



Cognex In-Sight URCaps User Guide

This User Guide describes how to set up the Cognex In-Sight URCaps together with a Cognex In-Sight Vision System (Series 7000 Gen2 or 8000) and Universal Robot (UR3, UR5, or UR10) to develop a robot guidance application.

Introduction:

The Cognex In-Sight 2D Robot Guidance plugin greatly simplifies the communication, hand eye calibration, and vision guided robotics development between a UR robot and Cognex In-Sight 2D Vision System.

Take advantage of Cognex's world class vision tools for any robot application. The system can be used to guide the robot to specific coordinates, inspect the part after manipulation, and output valuable data for downstream analysis.

For further details on how to setup and program the Cognex Vision System or the Universal Robots please see the respective manuals.

Supported Products:

Cognex	Universal Robots
In-Sight 7000 Gen2 Series	UR3
In-Sight 8000 Series	UR5
	UR10

UR PolyScope® Support

Version 3.5 or greater

Cognex In-Sight URCaps

This user guide references v 1.2.2 of the Cognex URCaps program

Please visit Cognex.com/URCaps for further details and to download the URCaps software.

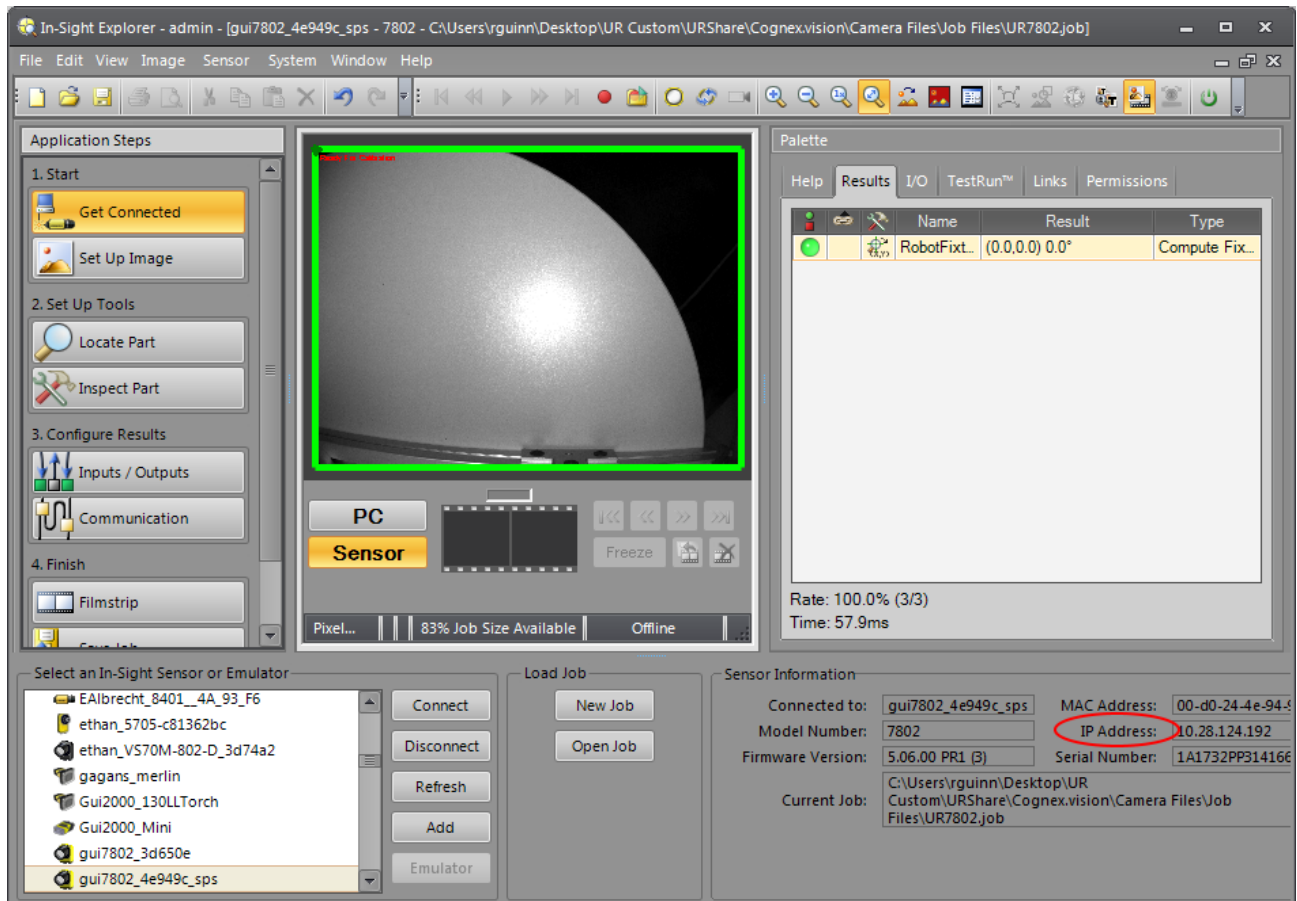


Connection and Calibration:

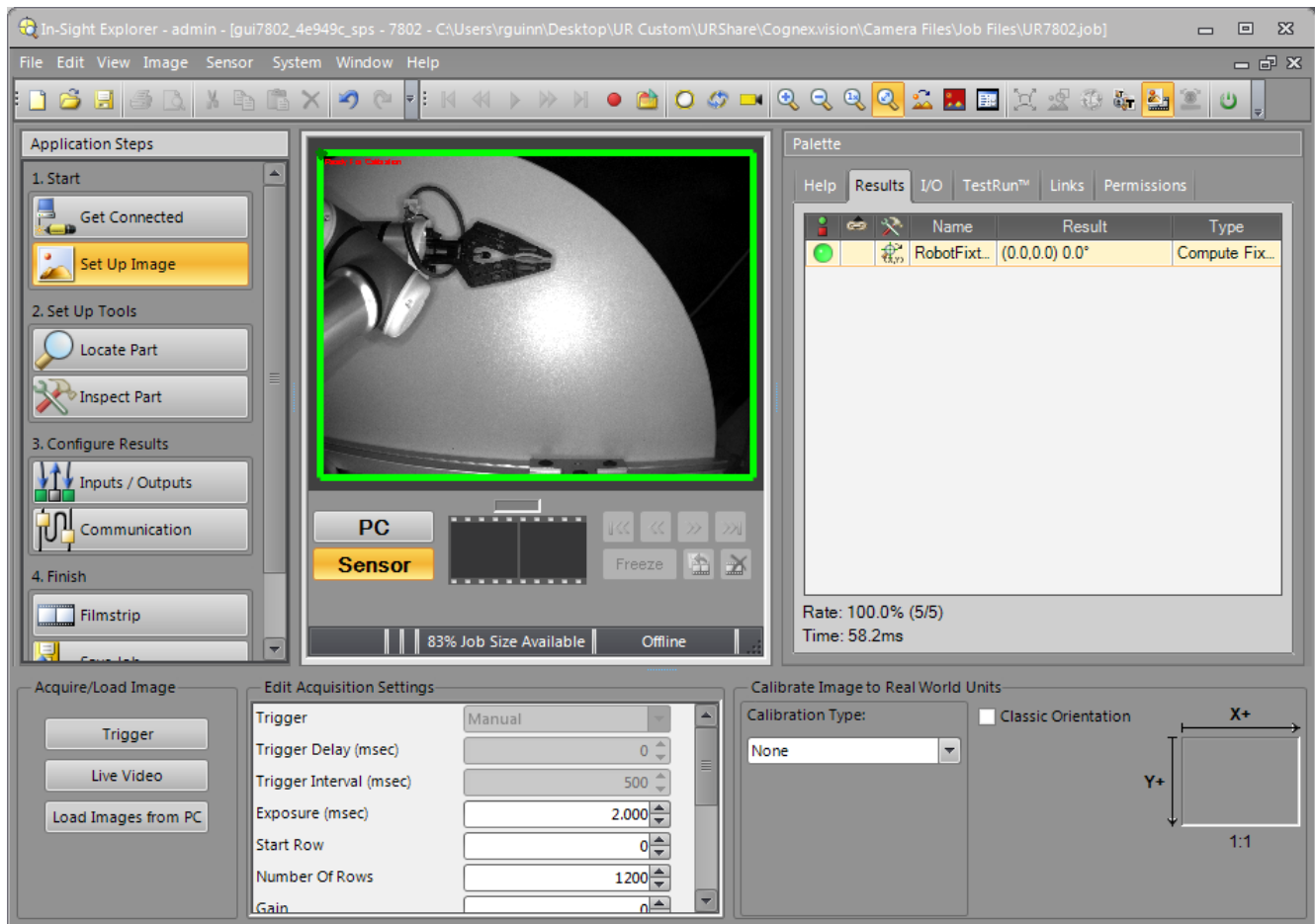
Camera Instructions:

To get started, mount the camera in an area where the parts will be presented to the robot. Be sure there is enough clearance between the robot's pick location and the area where the camera is mounted. Move the robot's tool center point (TCP) into the camera's field of view (FOV).

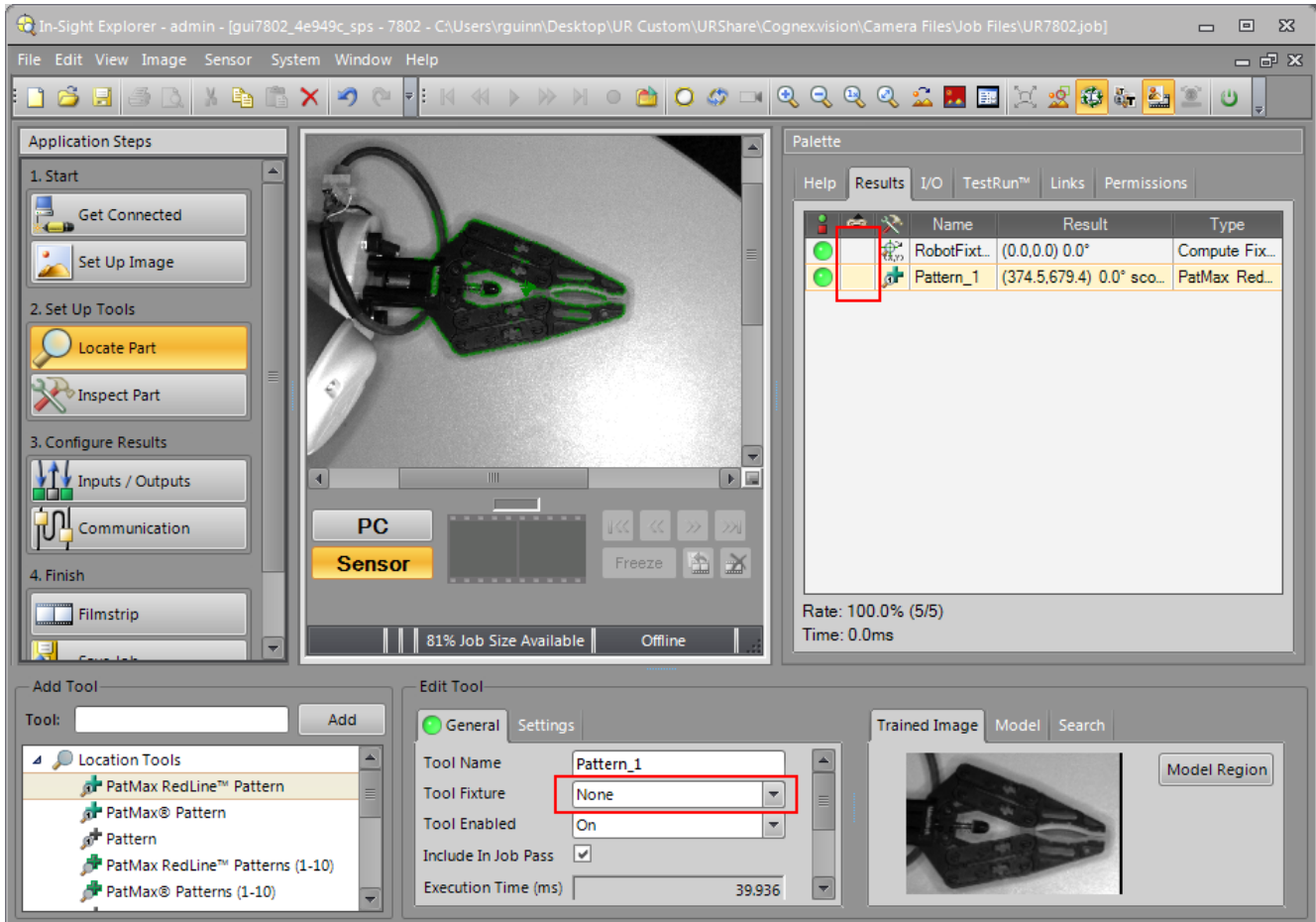
1. Open In-Sight Explorer (Easy Builder interface) and connect to the camera mounted in the robot work cell.
2. Load the URCaps job associated with your camera (take note of the IP Address).
 - a. A RobotFixture tool will automatically be added to the job under the Results tab.
 - b. URCaps is supported on 2 In-Sight Vision Systems (In-Sight 7000 and In-Sight 8000). You will need to choose the appropriate job file for your particular camera.
 - i. IS7XXX Mono
 - ii. IS7XXX Color
 - iii. IS8XXX Mono
 - iv. IS8XXX Color



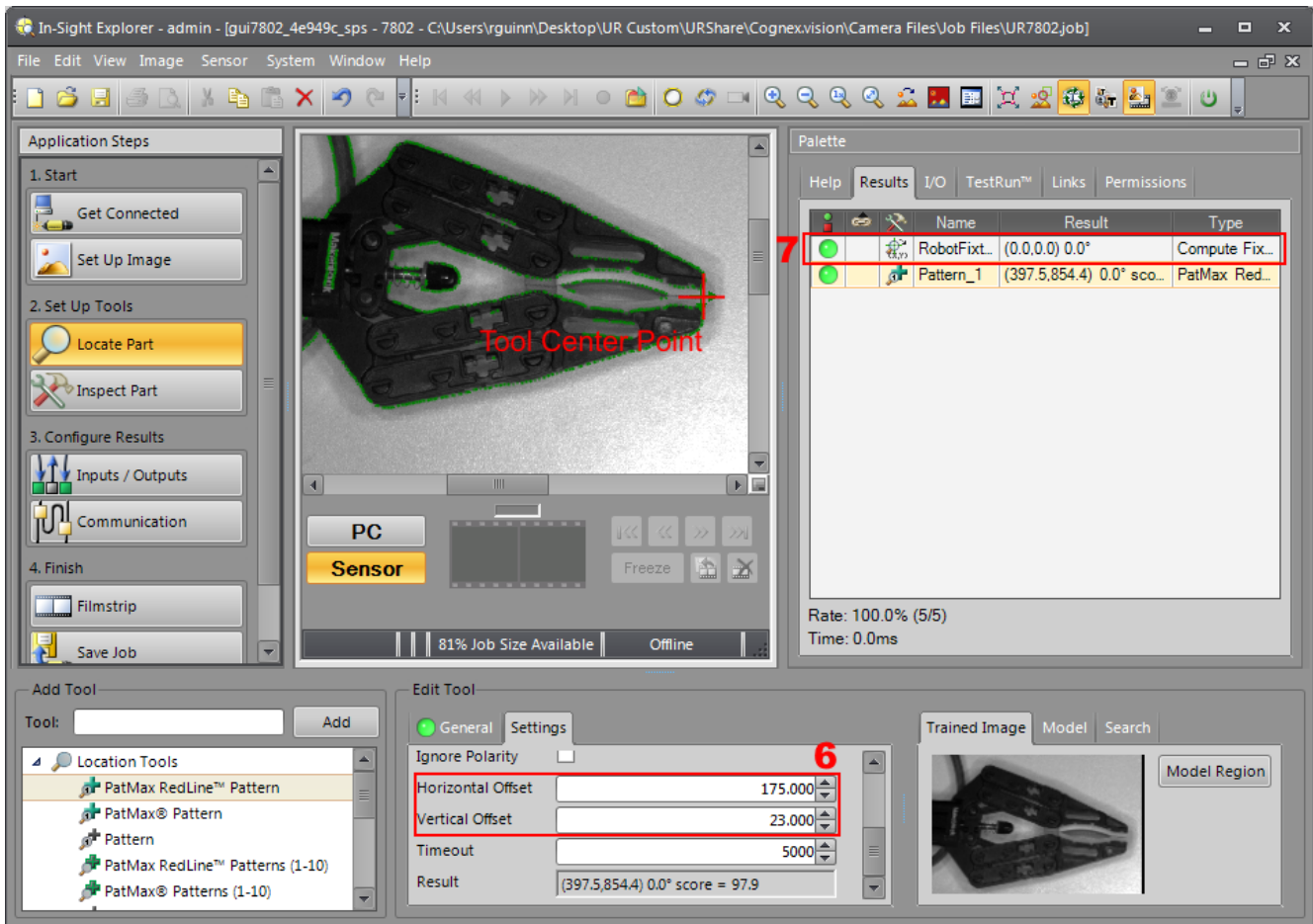
3. Go to the “Set Up Image” step.
4. Ensure the Tool Center Point or the part being picked by the robot is within the FOV and adjust image settings to get a well-lit and focused area of your tool.
 - a. **Note:** Do not change the calibration type at this point, it would overwrite the calibration settings you are about to perform and you would have to start over.
 - b. **Note:** The default gain in the supplied job file is configured for a 5MP sensor, this may need to be adjusted if you are using a 2MP sensor.



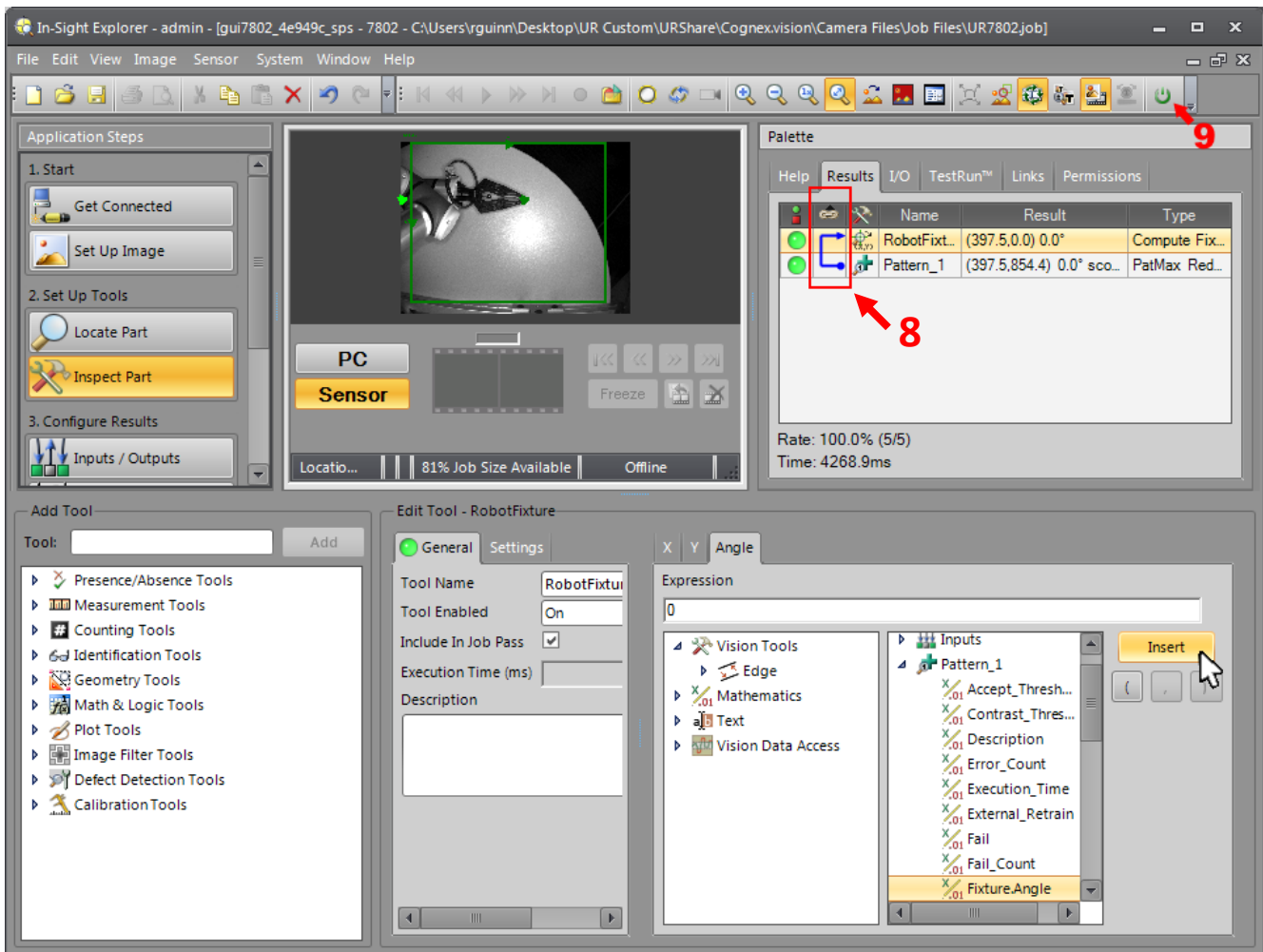
5. Add any necessary tools to locate your part.
 - a. Any unique area of your end of arm tooling will work here.
 - b. When you assign a tool (in the example below, a PatMax RedLine Pattern) click the tool and set the Tool Fixture to "None".
 - i. **Note:** This is important. Most tools will default to using the Robot Fixture as the Tool Fixture. If you do not change to none you will not have the ability to set up the RobotFixture correctly in step 8.



6. Adjust the crosshair on your tool to be centered on the TCP by adjusting the offsets:
 - a. For a Pattern tool, click on the Settings tab and adjust the Horizontal Offset and Vertical Offset to align the crosshair as close to the TCP as possible.
 - i. More info on TCP Configuration available in [Appendix B](#).
7. Next, connect the vision tool to the RobotFixture by selecting the RobotFixture tool In the Results Pane. This will bring up the RobotFixture settings in the Edit Tool area.



8. Click on the “X” Tab, and select the Fixture.X function under the tool you are using to locate the tool tip.
 - a. Repeat this step for the “Y” and “Angle” tab.
 - b. At this point, your vision tool is “wired” to your RobotFixture tool, and you are ready to bring the job Online.
9. Switch the Camera to “Online Mode”.
 - a. **Note:** This is a critical step. If the camera is not Online, it will not be able to communicate with the robot.



10. When you run Calibration on the robot (this is described in the next steps), the display will indicate the status of the calibration in the top left. Once the robot is finished, the calibration will be saved on the camera as "<DateTime>Calib.cxd"
 - a. This calibration file can now be imported later to this job or to start a new job (this is described later as well).



Robot Instructions:

Now that the job file is running, it's time to go to the robot teach pendant to run the URCaps hand eye calibration routine.

Install the URCaps:

1. Go to Cognex.com/URCaps to download the URCaps file, and transfer to a USB stick.
2. Insert a flash drive with the URCaps file into the teach pendant.
3. From the main menu, go to Setup Robot->URCaps and then click the "+" button to add the URCap file.
4. Restart the robot when prompted.

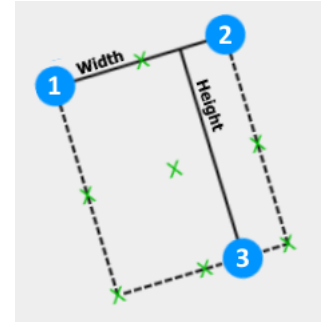
Connection and Hand Eye Calibration:

1. In the program menu, go to the Installation tab.
2. Click on the Cognex URCap.
3. Enter the IP address for the camera you want to connect to.
 - a. Press the Refresh button to confirm that the camera and robot are communicating properly.
 - b. The following errors could be displayed if it fails to establish a connection:

Error Message	Troubleshooting
Note: The format of the IP Address is invalid (example address: 10.28.183.134)	• Check that the IP Address from the camera is entered correctly
Note: Camera was not identified, ensure IP address is valid before proceeding	• Check that the IP Address from the camera is entered correctly
Note: Timeout reached, make sure the network adapter is enabled in: Set Up Robot -> Network.	• Check that the robot is on the network
Note: The current job file is not configured to perform a calibration.	• Check that the job file contains the robot fixture tool and it is wired to a location tool
Note: Make sure the camera is online and the proper job file is loaded.	• Check that the camera is in Online Mode

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4. Set the work plane by aligning the Tool Center Point with the points that define your work plane. (See [Appendix A](#) for a visualization).
 - a. This step defines your work plane, which corresponds to the field of view (FOV) of your search area.
 - b. The user will guide the robot to 3 different points as defined by this grid on the right.
 - c. Click the “Set Point” button to bring up the Robot Move tab, guide the robot to the desired point, and press OK to save the waypoint.
5. Once all points have been set, the Start Calibration button will be enabled. Click the “Start Calibration” button and wait for a pop-up message to indicate that the robot has finished calibration.
6. Click “OK” when complete.



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Connection

 IP Address: 

Camera name: gui7802_4e949c_sps

Calibration

Width: 57.50 mm

(1) Work Plane Corner 

(2) Work Plane Corner 

Height: 236.71 mm

(3) Work Plane Edge 

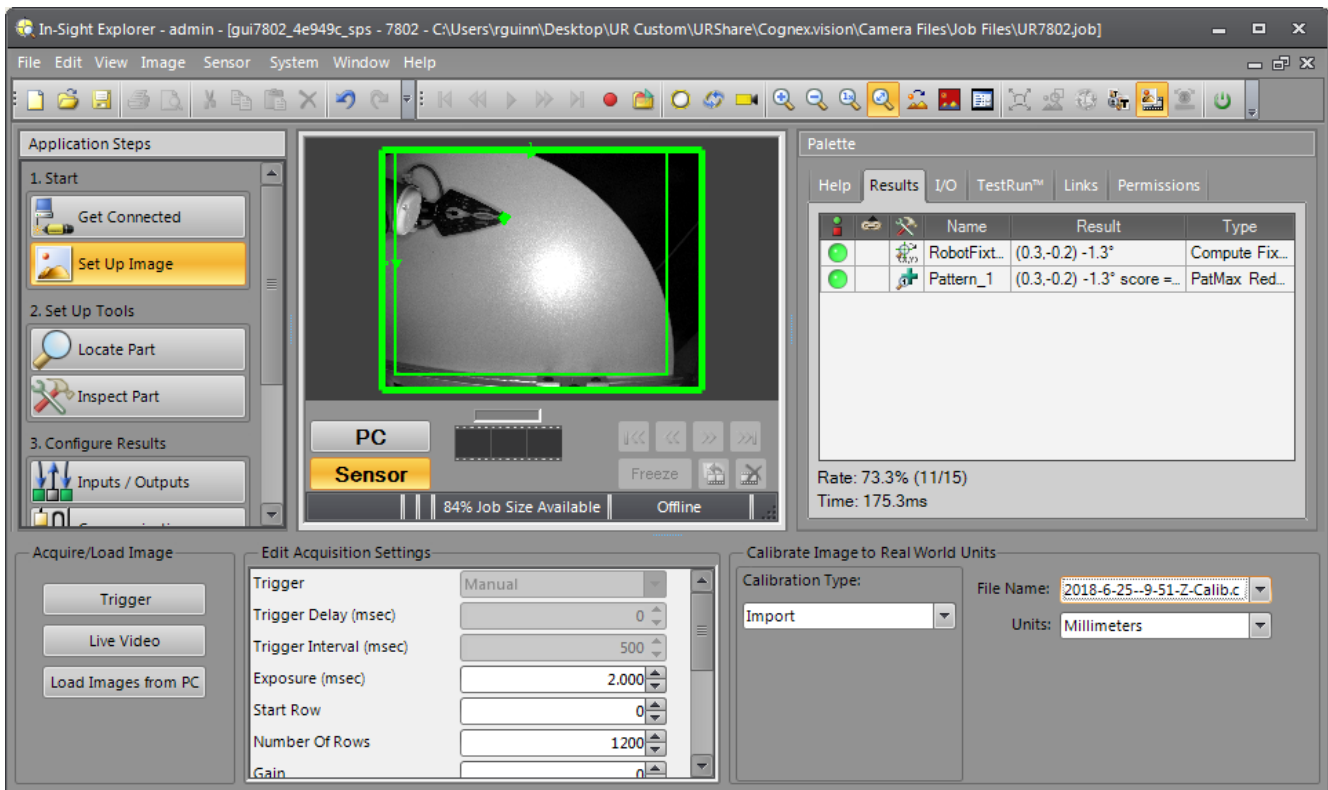
A diagram showing a tilted rectangular grid representing a work plane, identical to the one in the previous image. It features dashed lines with green 'x' marks at the corners and midpoints. Three points are highlighted with blue circles and numbered: Point 1 at the top-left corner, Point 2 at the top-right corner, and Point 3 at the bottom-right corner. The horizontal distance between Point 1 and Point 2 is labeled 'Width', and the vertical distance between Point 2 and Point 3 is labeled 'Height'.

Vision Guided Robotics (VGR)

Camera Instructions:

Now that the calibration file has been created, you can now use the URcap to create a program to guide the robot to a specific location supplied by the camera “camera pose”.

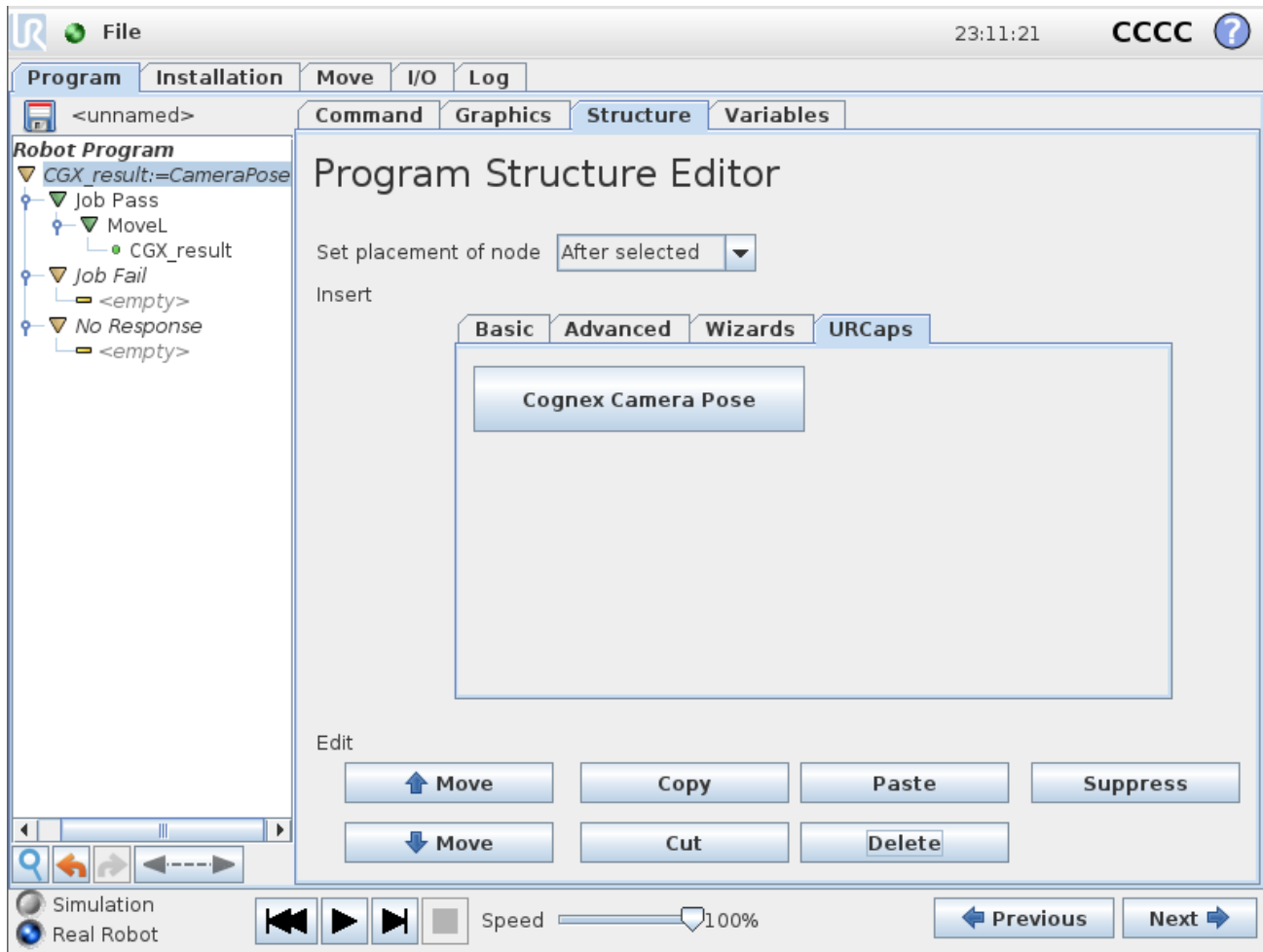
1. To get started, either load the default URcap job or continue using the job that was used for calibration in the previous step (camera must be offline).
 - a. It is a good idea to save a copy of the job file before importing the calibration in case you want to use it to perform another calibration. Once a calibration is imported, the job file can no longer be used to perform a calibration.
2. A calibration must be loaded into the job, to do this go to the “Set Up Image” step and choose “Import” from the “Calibration Type dropdown” selector



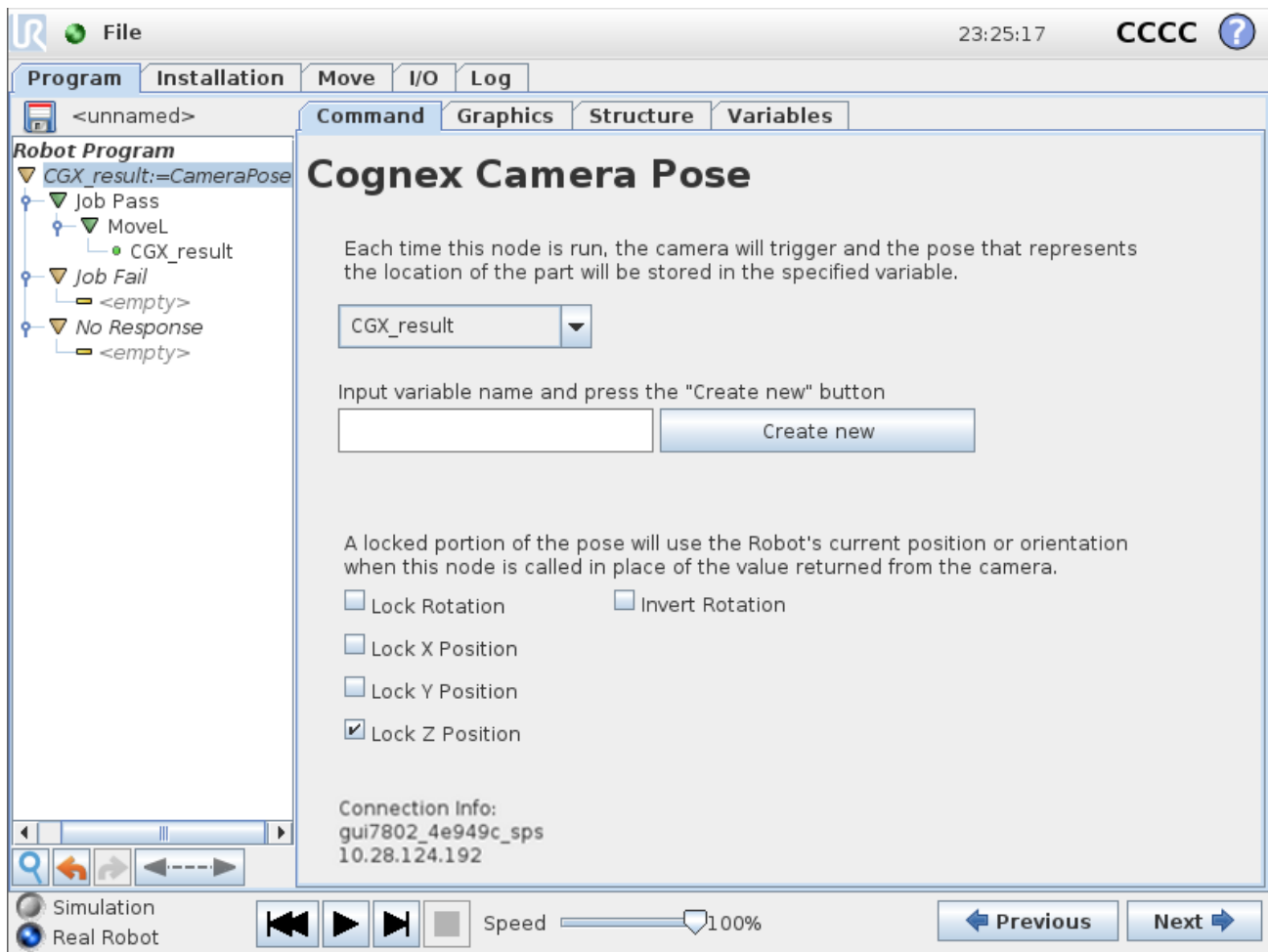
3. Set up the necessary Locate tools to find the part you want the robot to pick and wire that tool's X, Y, and angle values to “RobotFixture”
 - a. This is the same process that was used during calibration step 8.
4. The job is now configured to run VGR, simply switch it online and it will respond to the robot commands.

Robot Instructions:

1. In order to receive a Camera Pose from the camera, add the Cognex Camera Pose Node into your robot program from the URCaps Tab in the Structure Menu.



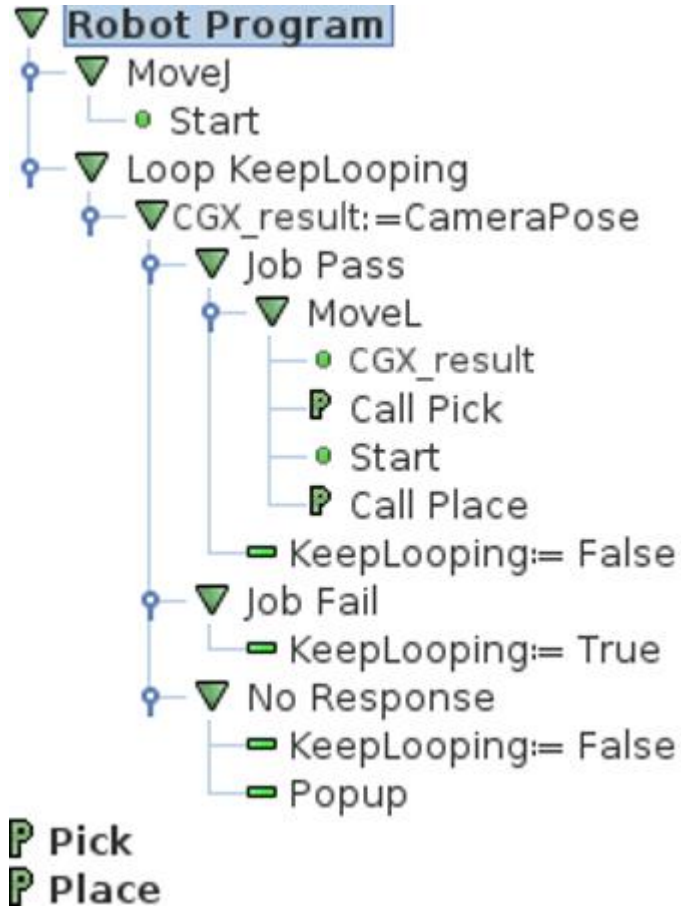
2. By default, a variable named “CGX_result” will be created for you to store the pose from the camera. This pose will correspond to the location of the part that the camera finds.
 - a. A different variable can be used by selecting it from the dropdown menu or by creating a new one.
3. Lock any positions you do not wish to obtain from the camera (if unlocked, the rotation will be relative to the current rotation). By default, the height is locked to approach above the part.
4. When the Cognex Camera Pose node is reached in the robot program, the camera will trigger and communicate the result to the robot.
5. There are three paths a program can go down, based on the response from the camera.
 - a. If the job running on the camera passes, the variable storing the camera pose is updated and the program will execute the child nodes under the “Job Pass” node. By default, the robot will move linearly from its current location to the Camera Pose.
 - b. If the job running on the camera fails, the variable will not be updated and the child nodes under the “Job Fail” node will execute.
 - c. If a response from the camera is not received, the variable will not be updated and the child nodes under the “No Response” node will execute.



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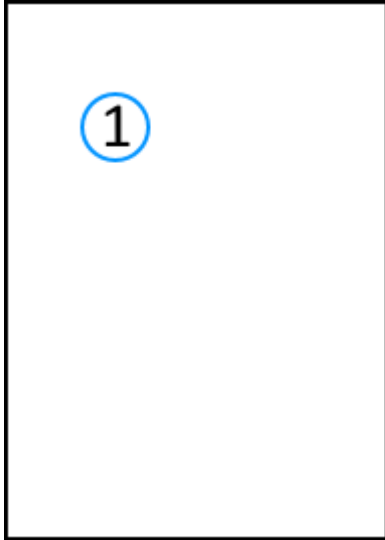
Example Robot Program

Below is an example of a basic pick and place using the camera to locate the part.

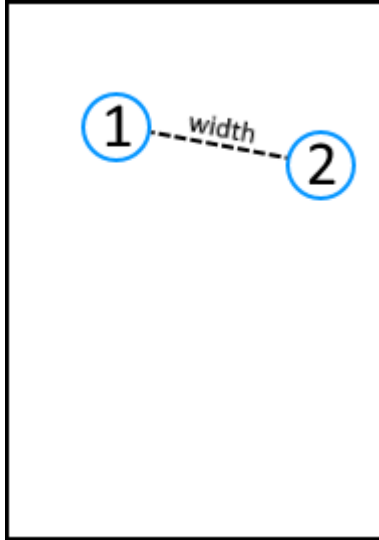


Appendix A – Calibration Visualization

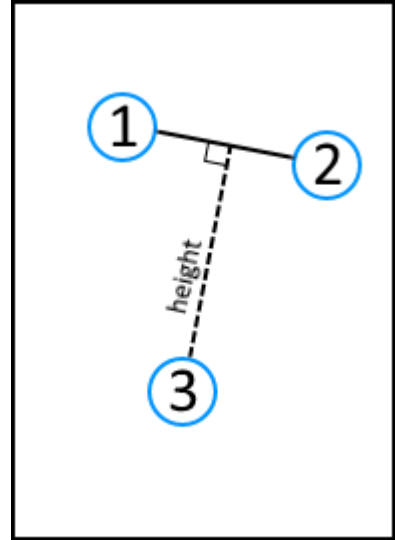
1) The first point can be in any corner of the work plane



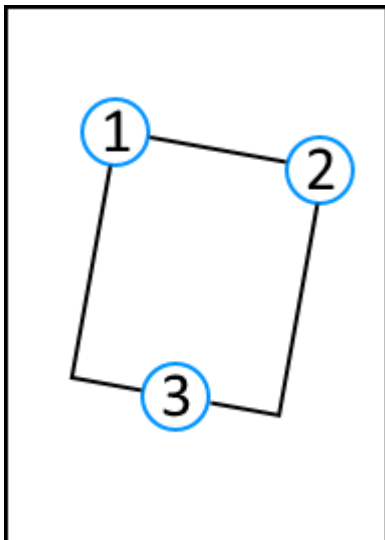
2) The second point will define the first edge of the work plane



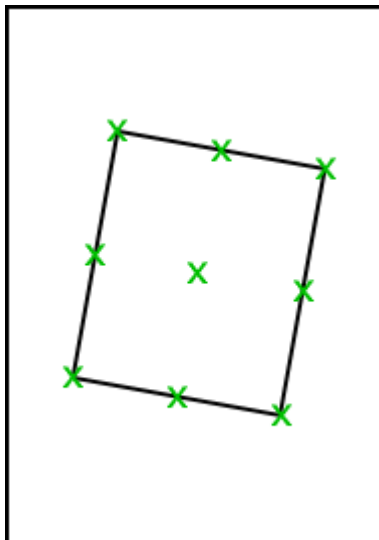
3) The third point defines the height of the work plane



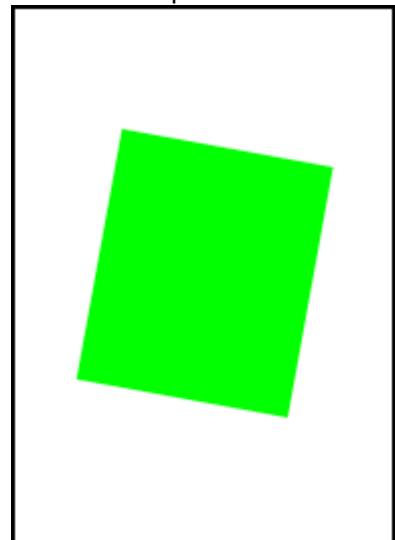
4) The black box is the work plane defined by these 3 points



5) During calibration, the robot will travel to a grid of points within the work plane



6) The generated calibration can be used to determine the position of any part in the work plane

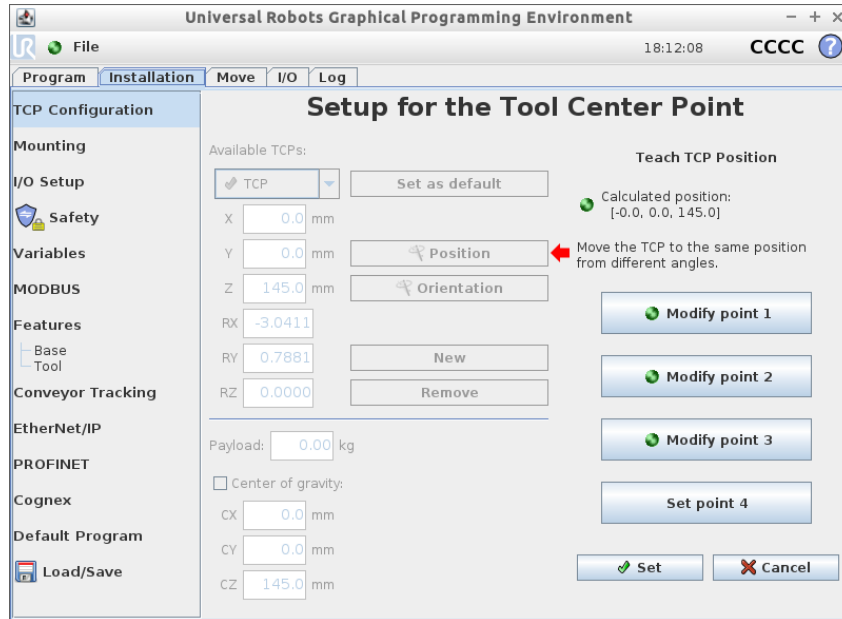


Appendix B – Tool Center Point (TCP) Configuration

Position Configuration

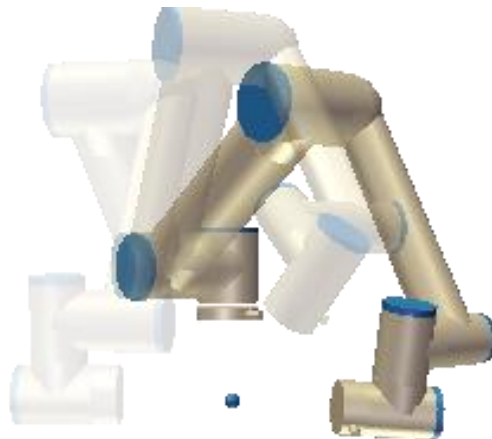
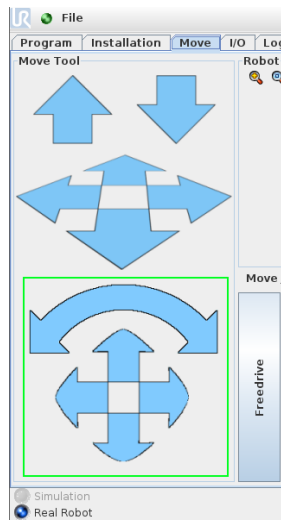
Setting the Position:

The position of the TCP can be configured by measuring the tool manually and entering the measurements relative to the tool flange, or by using the Position wizard.



Testing the Position:

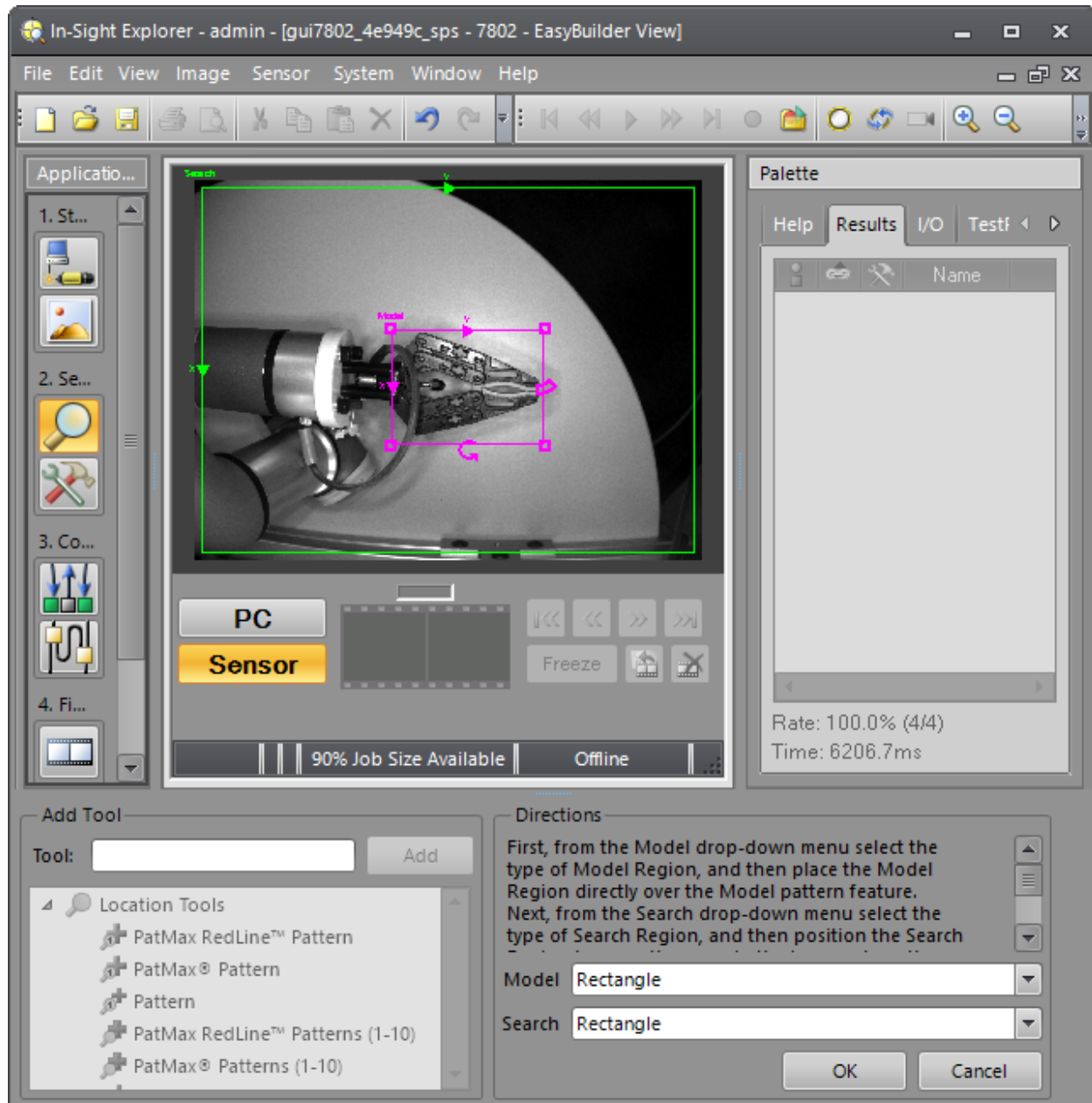
The Position of the TCP can be tested by using the controls in the Move tab. While using the controls inside the green box, the TCP should not move, only change orientation.



Locating TCP on the camera

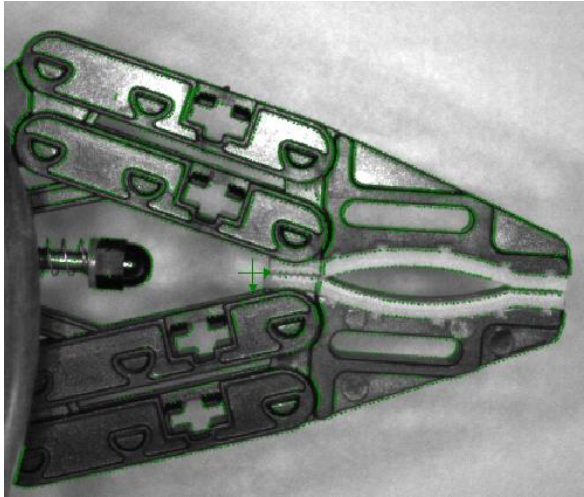
During calibration, the robot sends the location of the TCP to the camera. The user must specify where in the image, that TCP is located.

1. Locate Gripper



2. Specify TCP Location Relative to the pattern

Default:



General Settings

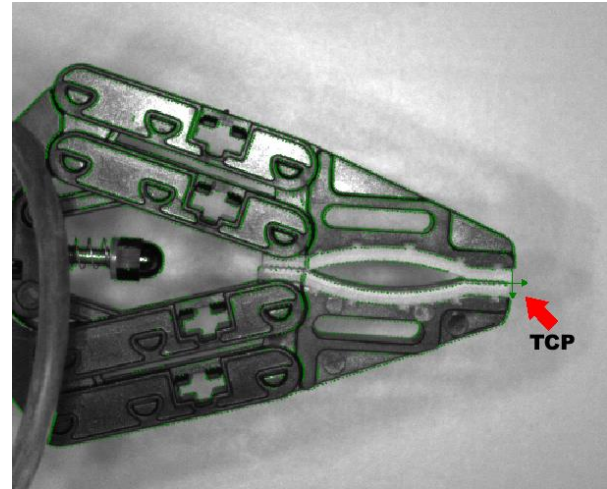
Ignore Polarity ☐

Horizontal Offset

Vertical Offset

Timeout

With Adjustments:



General Settings

Ignore Polarity ☐

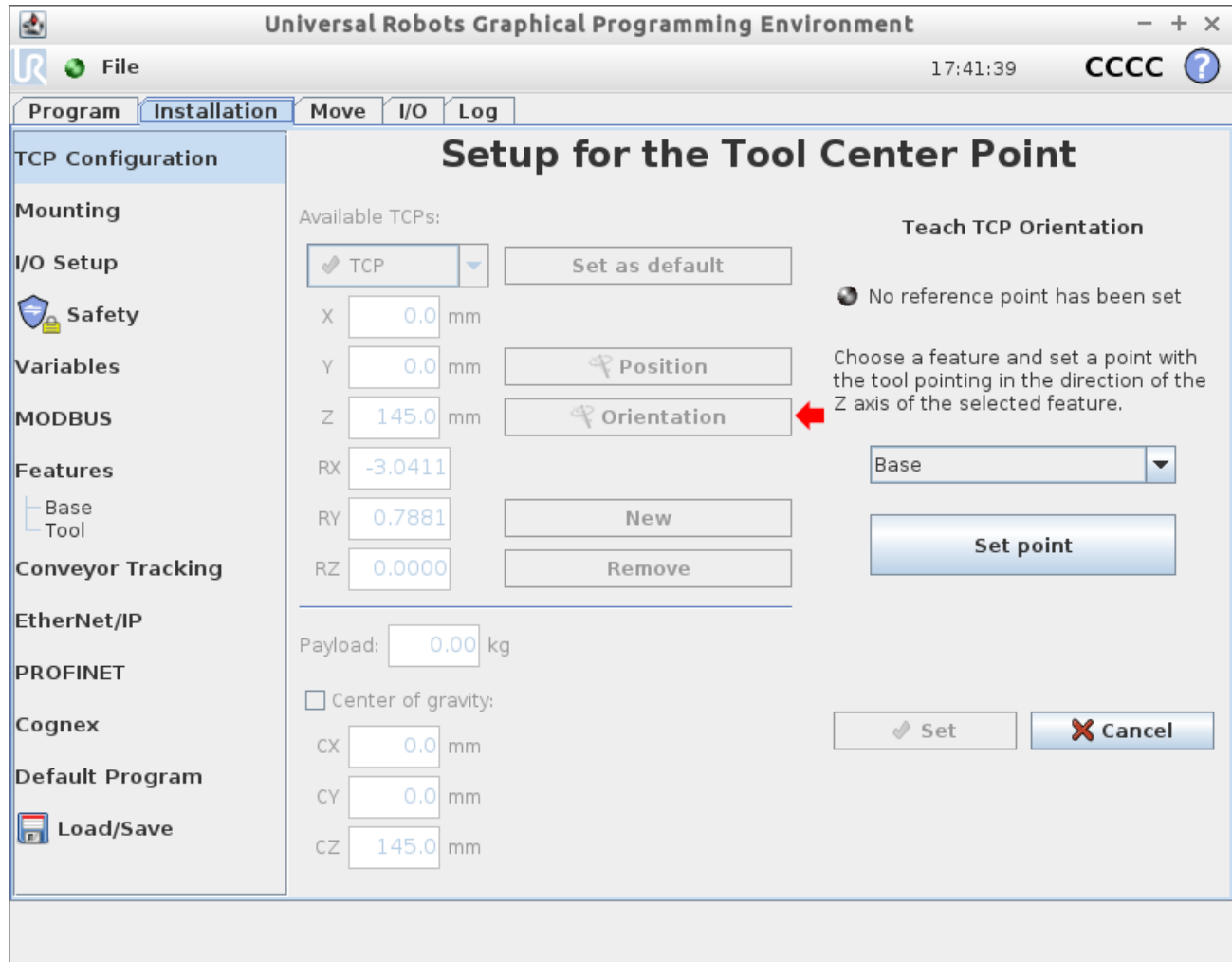
Horizontal Offset

Vertical Offset

Timeout

Orientation Configuration

Use the Orientation Wizard in the Installation tab to set the axis the robot will rotate on.



When setting the point, put the arm in the orientation it will be in while doing a pick as part of a “pick and place.”