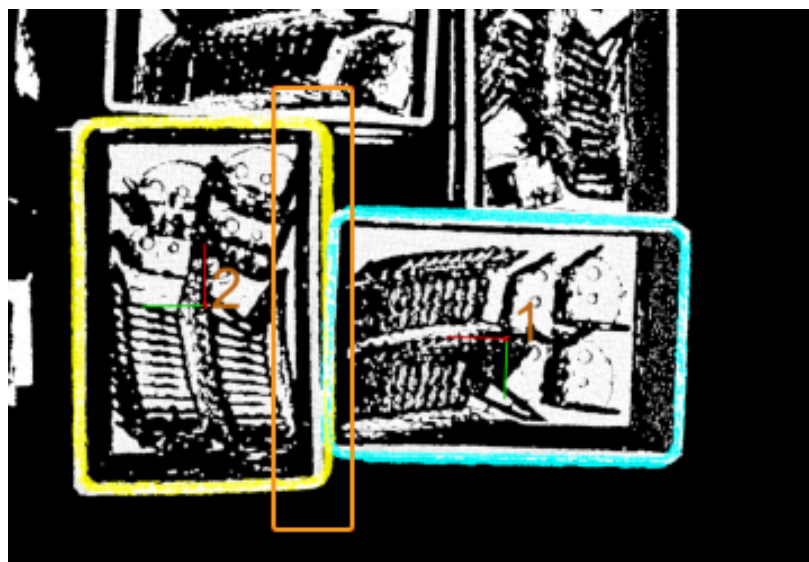
- Due to incorrect setting of 3D ROI, the turnover box(es) is beyond the 3D ROI. Hence, no result can be output from the Mech-Vision project.



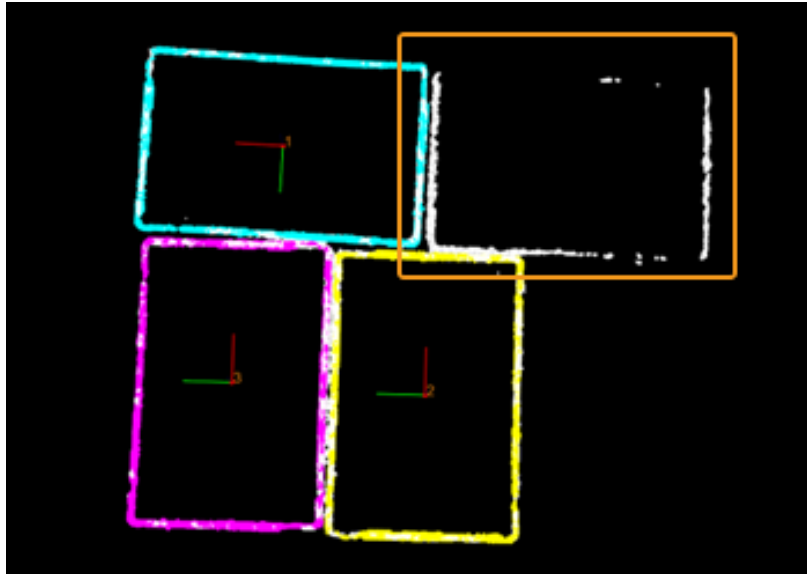
- The material inside the turnover box obscured the top edge of the turnover box (as shown in the figure below), resulting in a low turnover box pose score from 3D matching and no output from the Mech-Vision project.



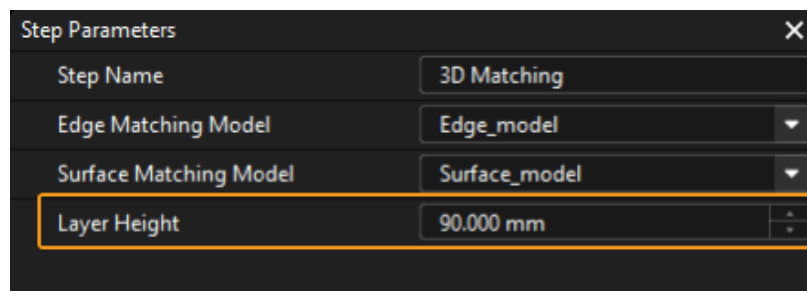
- There was severe deformation in the turnover box, or a large difference in the size of the turnover box, which was significantly different from the point cloud model, resulting in a low turnover box pose score from 3D matching and no output from the Mech-Vision project.



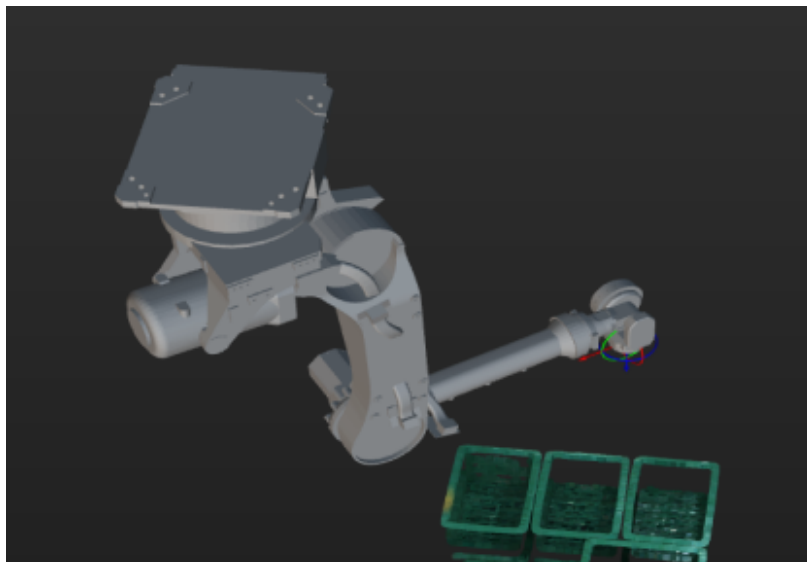
- The turnover box point cloud was in poor quality (as shown in the figure below), resulting in a low turnover box pose score from 3D matching and no output from the Mech-Vision project.



- The parameter of **Layer Height** in the Turnover Box Poses of the Highest Layer Step was not set correctly.



- The robot is mounted on the ceiling or on a slope.

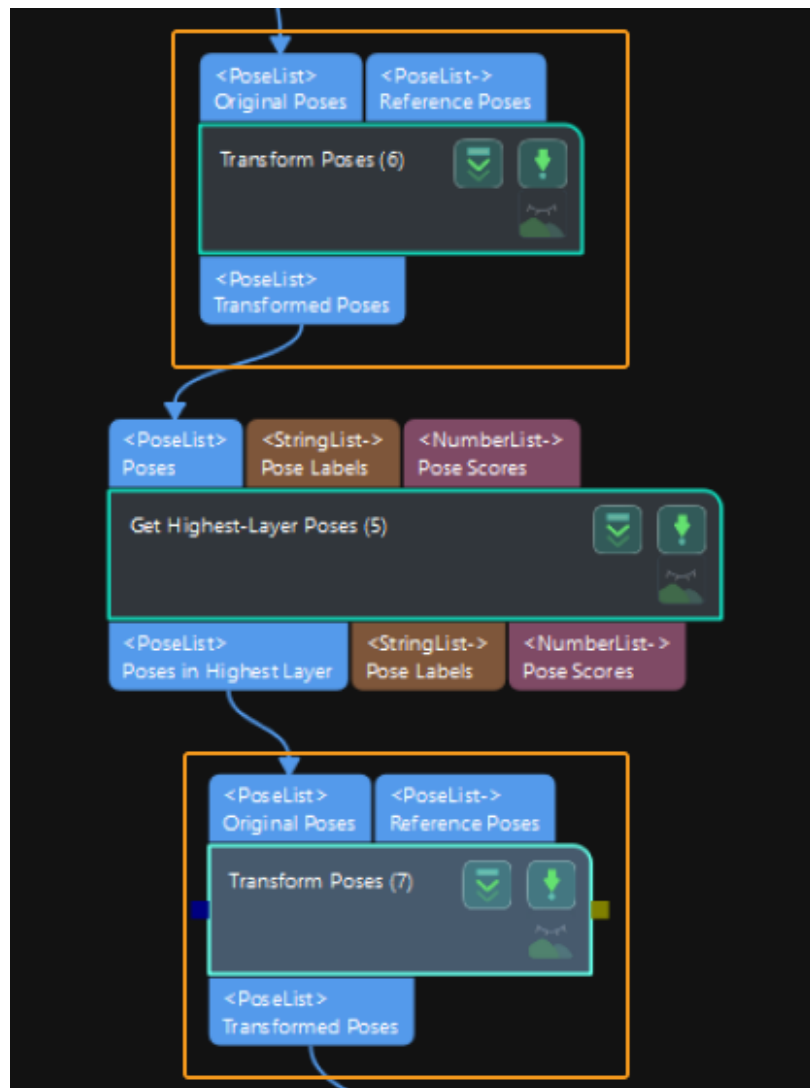


## Solutions

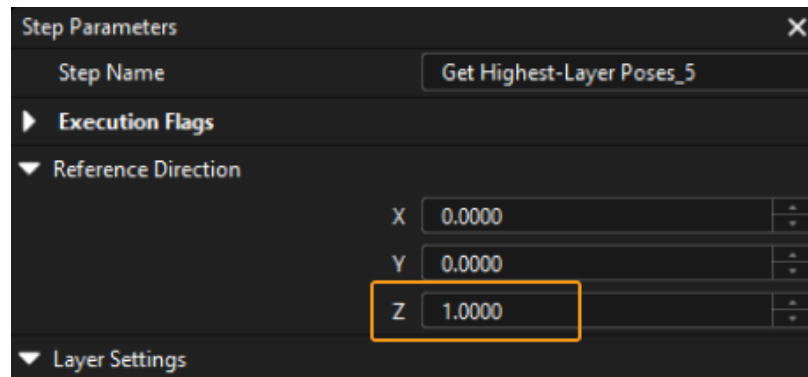
- Reset 3D ROI based on workstation layout and pallet pattern dimensions, so that the turnover box will be within the ROI.

- Regulate incoming material, so that it does not extend beyond the turnover box and does not obscure the top edge of the turnover box.
- Make sure that there is no deformation of the turnover box in the process of real production. Eliminate the deformed turnover box.
- To acquire qualified point cloud, it is recommended to use Mech-Eye Viewer to adjust camera exposure. For detailed adjustments, please refer to **Problem 2**.
- Adjust the parameter of **Layer Height** to the standard height of turnover box.
- If the robot is mounted on a slope, you should obtain the pose of turnover box on the highest layer in the camera reference frame.

First, delete **Transform Poses** Steps before and after Step **Get Highest-Layer Poses** in the **3D Matching** Procedure, and then connect **Get Highest-Layer Poses** Step and **Merge Data** Step.



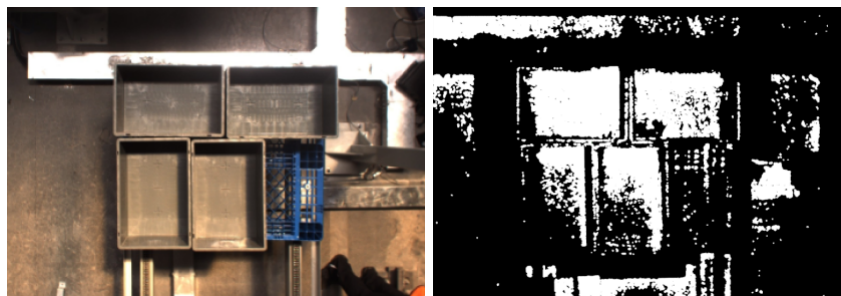
Then go to the Step Parameters panel of **Obtain Poses of Turnover Boxes on the Highest Layer**, set Z value of **Reference direction** to -1.



## Problem 2: Poor Quality of Turnover Box Point Cloud

### Symptom

The obtained turnover box point cloud was in poor quality. As shown in the figure below, the left figure is the 2D image of turnover box and the right figure is the point cloud of turnover box.



### Possible Causes

- The ambient light on site was too strong.
- The setting of camera 3D exposure parameter was not proper.

### Solutions

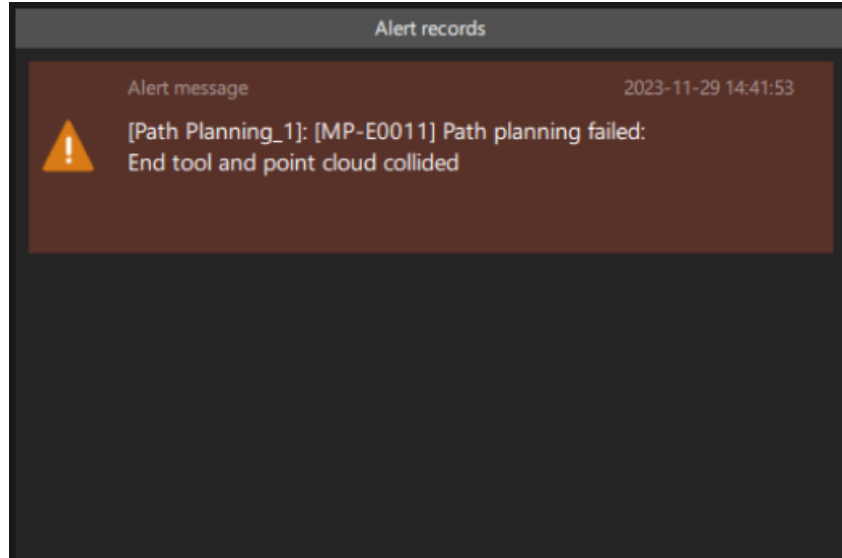
- When the ambient light is too strong, it is recommended to use longer exposure time to enhance the image quality. When the ambient light is too strong and it is not effective to increase the exposure time, you can consider shading the station so that the ambient light intensity at the station remains constant.
- As the captured image tends to be too bright when the turnover box is white, it is recommended to use shorter exposure time; as the captured image tends to be too dark when the turnover box is black, it is recommended to use longer exposure time.
- When there are turnover boxes with different colors, it is recommended to capture images using the method of combining shorter exposure time and longer exposure time, that is, set two exposures in Mech-Eye Viewer as shown below.

Param Name	Value
3D Parameters	Auto Set
Exposure Multiplier	2
Exposure Time	12.0 ms
Exposure Time 2	8.0 ms

### Problem 3: Path Planing Failure Resulting in Tool Colliding with Point Cloud

#### Symptom

The path planning failed, and the alert message saying that “tool collided with point cloud” appeared in the production interface.

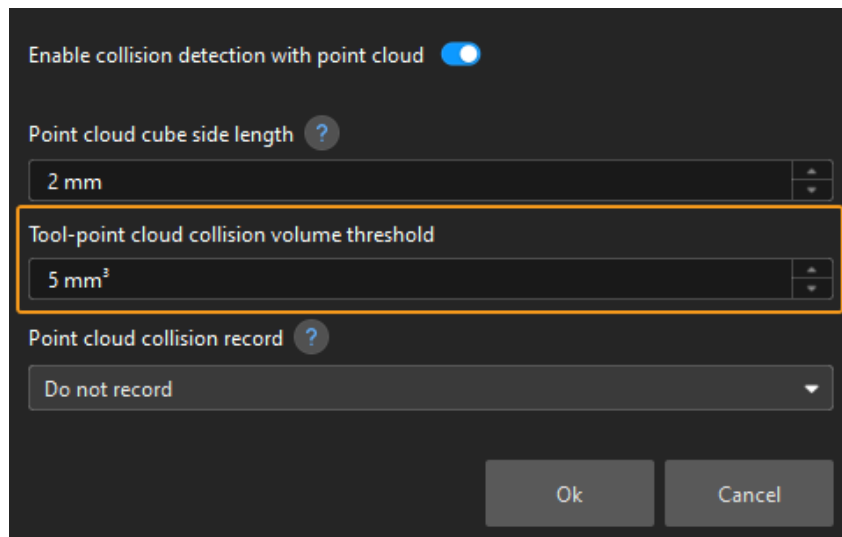


#### Possible Causes

- As the material exceeded the top edges of turnover box, the robot collided with material when the robot simulated picking the turnover box.
- When the robot simulated picking the turnover box, it detected that the collision volume between the end tool and the point cloud exceeded the **Collision Volume Threshold**.

#### Solutions

- Regulate incoming turnover box material, and make sure the material does not extend beyond the turnover box.
- Adjust **End Tool and Point Cloud Collision Volume Threshold** in the **Point Cloud Collision Detection Configuration**.



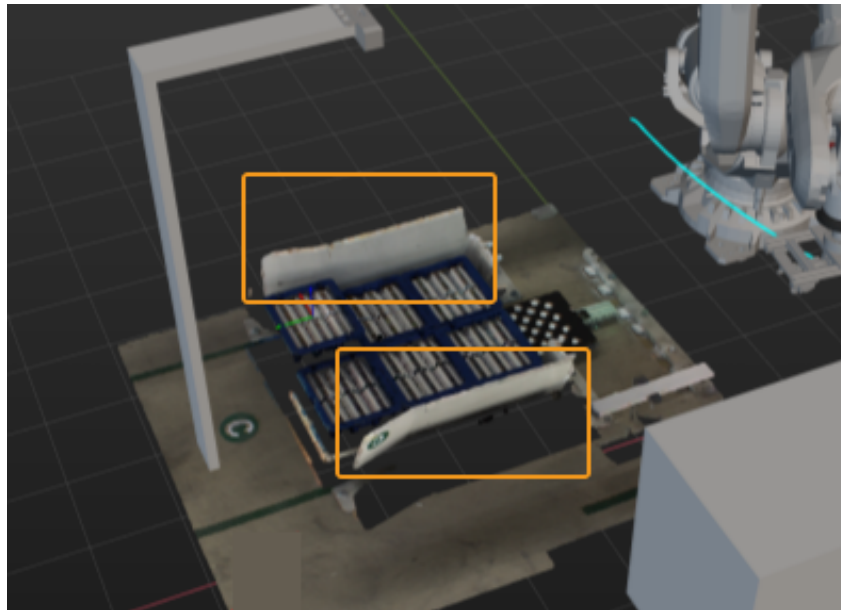


## Problem 4: Too Much Point Cloud Noises in Mech-Viz or Presence of Scene Point Cloud Unrelated to Picking

### Symptom

There were too much noises in the point cloud sent to Mech-Viz, or there were scene point cloud that was not relevant to picking (except ROI).

Take the following figure as an example, scene point cloud that was unrelated to picking was displayed in the Mech-Viz 3D simulation area.



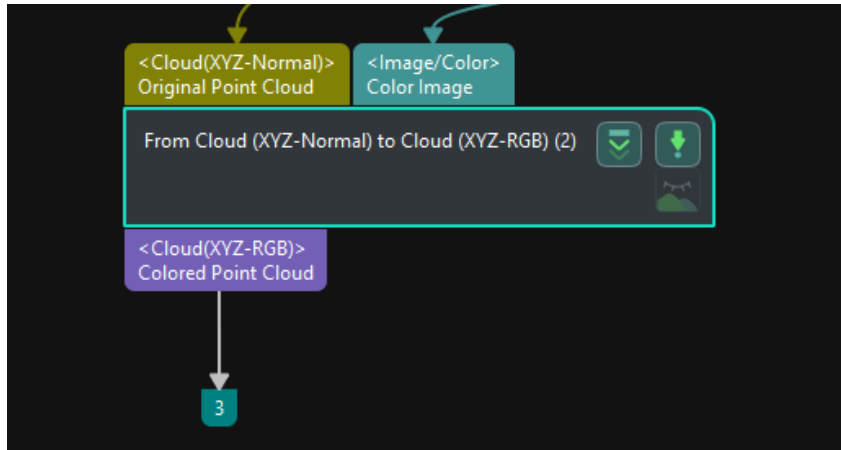
### Possible Causes

The point clouds sent to Mech-Viz have not been preprocessed.

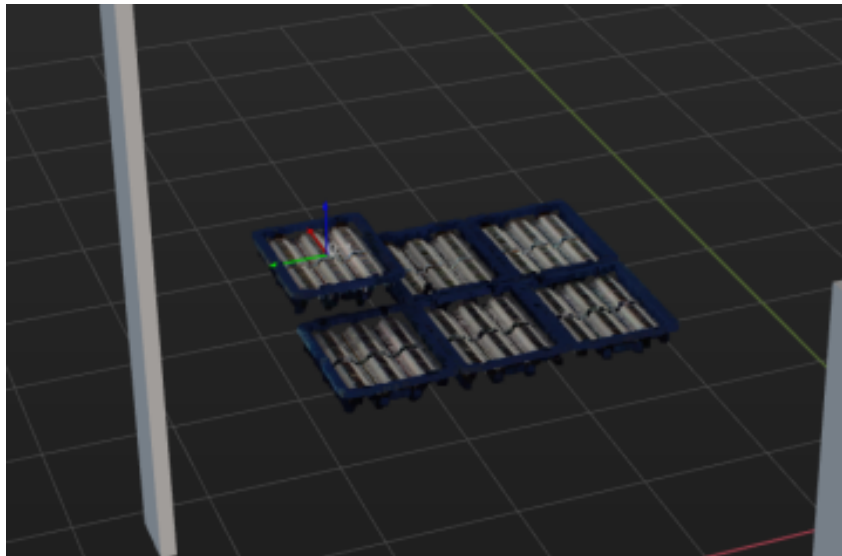
### Solutions

As in the **From Cloud (XYZ-Normal) to Cloud (XYZ-RGB)** Step, the preprocessed point cloud is input into the first input port, you need to connect the **Send Point Cloud to External Service** Step to send the preprocessed point cloud to Mech-Viz.

As shown in the figure below, the **Colored Point Cloud** output port of this Step is connected to the **Collision Point Cloud** input port of the **Path Planning** Step.



After point cloud preprocessing, the point cloud in the Mech-Viz 3D simulation area is shown in the figure below. The scene point cloud that is unrelated to picking is removed.



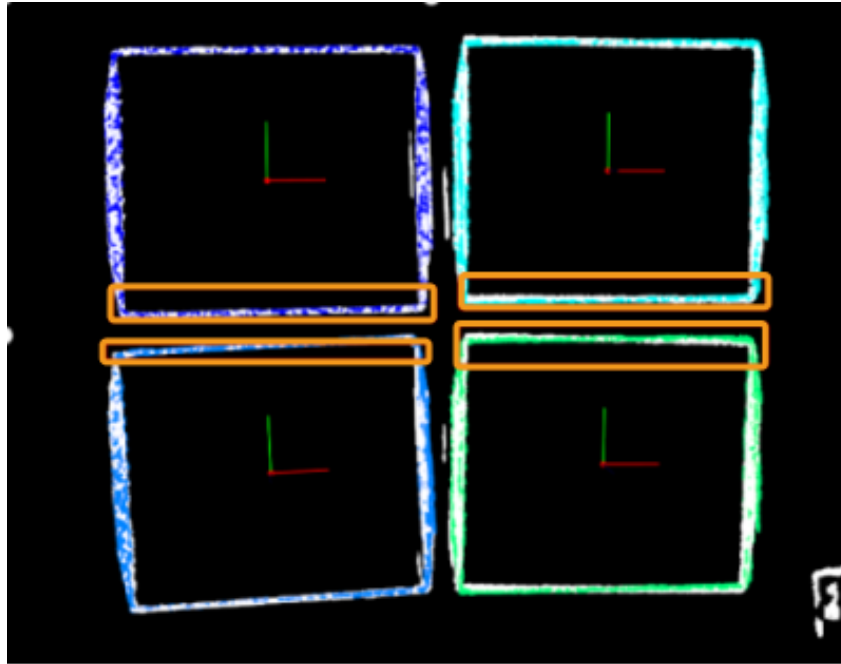
### Problem 5: Possible Collision between the Gripper and Turnover Boxes When Picking

#### Symptom

When the robot picked the turnover boxes, it was possible for the gripper to collide with the turnover boxes.

#### Possible Causes

During the picking process of the robot, the gripper needs to reach into the gap between two neighboring turnover boxes (as shown in the figure below), and thus is prone to collision.



## Solutions

To avoid the collision, Mech-Viz is needed for collision detection. The configuration method is shown below.

1. After importing the gripper model into the Mech-Viz, click [ **Collisions** ] at the bottom of the panel, and then click [ **Collision detection configuration** ] at its top.
2. In the “Collision Detection Configuration” window, select **Detect collision between held workobject and others**, and then set **Point cloud cube edge length** and **Collision volume threshold** according to actual situation.

