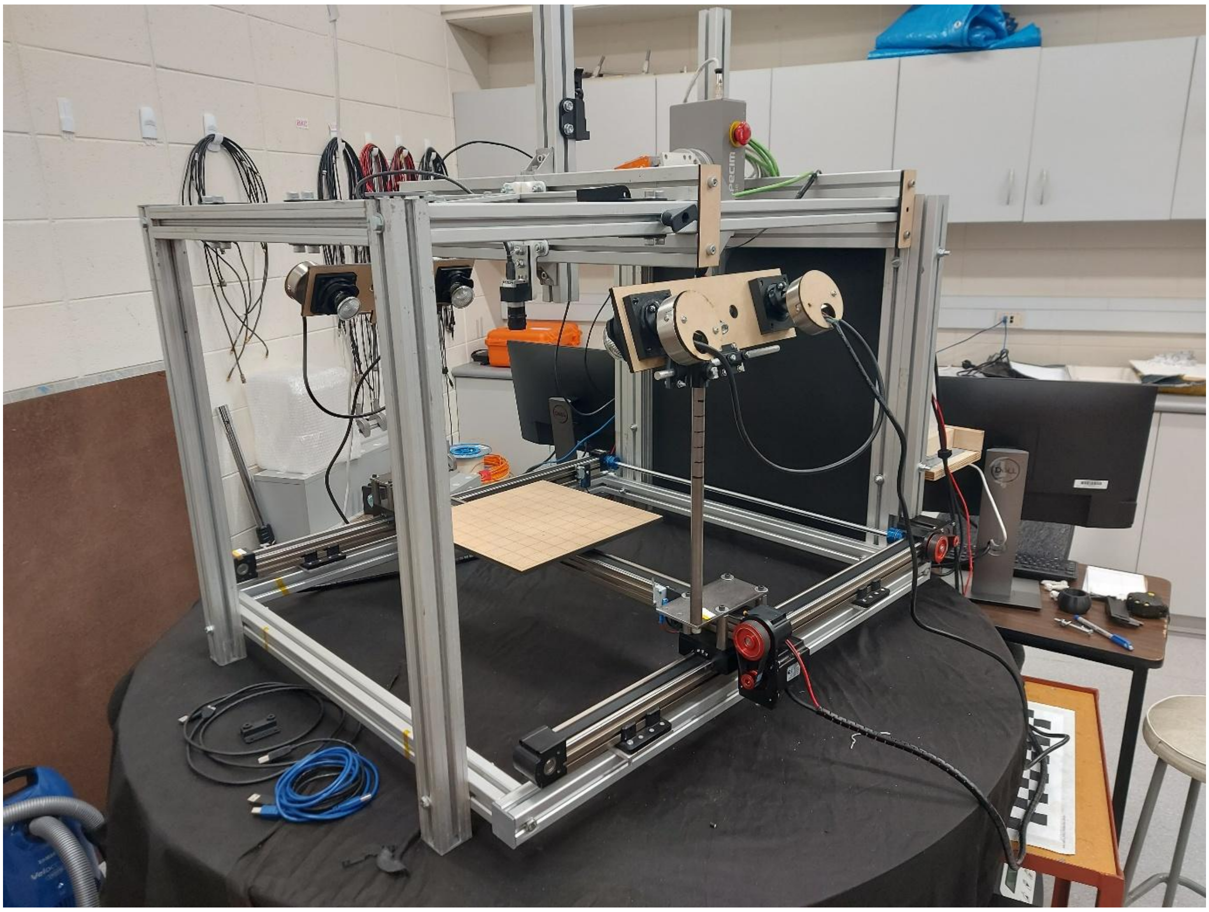
User Guide for Testing System



Contents

Inventory 2
Setup 3
- Basler RGB Camera 3
- Specim IQ 6
- Specim FX17 10
- WAILight Multispectral Light 13
- Electronics Box 15
- Lights 16
- Connections 17
- Calibration Plate 17
- Sampling Plate 18
- Viewing Platform 18

Software 19
- Pylon Viewer 19
- Specim IQ Studio 21
- LUMO Scanner 26

Running the Machine 28
- Moving the platform 28
- Adjustments 29

Calibration Checks 30
- Lighting 31
- Alignment 32
- Sharpness 33

Image Correction 35
- Creating A Calibration 35
- Using A Calibration 36

Troubleshooting 38
- Common issues 38
- Issue: Motors not running 38
- Issue: Motor not changing direction/running over limit switches 39
- Issue: Specim FX17 not taking images 40
- Issue: Platform not reaching the end of belt before turning around 42
- Issue: Dim lights 42

GPIO Table 43

Inventory

You should have:

- A calibration board
- A sampling board
- White and black Teflon (PTFE) sheets
- 3 White camera rails
- Basler ace U acA1300-200uc RGB camera and 2m cable
- Specim IQ visible range hyperspectral camera and 2m USB-C cable

  This camera comes with:

  - 2 removable batteries
  - Battery charger
  - A 32GB SD card
  - Lens cap
  - Cloth bag
  - White reference tile
  - Colour reference tile
  - Camera mount and clip
- Specim FX17 NIR hyperspectral camera

  This camera comes with:

  - RS10 rotator mount
  - Rotator clip
  - Angle bracket
  - Power cable with communication adaptor
  - Green data cable
  - Lens Cap

The Testing Rig should have:

- Halogen lights 4x50W
- Light poles
- Belts and mountings
- Stepper motors
- Electronics Box

  This box should contain:

  - Raspberry Pi
  - 2 stepper motor drivers
  - Circuit board

- Power supply for electronics box
- Desktop Computer
- Keyboard and mouse
- Modem and ethernet cables
- WAILight (Multispectral light)

Setup

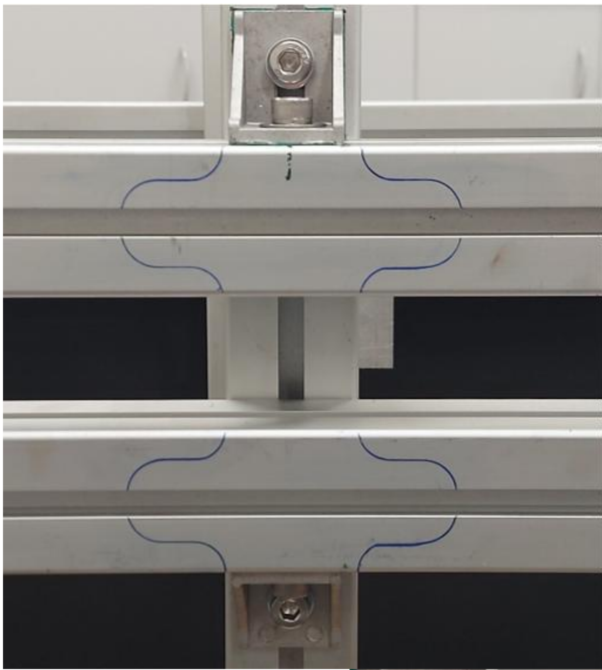
Basler RGB Camera

The Basler ace U acA1300-200uc RGB fits in the black mount provided in the orientation shown below. Before placing the camera into the mount ensure the lens is removed as it prevents the camera fitting well, attach the lens once the camera is in the mount.

The orientation of the camera in the mount matters for two reasons. Firstly, placing the camera such that the cable is farthest away from the back of the mount orients the camera to match the Specim IQ, and secondly it ensures there is room for the tightening bolts to keep the mount in place on the slider.

Which slider to use depends on the viewing area and lens you intend to use with the camera. The C125-0418-5M fisheye lens has a field of view of approximately 60°, sitting it at the bottom of slider 1 will place the lens 296mm above the viewing platform, sitting with the bottom of the camera mount level with the end of the rail gives a height of 340mm. At these heights the in-focus areas will be 347.4x347.4mm and 399x399mm respectively. Note that this is at the height of the calibration board which does not take up the whole frame.

Sliders for the Basler RGB Camera



On the frame there is a blue outline for the slider to fit within, the outline is the same for each slider. Secure the slider in place with the four bolts on the rails. When the slider is secure plug the camera in and set it up at the desired height. Run the cable along the frame to the back of the computer, there is an orange tie to help keep it in place. Once the camera is plugged into the computer it turns on automatically, the only way to turn it off is by unplugging it.

Specim IQ

The Specim IQ is the visible range hyperspectral camera kept in the orange box. In the box is a photo with everything in the box as well as an inventory list. There is also a 3d printed mount and separate clip for the camera. Like the slider for the Basler camera, the mount has an outline set for it on the upright piece of aluminium on the opposite side of the cross beams the Basler camera sits on.

Inside the Specim IQ travel box

Top left: Specim IQ Tripod Clip; Top Right: placed in the mount; Bottom: reverse angle showing bolt placement.

Place the clip into the mount and screw the brass bolt into it through the hole in the back as tight as you can with your fingers. This bolt will go down the gap in the aluminium extrusion, its main purpose is to provide a direct connection to the frame. It needs to be reasonably tight against the extrusion because this is one of the most important things keeping the clip square once the camera puts its weight on it. It will not make it into the channel if it is overtightened with the spanner. There are also 4 bolts to go into the holes along the back plates extending from the back of the mount, feed them from the inside out, then put on the washer and nut tight enough they don't rattle. These bolts hold the mount in place on the frame.

Slide the mount to the outlined position on the frame to match the outline drawn. This height will ensure the field of view captures the sampling area perfectly. Tighten the nuts on the 4 bolts with the spanner until the mount will not slide when tugged.

In the orange box is a battery charger and two batteries. When plugged in, the charger can show how much charge a battery has before putting it in the camera, make sure there is at least one battery with full charge available before and after each use.

Kept with the camera is a 32GB micro SD card and white adapter, usually inside the SD card slot within the camera itself.

Take the camera out of the cloth bag and open the side panel, you will see a large slot for the battery and a slot for an SD card. Insert the battery and check the SD card is in place, close the cover when both are in place.

Inside the orange box there are two metal adapter plates, the lighter coloured one with the larger pattern in the rubber is for use on the testing rig. It is the clip on the right in the image below. The adapter plates are very slightly different in size, the darker one is for use on a tripod and does not fit into the clip on the testing rig. On the underside of the camera the is a silver threaded hole for the plate to be screwed into. Align the arrow on the bottom of the plate such that the arrow indicating the direction of the lens is in line with the lens on the camera.

There is a 2m USB-C cable for the camera, it may be preferable to plug it into the camera before putting it onto the frame. The plug is under the rubber hatch on the top left side of the camera. Similarly if you are intending to use the camera straight away it may be preferable to turn the camera on now. It will likely ask you to set the time and date, this can be done either on the camera or on the computer.

Ensure the clip in the mount is secure and open, then place the camera into the clip from the lens side first, then push it into the clip until the latch closes. The camera should feel rigid in the clip, gently attempting to wobble it should feel like you are pulling the whole frame. Run the cable along the frame to the back of the computer along the same path as the Basler camera. Plug it into one of the high speed USB ports.

Specim FX17

The Specim FX17 is the near infrared (NIR) hyperspectral camera. It needs the Specim RS10 Rotary mount to function. There is also a large angle bracket for attaching the rotary mount to the frame. On the upright piece of aluminium on the cross beams closest to the computer there is an outline for the the angle adapters holding the upright to align with, as well as a line for the underside of the angle bracket to line up with. Make sure that the bolts are all screwed tight.

The rotary mount has 2 5mm cap screws and a bolt for attaching it to the angle racket. Prepare the necessary Allen key and adjustable crescent to be in front of you before proceeding. Holding the rotary mount up to the bracket with your left hand, use your right hand to screw in the bolt and cap screws finger tight through the angle bracket into the mount. Do not let go of the rotary mount with your left hand at any point until both the cap screws and the bolt are screwed in.

One the rotary mount is attached finger tight go back with the Allen key and adjustable crescent to tighten them fully.

On the Specim FX17 camera there should be a mounting attached to the case on a slider. This mounting has two slots on it and a hole for a pin in the middle. The rotary mount has two poles that should align with the slots on the camera mount as well as a spring loaded pin to lock the camera in place.

Pull the pin on the rotary mount and slide the camera on such that the ports for the cables coming out of the back of the camera are facing same side as you are on. When you release the pin it should fully return to its starting position and should audibly click into place. You may need to wobble the camera back and forth a little to get it actuate.

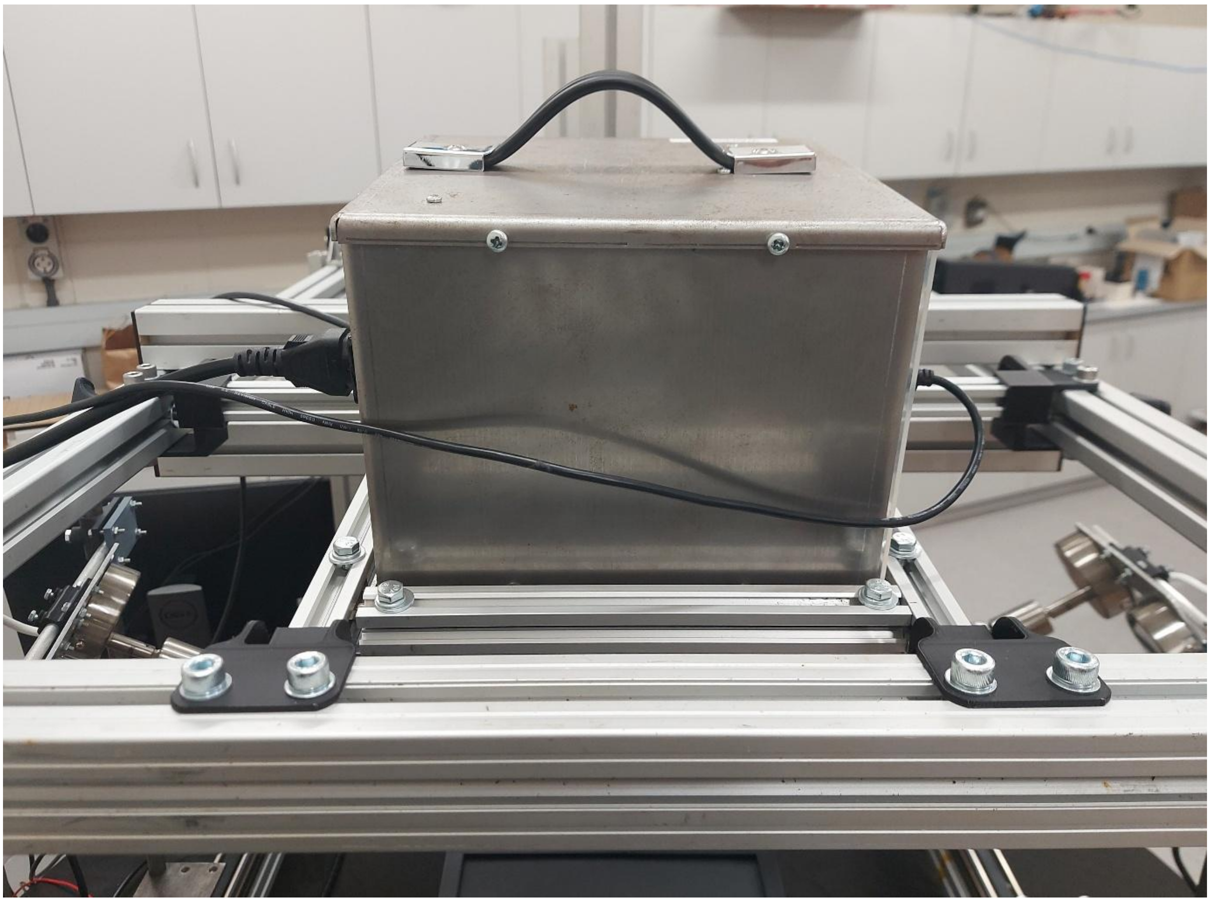

The back of the camera has two ports for cables, the one on the top left is for the green data cable. There are slots on the cable that force its alignment into place on the camera, the correct alignment follows the curve of the cable. When inserted the cable will reach most of the way into the port, screw the nut on the cable until it is finger tight. The other end of the cable should have an ethernet to USB adapter on it, plug it into one of the high speed USB ports on the back of the computer.

The power cable has a smaller wire with two extra pins coming out of it, these are for the hardware trigger and not used. It has a half circle running along the inside of the port on the back of the camera to force the correct alignment. Plug the power into the daisy-chained power strip into the port closest to where the cable meets the box to prevent obstructing the other ports. When the testing rig is started or shut down it is useful to have some of our power points grouped together so the only thing to unplug to ensure everything is powered off is the daisy-chained power strip.

The rotary mount has a unique cable. The end of the cable that goes into the mount has a dot on the outside that should align with a dot on the port itself, this also roughly follows the natural curve of the cable. The other end of the cable is split between a power supply section and a control section. There is an adapter that splits the two sections. Plug the USB port into the back of the computer, ensuring to leave one of the high speed ports for the Specim IQ. Plug the power section into the daisy-chained power strip.

WAILight Multispectral Light

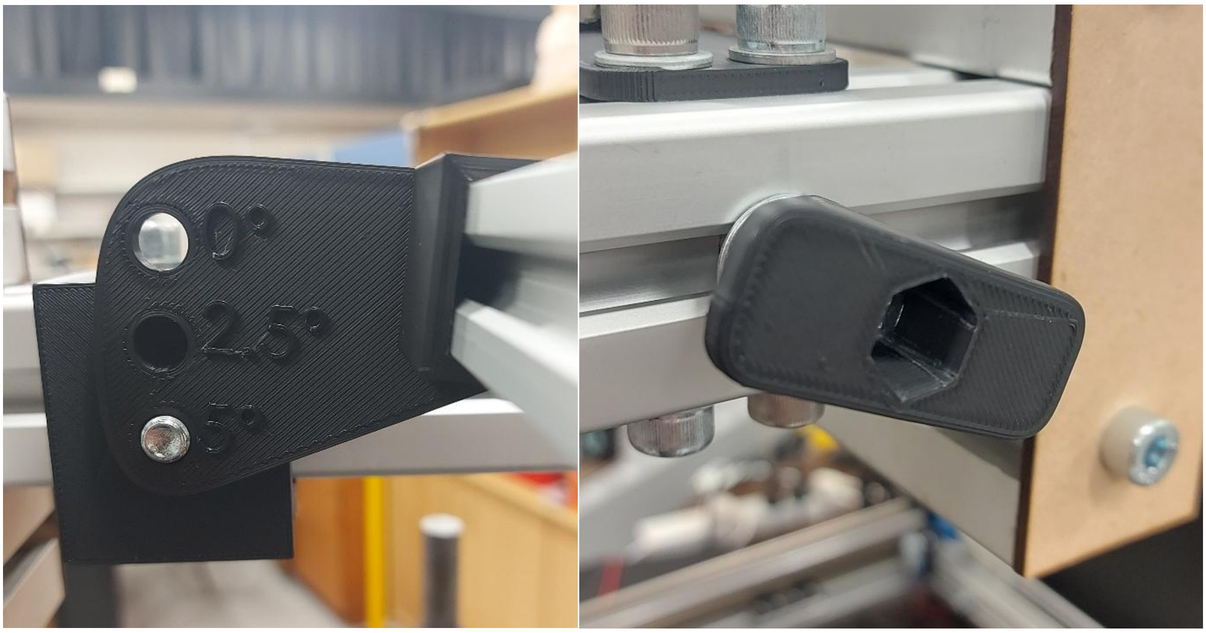
The WAILight is a multispectral light designed to emit light at specific wavelengths within the visible range. It fits in the tiltable shelf on top of the testing rig. It should have a power cable and a USB-A cable for connecting to the computer. It fits in the shelf such that the handle is facing across the rig, it is not rotationally symmetric and neither is the shelf.



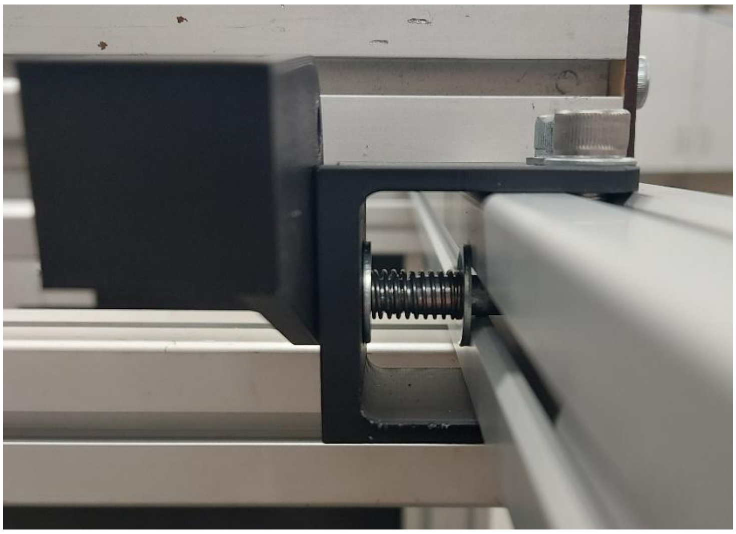
WAILight in place on the tiltable shelf

On each end of the shelf are spring loaded bolts holding the shelf in place. To adjust the tilt of the shelf it is best to remove the light before pulling on the bolts. The bolts should reach the whole way through the holes in the angle guides.

When in use the halogen lights should not be turned on.

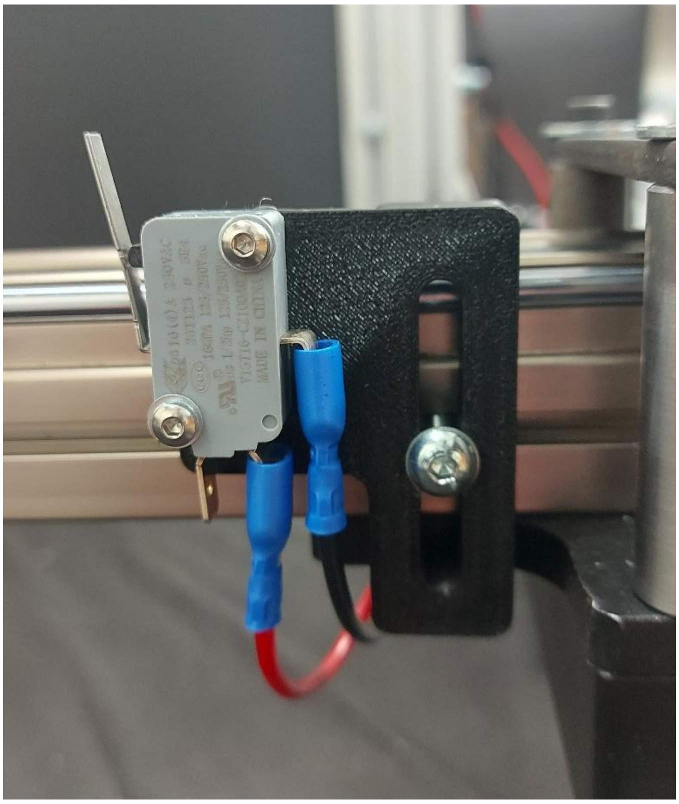


Left: Angle guide for the shelf. Right: Handle for spring loaded pin


Side view of the spring loaded mechanism

Electronics Box

The electronics box has several wires running out of the top of it that go to the stepper motors and limit switches. Now is a good time to check the limit switches connections, they should look like this:



Inside the electronics box there is a Raspberry Pi for controlling the motors. A power cable for the Raspberry Pi should be supplied with the testing rig, plug it in through the side of the electronics box. The other end should go into the daisy chained power strip, on the end furthest from where the cable joins the box as it obstructs its neighbouring ports.

There is a general power supply for the rest of the box that plugs into the port on the same side of the box, this should also go into the daisy-chained power strip.

On the inside of the lid of the electronics box is a table for all the GPIO cables to control the translation table. Check for any disconnected jumper cables around the Raspberry Pi and use the GPIO Table to figure out where the wire is supposed to be.

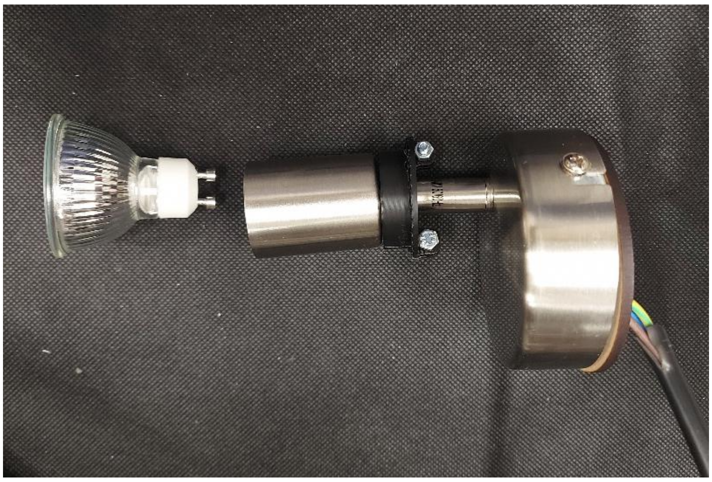
Lights

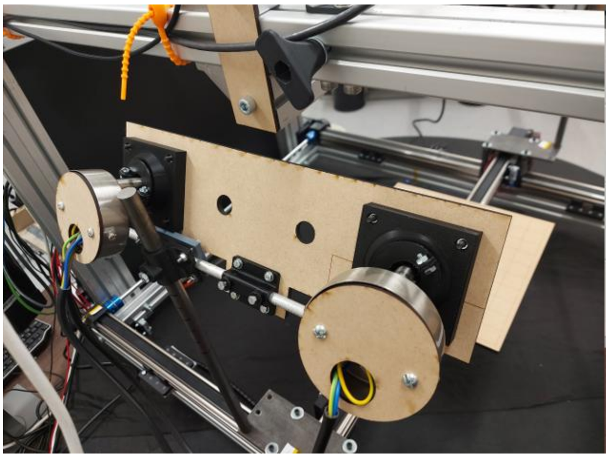
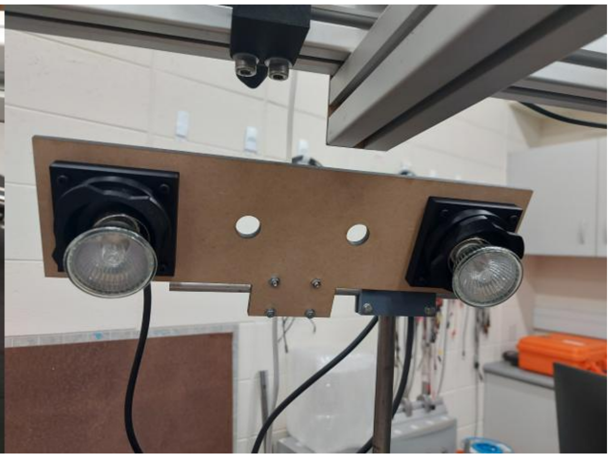
The lights have no power switch, if they are plugged in they are turned on. They share a common cable to a box that then splits into the two sides that run to the lights. The cables leading to the lights should be tied to the wiring for the limit switches and stepper motor so they are pulled together as the viewing platform is moved around within the testing rig.

On the poles the lights are attached to is a series of lines starting at 200mm and going up in 20mm intervals. The sliding 3D printed bracket can be adjusted to the desired height with the bolt on the back. The intended measurement is based off the bottom of the bracket, if you wanted to set the height of the lights to 240mm you would set the bottom of the bracket to be at the height of the third line from the bottom.

There is an arm coming from the side that can offset the lights from the pole such that they are in line with the centre of the platform. On that arm is another bracket with bolts coming from the back that can set the angle and alignment.

The lights themselves sit in a bearing that can aim the lights with more precision. To assemble the light into the bearing piece the plug pieces together around the base of the light enclosure, these ensure the light remains clear of the 3D printing. Unscrew the light before sliding it through the bearing. On the front of the bearing is a screw cap that locks the internal ball in place. Loosen the cap and aim the light to the desired position then tighten the cap to lock it into place.



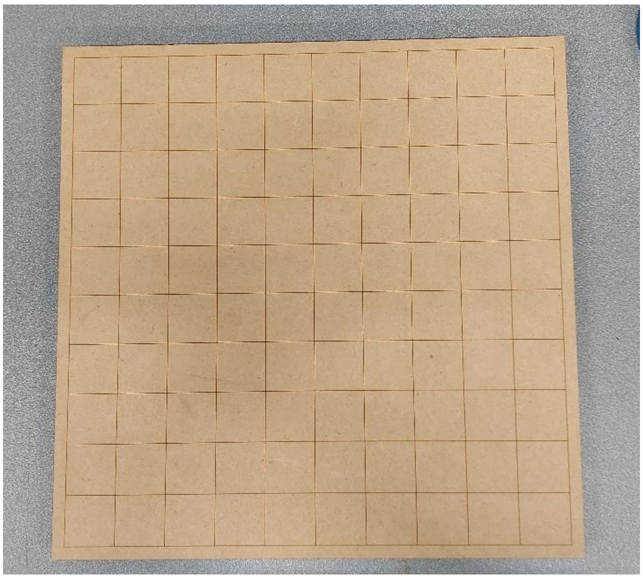
Note: because the brackets are 3D printed it is possible to crack them along the seams by tightening the bolts too far. If you crack one you will have to print another one and replace it. The brackets have a nut on the inside that can be difficult to get to sit right before the bolt can be screwed in, this can be a tedious task that is best avoided.

Connections

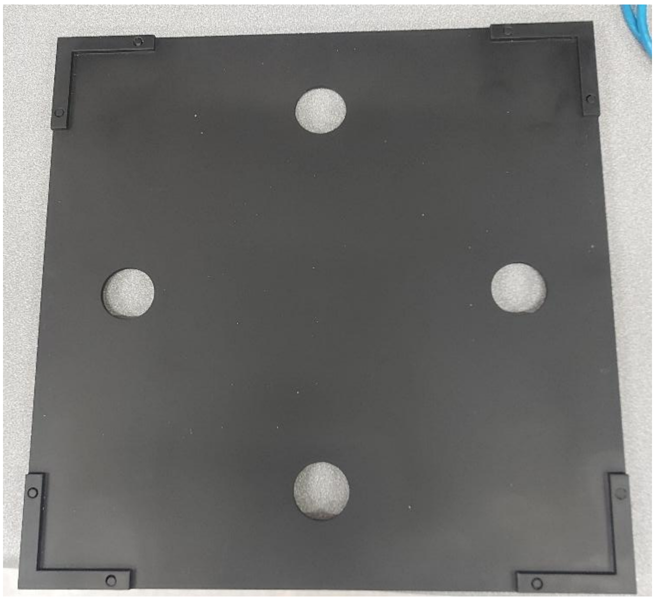
There is a recommended USB layout to make the most of the higher speed ports for the cameras and drivers. Note that if the WAILight is to be connected there will be more devices than ports listed, it or the keyboard or mouse can be plugged into the front of the computer.

Recommended USB Connection Layout			
Keyboard / Mouse / WAILight	Keyboard / Mouse / WAILight		
10	10		
SpecimFX17 Data Cable / Specim IQ	SpecimFX17 Data Cable / Specim IQ	Specim FX17 Motor Driver / Basler Camera	Specim FX17 Motor Driver / Basler Camera

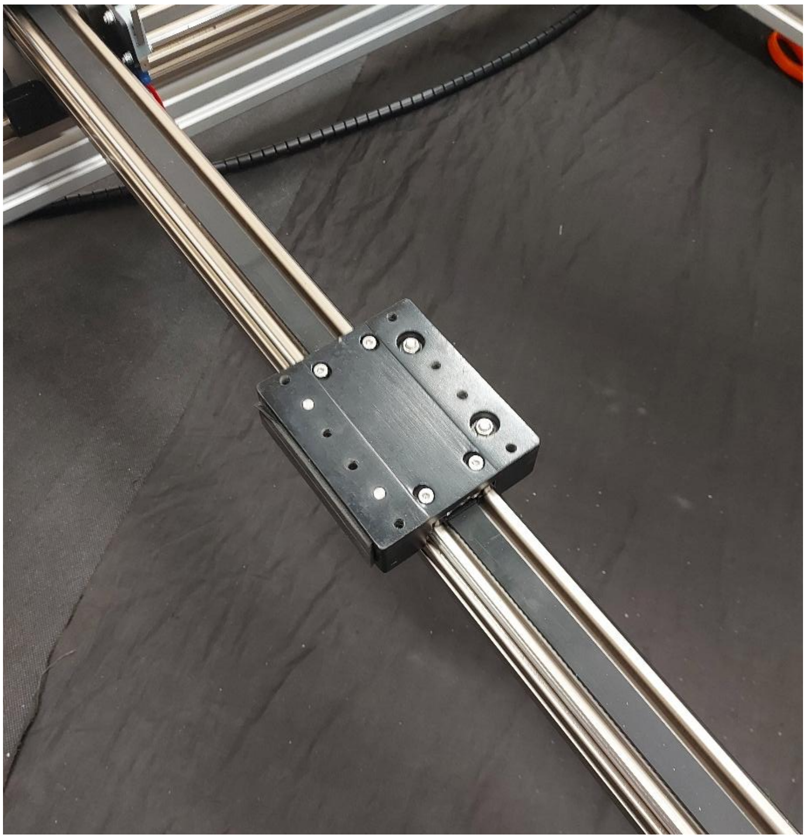
Calibration Plate



Sampling Plate



Viewing Platform



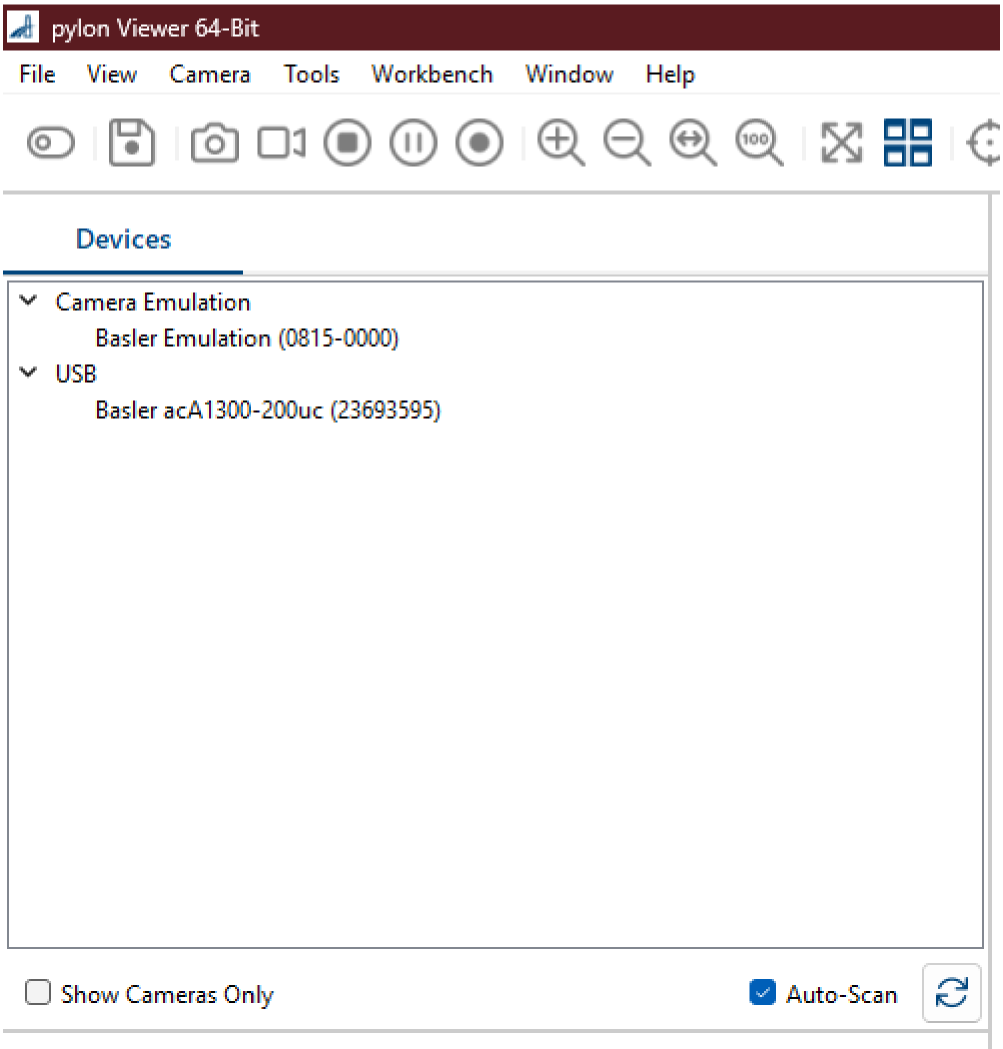
The calibration and sampling plates have moulds on their backs that fit snugly over the block on the belt.

Software

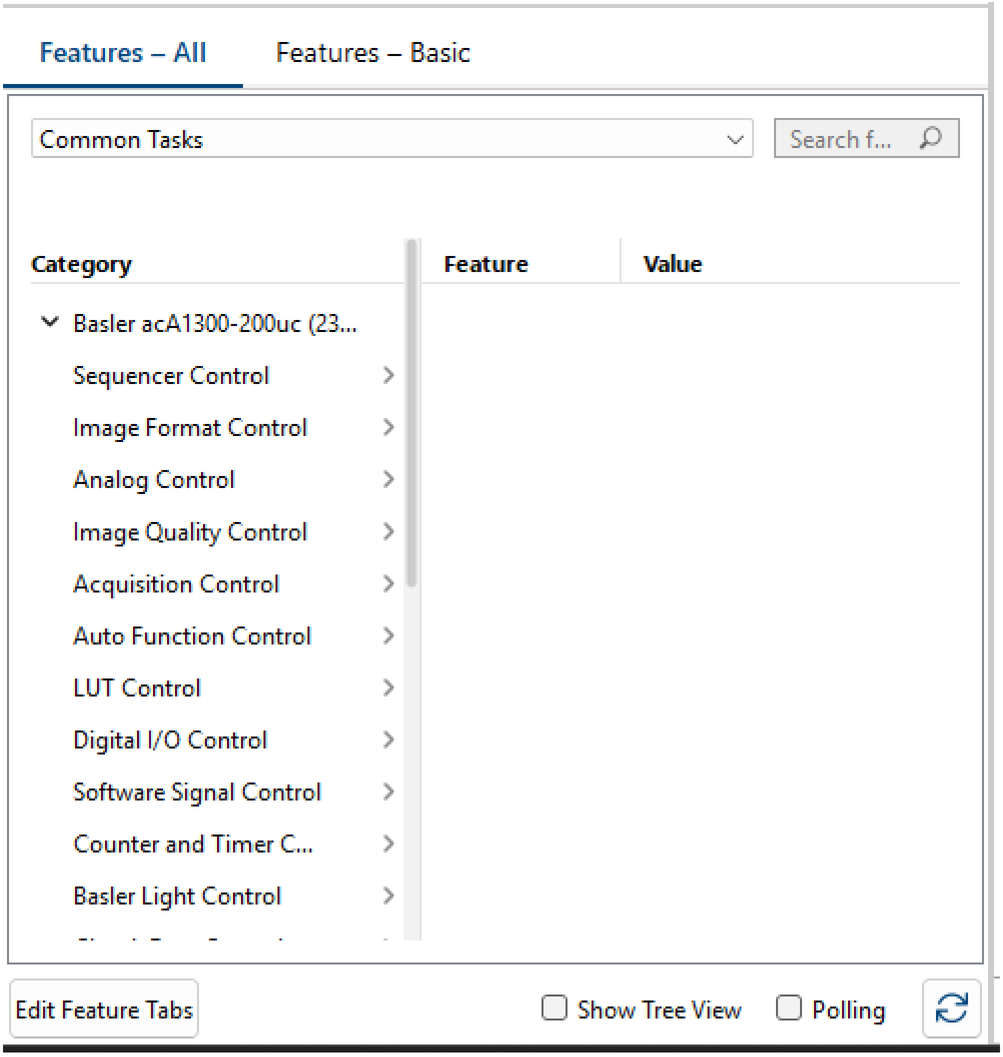
Pylon Viewer

Pylon Viewer is the software suite that runs Basler cameras. It allows you to operate the camera from a computer, either capturing single shots or live videos with varying settings. It also allows setting up camera profiles as a way of saving settings.

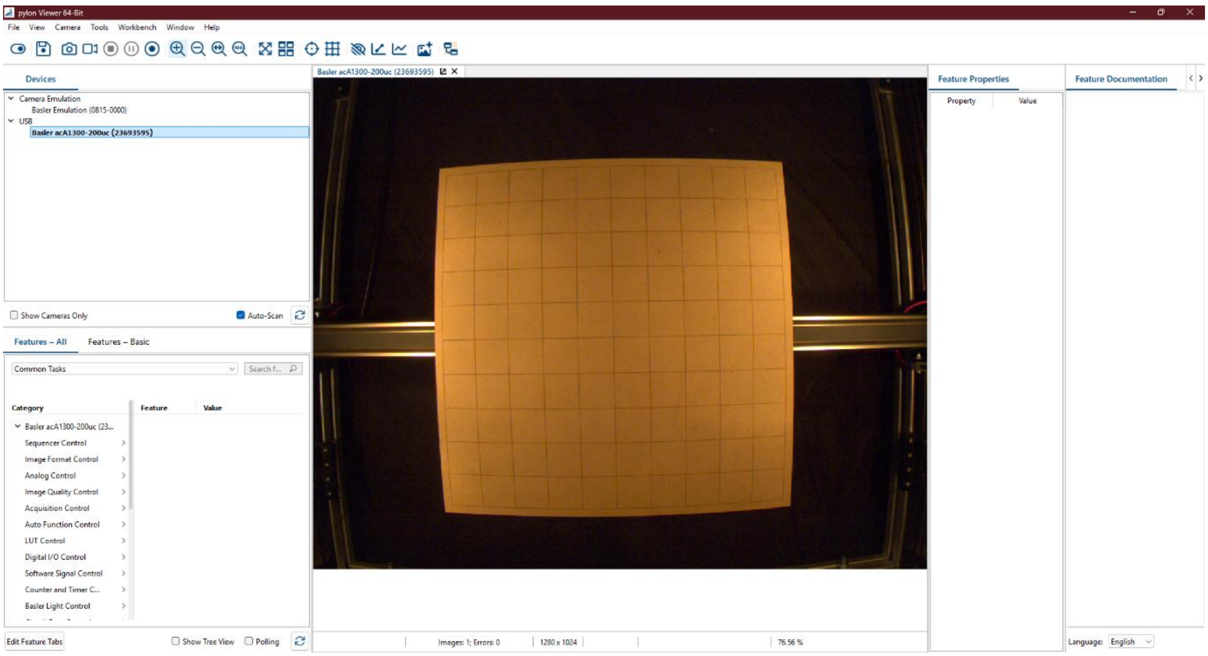
The first screen when Pylon Viewer is opened has a list of devices in the top left window, select the camera under USB devices, it should be the only option, even if the other cameras are plugged in.



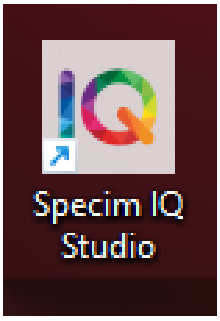
In the bottom left window there is a settings menu with beginner and advanced tabs. In these settings image gain and exposure can be found, among a plethora of other settings. There is a search bar to help find anything you may need.



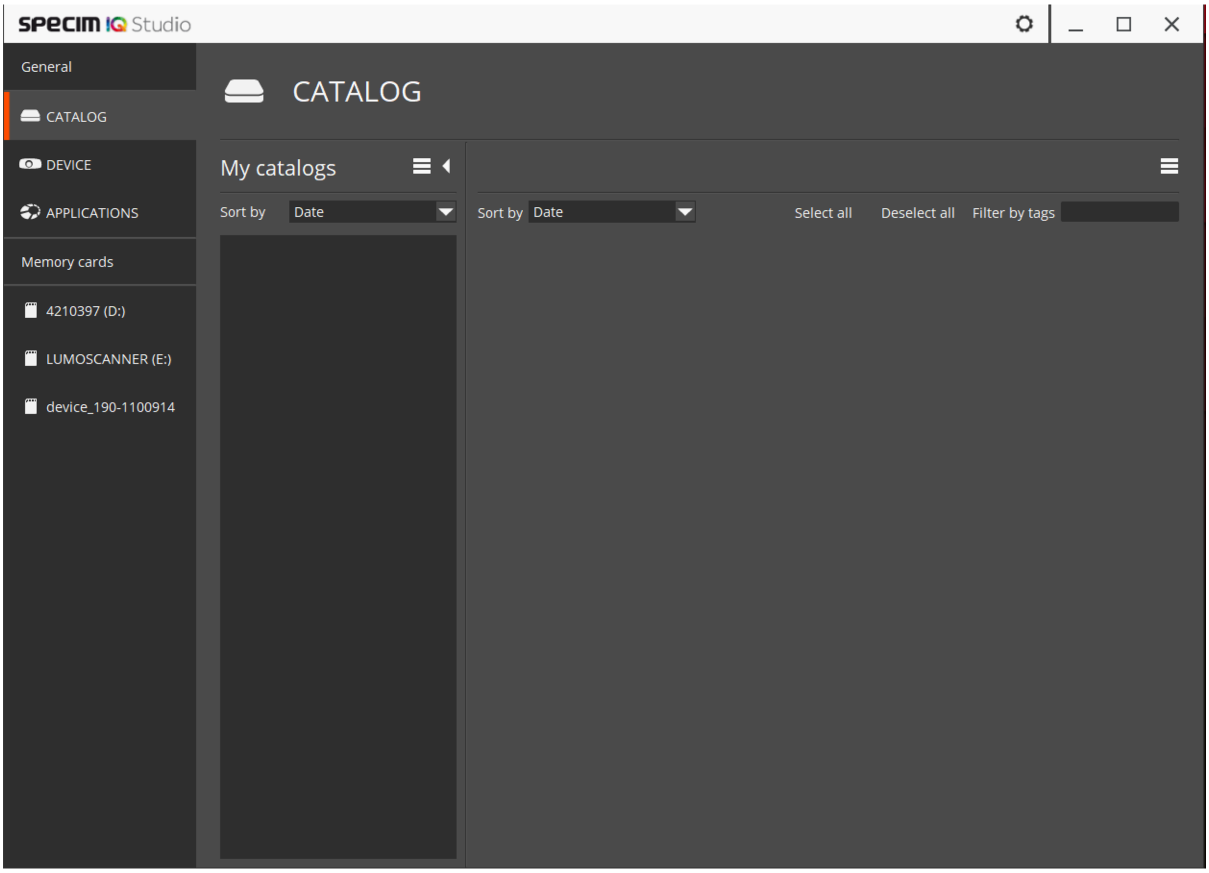
Along the top toolbar above the windows are buttons for operating the camera, taking images and saving them, or operating as a live video feed.



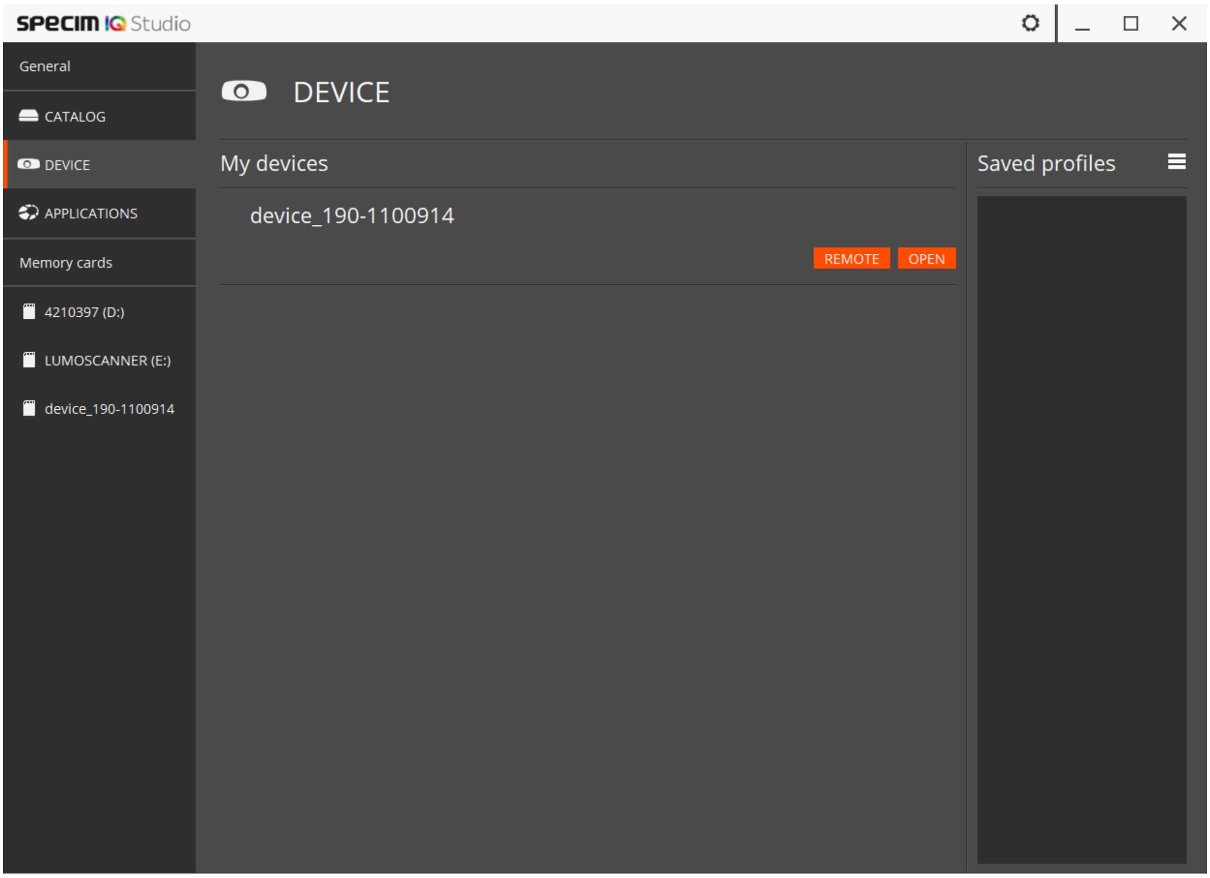
Specim IQ Studio



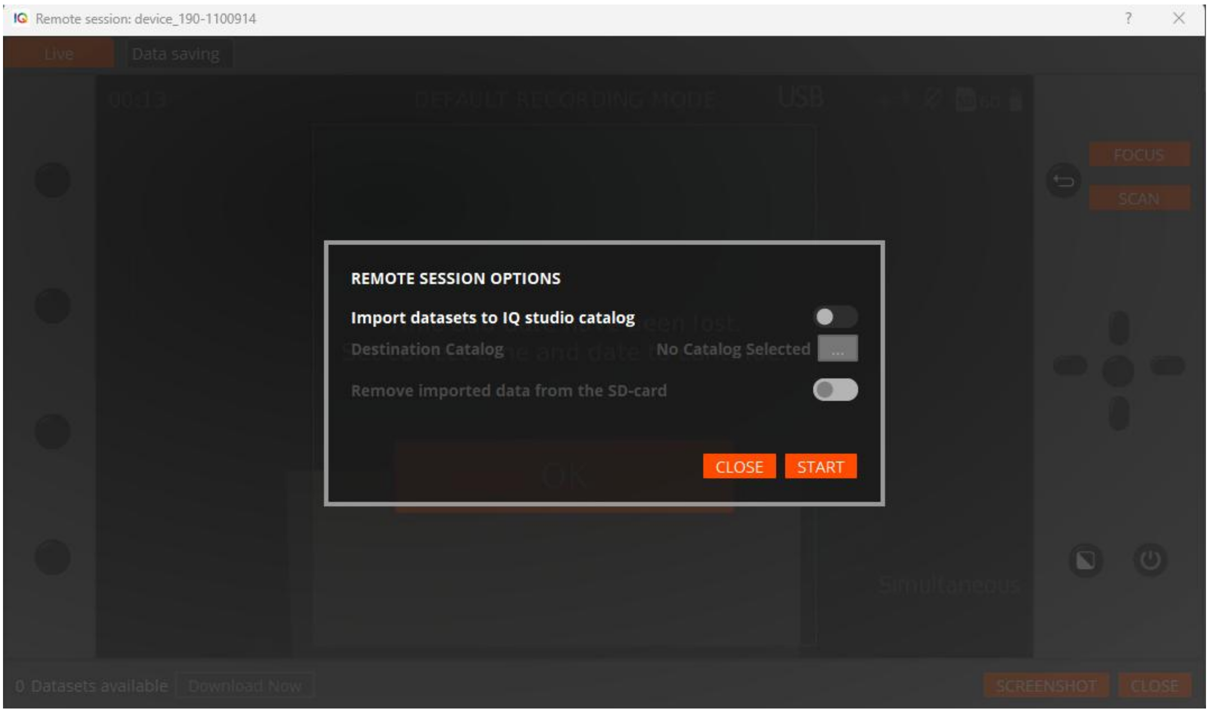
Desktop Icon



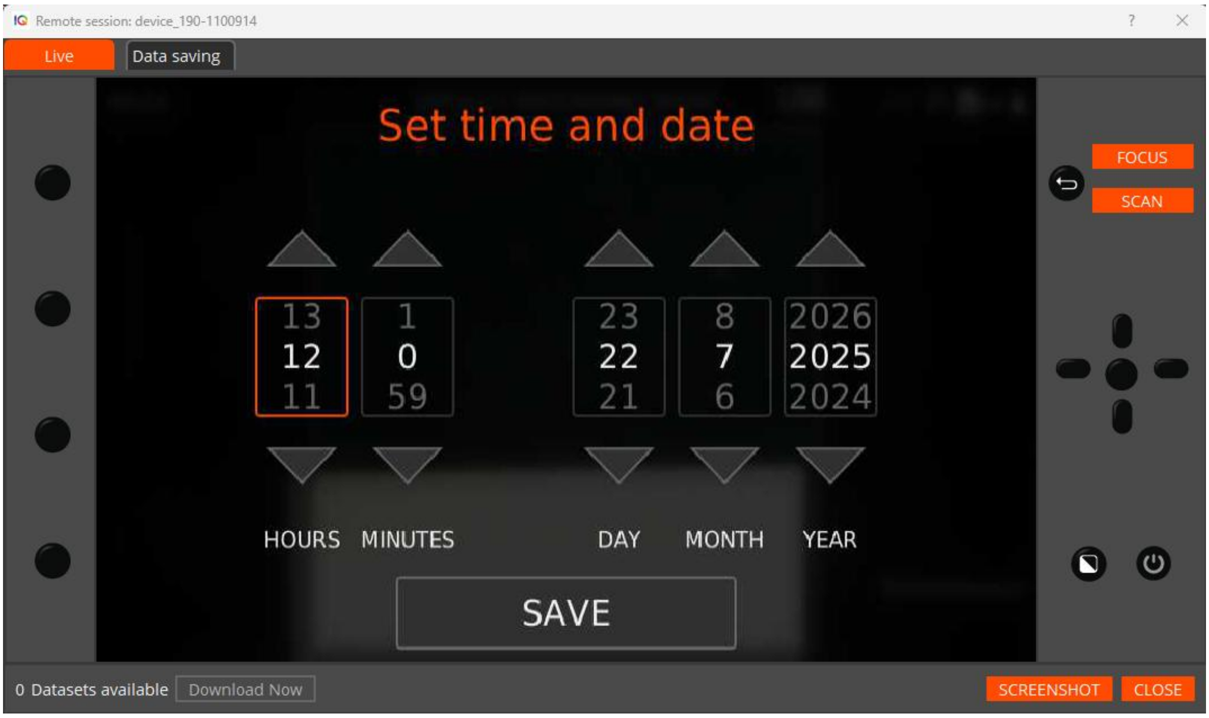
IQ Studio is the program used to operate the Specim IQ camera. Open the program and you will find this screen. Select the DEVICE menu.



Select Remote.

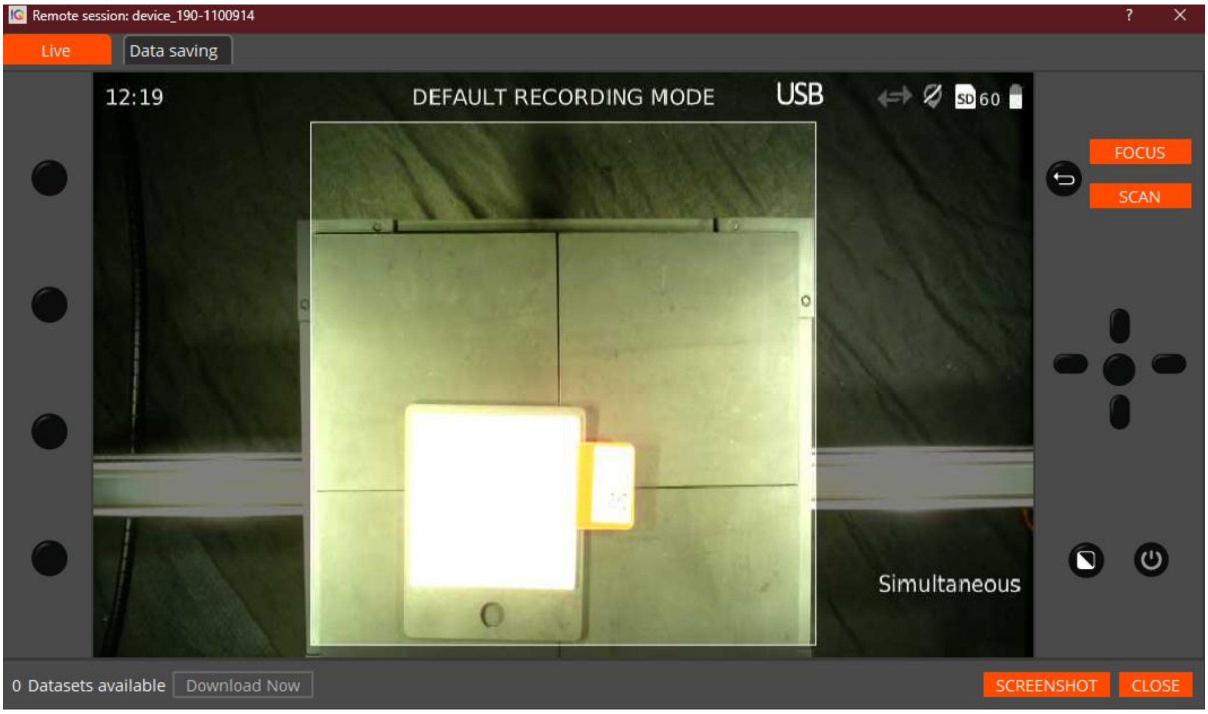


Select Start

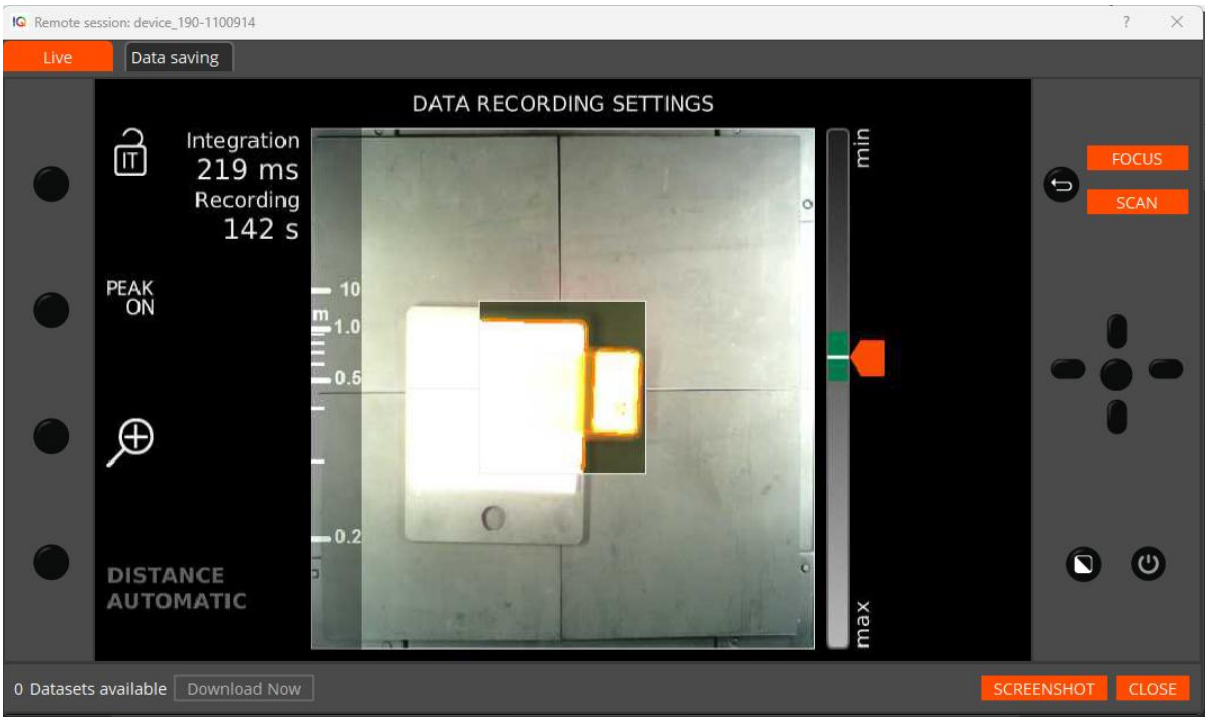


If you didn't do it on the camera when you placed it on the rig you will be prompted to set the date and time, it is often very incorrect. Set it correctly as it is used in the default file naming scheme.

From here the program works exactly the same as the physical camera. In the travel box for the camera there is a guide to setting the calibration.



This is the screen you should see when the date and time have been set. Something important to note is that this screen should not be used for checking the position of the camera. On the Sqecim IQ camera there is a second camera on the top of the lens that is used in this view. The focus and lighting will be the same but the posiiton is slightly shifted. Select focus from the right hand side of the screen.



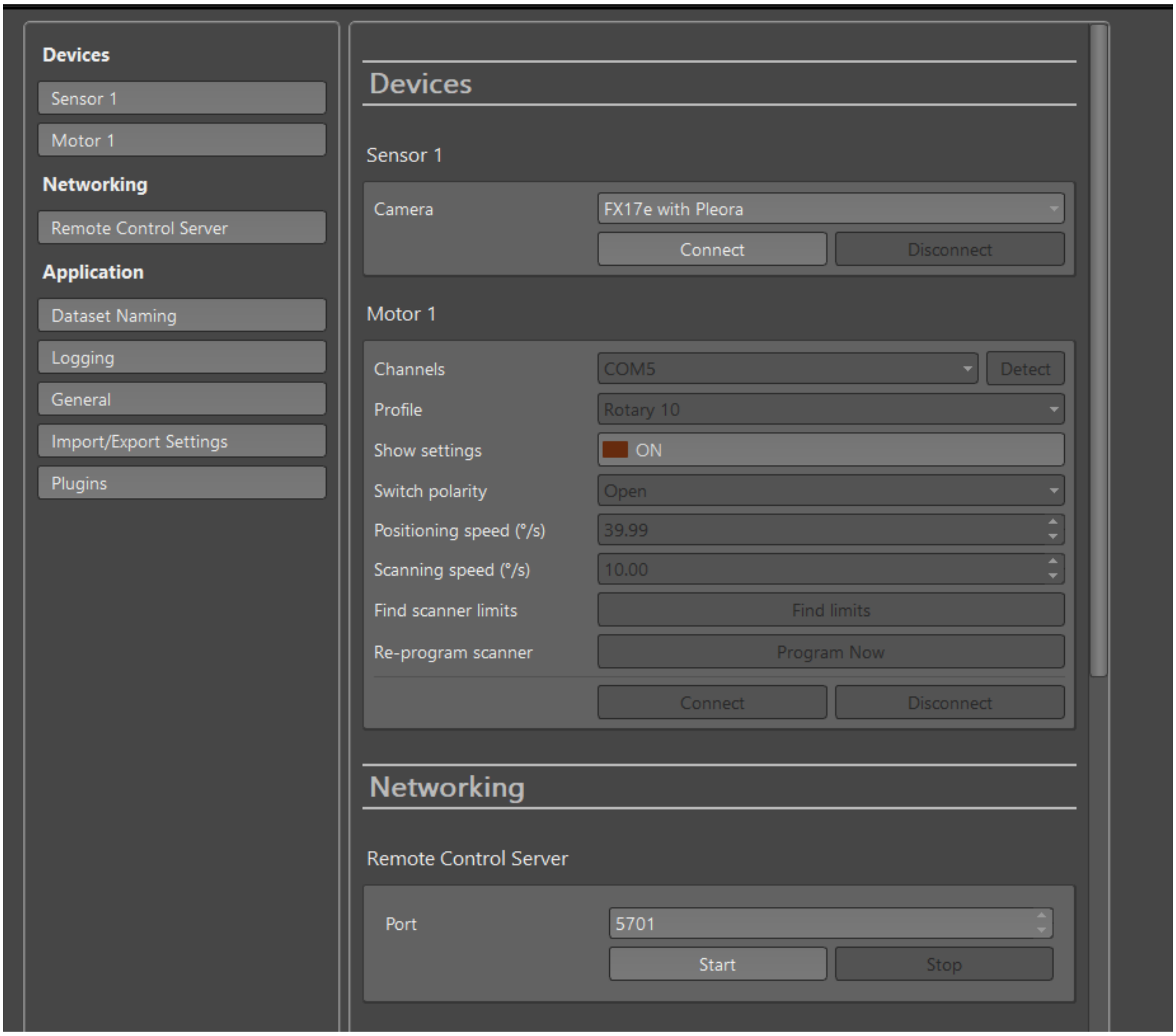
After selecting focus you will be taken to this screen showing the view through the view of the hyperspectral camera lens, the platform was not moved during this process. On the right the window is the meter controling the integration time (exposure). In the top left there is the padlock icon with IT on it, the button on the left of it controls if it is open or closed. The padlock being open or closed changed whether you will be able to drag the slider on the right to change the integration time or not. Move the slider to a point where the orange colour checker panel has a clear border around the label and there is an orange line outlining the edge of the white reference tile. There is an automatic algorithm that gets it pretty close, the ideal point should be somewhere in the green zone.

Once you are satisfied with the integraiton time setup select scan to take an image.

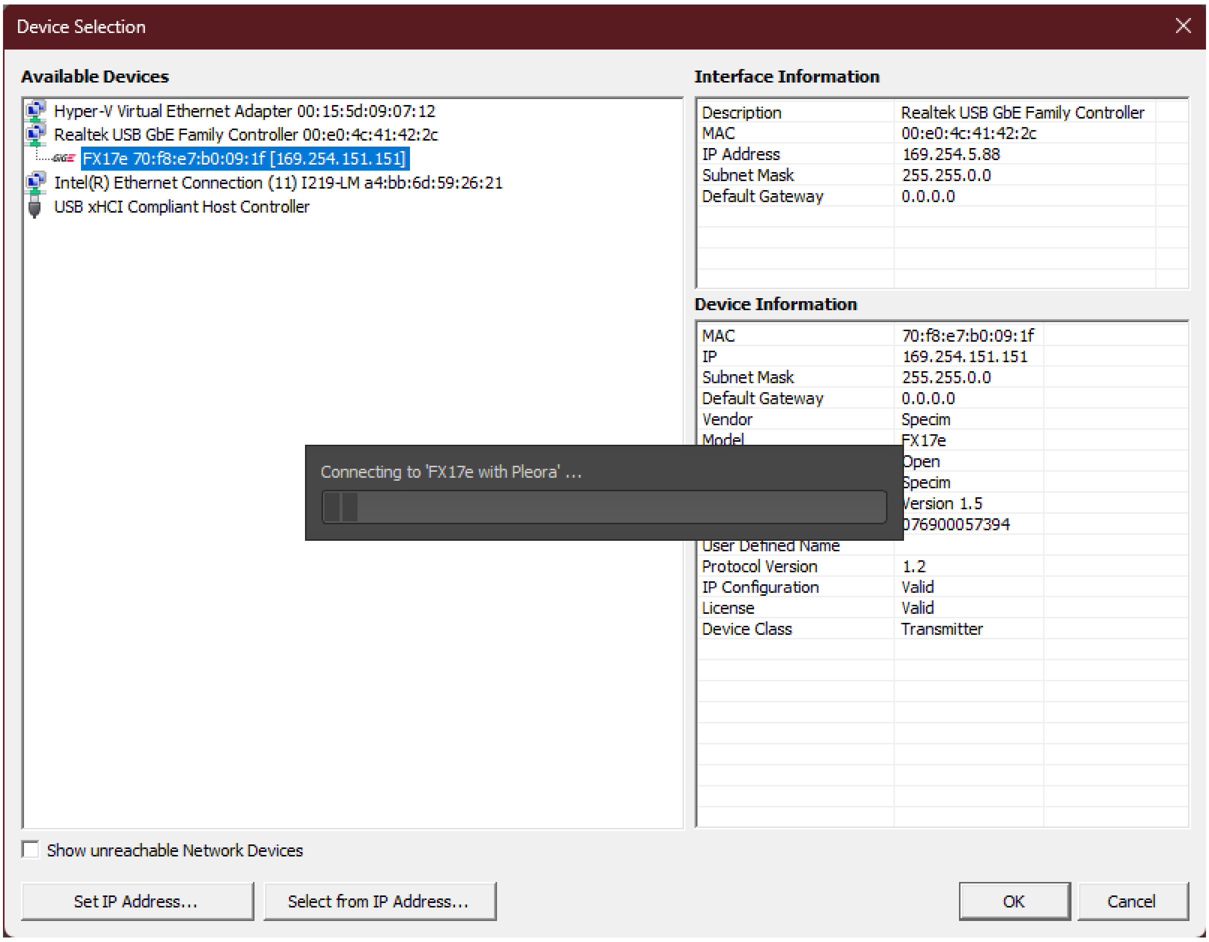
After taking the image it will take you to this screen, on the left the main image will cycle through a few variations with different lighting, from this point you can either keep or discard the image.

LUMO Scanner

LUMO Scanner is the software that drives the rotary mount and operates the Specim FX17.



Make sure that the camera setting is FX17e with Pleora then press connect, it will take you to the pop up screen below.



Selected the FX17e option under the Realtek USB GbE Family Controller and press OK. This may take several attempts.

Next is to connect the motor, it should find it automatically, press connect.

Once the motor and the camera are connected go to the Adjust screen by clicking the tab in the top right corner.

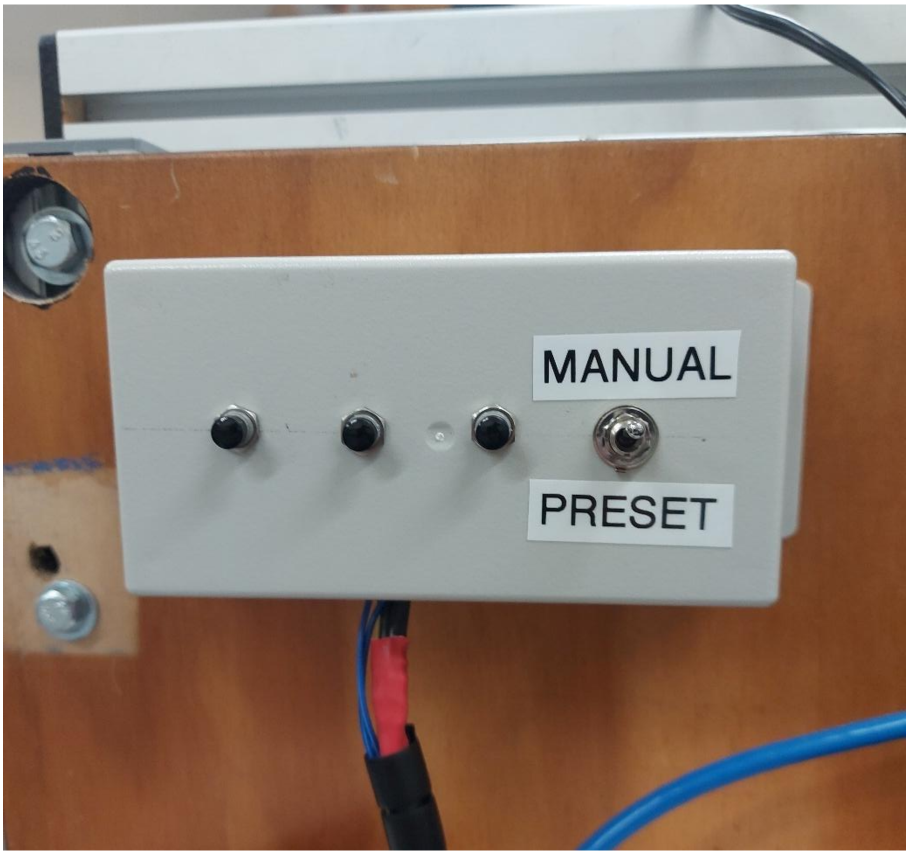
On the Adjust screen the current camera settings can be previewed and down the right hand side there are several options for setting it up. There should be a profile already loaded for these settings to be set.

Running the Machine

Moving the platform

When the electronics box turn ons the Raspberry Pi launches into a program called “buttons.py”. This program allows the control of the viewing platform to be moved to either preset positions or manually moved.

On the buttons box are three buttons and a control switch. The switch changes the function between going to preset positions or being manually driven. The table below illustrates the functions of each button in each mode.



The first time you move the viewing platform to a preset position after turning the rig on it will take the platform to the end of each rail then to halfway. The motor that moves the platform from camera to camera goes to the middle, stops for half a second, then moves to a preset position. This is intentionally quite a slow process as it is intended to keep the samples as still as possible from when they were placed on the tray. It should take about a minute.

After the first movement has been completed the program knows where the motors are and will go between positions directly.

Drive motor 1	Drive motor 2	Shutdown Pi	Manual
Button 1	Button 2	Button 3	Control Switch
Specim FX17	Specim IQ	Basler	Preset

It is important to note that if you switch to manual mode and press button 3 it will shut down the Raspberry Pi automatically. This takes about 15 seconds to complete. If you need to turn it back on the easiest way it to unplug the Raspberry Pi and plug it back in, this will turn it back on without switching anything else off or on. After 15-30 seconds it will be ready to use again.

Adjustments

If for whatever reason you need to do any work on the Pi, you need to leave the program running in the background. To turn this off find it in Documents and open it in Geany, comment out the line:

os.system(“sudo shutdown now”)

Save the file and shut Geany. Next time you restart the Raspberry Pi it will launch into the program again but you will be able to close it without turning the Pi off.

If you need to move the cameras to a different position on the frame the preset positions will need to be adjusted to reflect your changes. In “Documents/positions.json” the offsets are defined for each motor.

Calibration Checks

To assist in evaluating the calibration there are several python and MATLAB scripts in a folder called “Testing Scripts” on the desktop.

The first script is called “run_tests.py”, it is there to access the relative evenness of the lighting across the image, the alignment of the viewing platform under the camera, and the sharpness of the image.

Take an image using pylon and save it somewhere easy to get to. From the folder on the desktop double click the file “run_tests” and it will open inside VS Code. To ensure the computer knows where to run the file from go to the “File” menu and select “Open Folder” and make sure it is on the “Testing Scripts” folder from the desktop.

Find your image in the file explorer, right click the file and select “Copy as path” and paste it between the brackets in the path variable, the line should look something like this:

```
# Copy and paste your file directory here
path = pathlib.Path("C:\Users\\nb156\OneDrive - The University of Waikato\Desktop\Testing Scripts\Image__2025-08-26__16-03-13.bmp")
```

Be careful of characters with a backslash before them as this makes it an “escape” character, for example in the above I have had to put a second backslash before my username because “\n” is the newline character. On Windows it is good practice to double all the backslashes. Alternatively, you can copy and paste your image into the “Testing Scripts” folder and from within VS Code import its relative path.

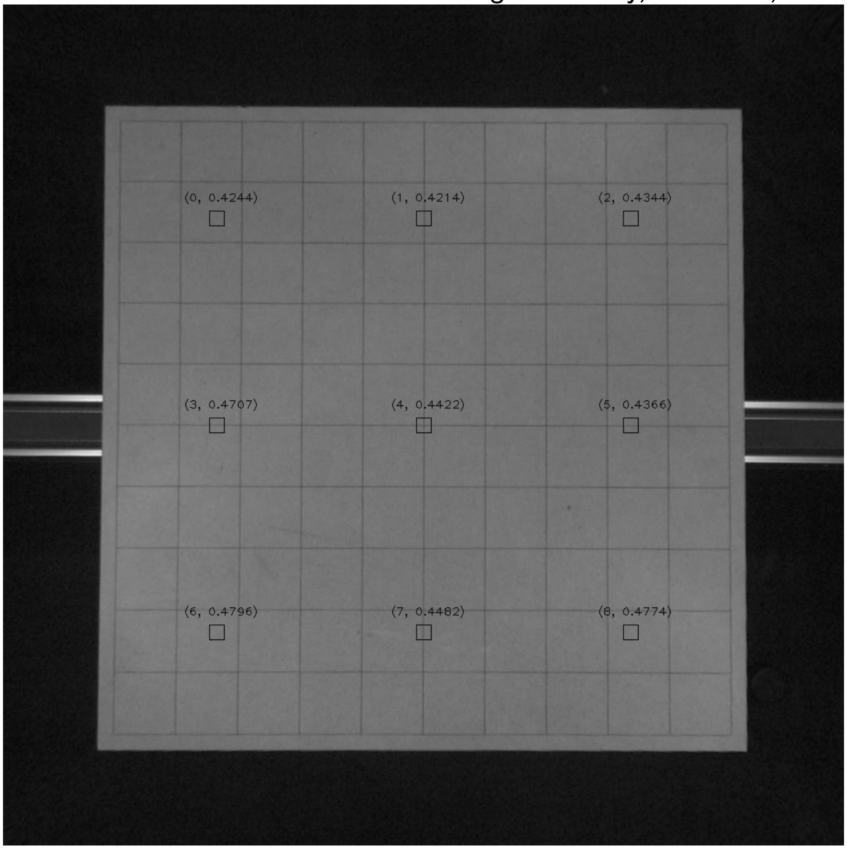
```
# Copy and paste your file directory here
path = pathlib.Path("Image__2025-08-26__16-03-13.bmp")
```

Once your image is input the next is to set the camera height. Measure from the lens of the camera to the viewing platform and input the height in mm.

Next uncomment the test you wish to run, and either press the play button in the top right corner or press ctrl+shift+Enter.

Lighting

The lighting test samples 9 patches in a square around the centre of the image and takes the mean of their light intensity values. It will return your image in greyscale with squares drawn around each patch and the normalised values for the light intensity, 0 is black, 1 is white.



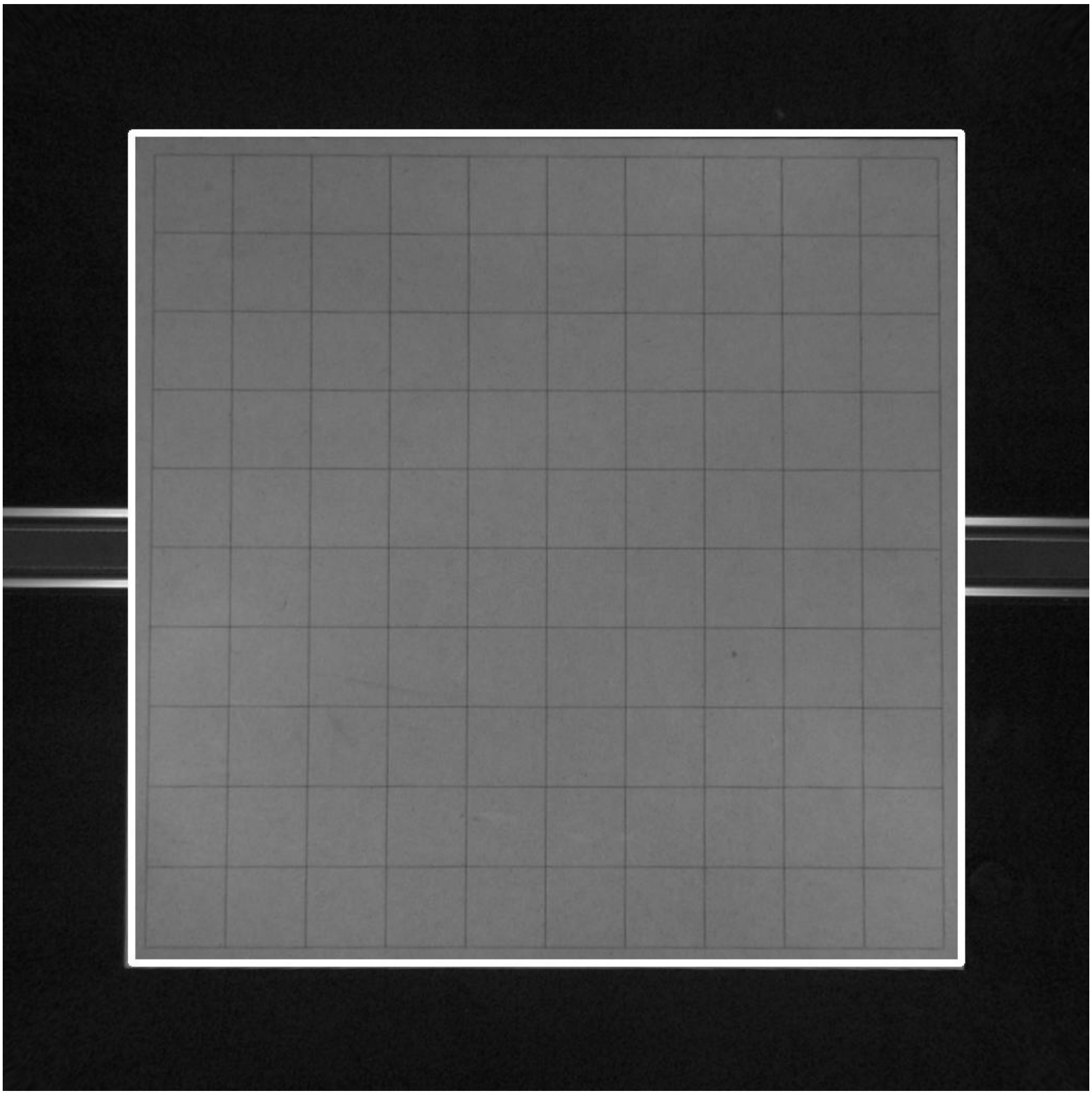
Press any key to close the image. In the terminal at the bottom of the screen it will print a statement like this:

```
The light evenness across patches is: 87.86500000000001%
Lowest: 0.4214  Highest: 0.4796
```

The light evenness is how bright the darkest patch is compared to the brightest patch.

Alignment

The next test is the alignment test. It draws a square around the centre of the image that the viewing platform should fit perfectly into. Once the testing rig is set up this should be perfect every time but if the camera is ever moved it will need to be repeated. We can see here the misalignment of the platform in the demonstration image.

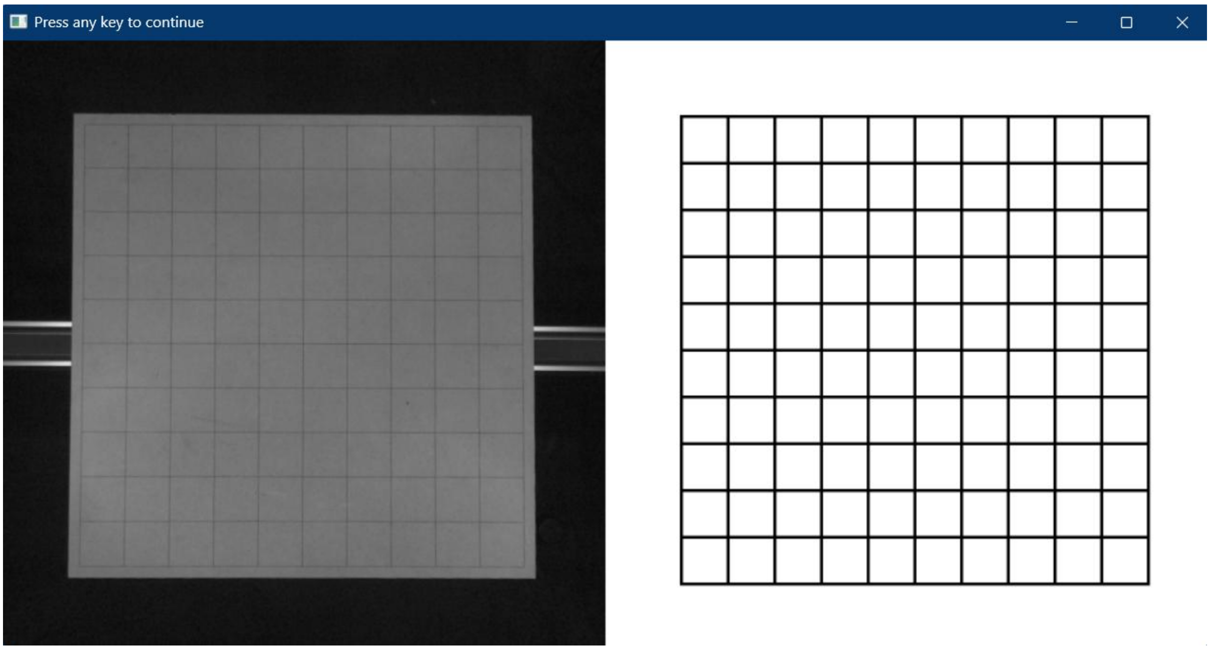


The alignment test will also output a deviation score in the terminal, this will show how far away the centre of the board is from the centre of the image.

Sharpness

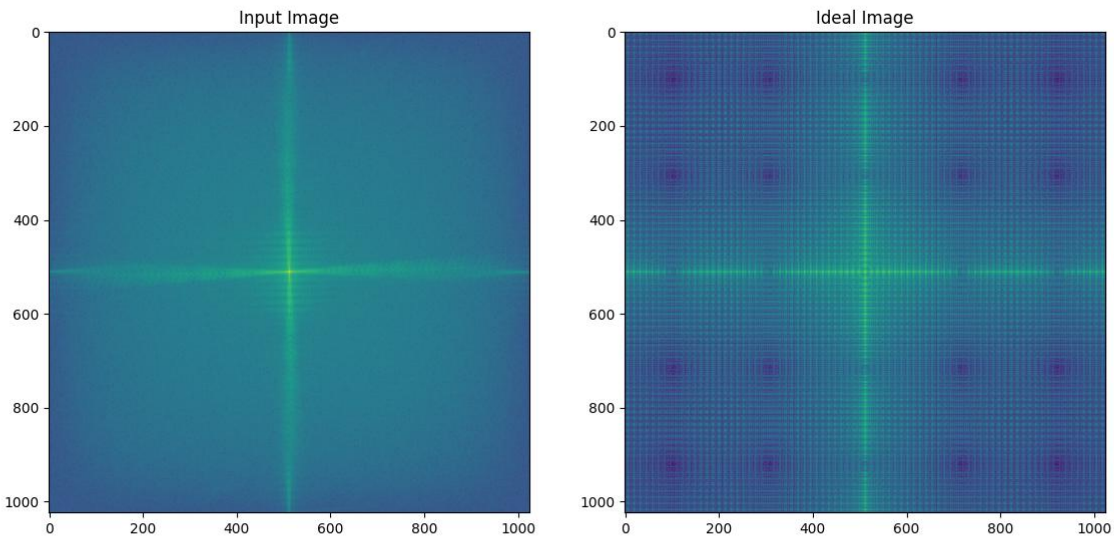
The final test is the sharpness test. This one is a little more technical but will never yield a perfect result, it's more for an idea of how far off you are. It generates a square with the same number of lines as the calibration plate and similar placement and thickness. It then takes the 2D Fourier Transform of both images and returns the magnitudes in plots.

First it shows your image and the "ideal" sharpness that is used later:



Press any key to continue.

Next it shows the plots of the magnitudes. In the input image plot, we can see that the green lines have bulges and quite blurry along with the blue background. The ideal image plot has very precise lines and no blurring. This is unattainable with a camera, but it shows what direction to head in when focussing the camera.



After you have examined the plots close out of the window.

After each of the tests a window pops up with “Test Results” in the title and an image of the outputs of the test, if you have run the lighting or alignment tests those will be drawn on there.

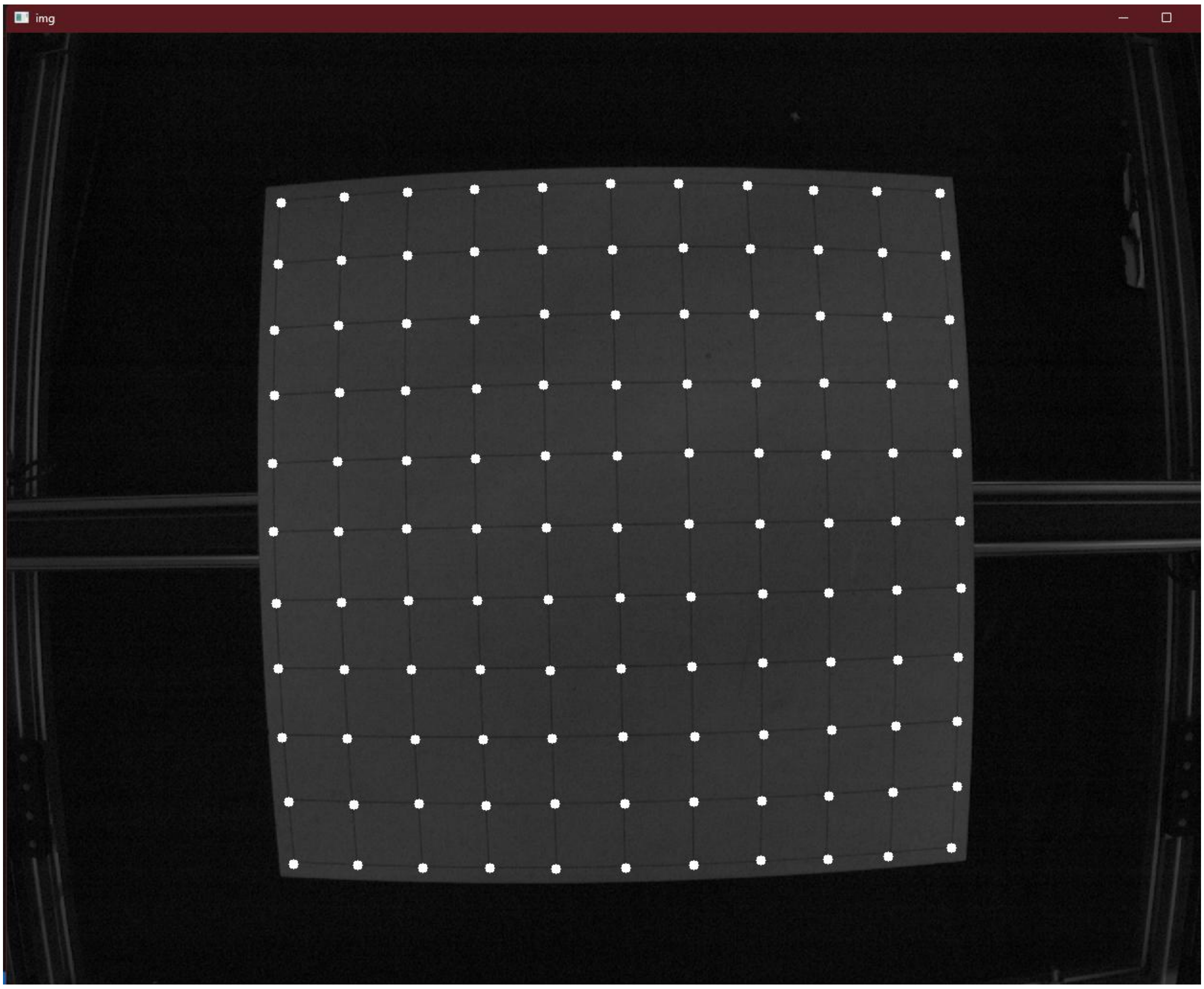
Press any key to close the window.

Image Correction

The Basler camera has a fisheye lens which applies a barrel distortion to the image, this must be corrected for to ensure correctness relative to the hyperspectral cameras which don't introduce this error. To correct this in the Testing Scripts folder there is a script called "fisheye_correction.py" that has a class to do a few useful things.

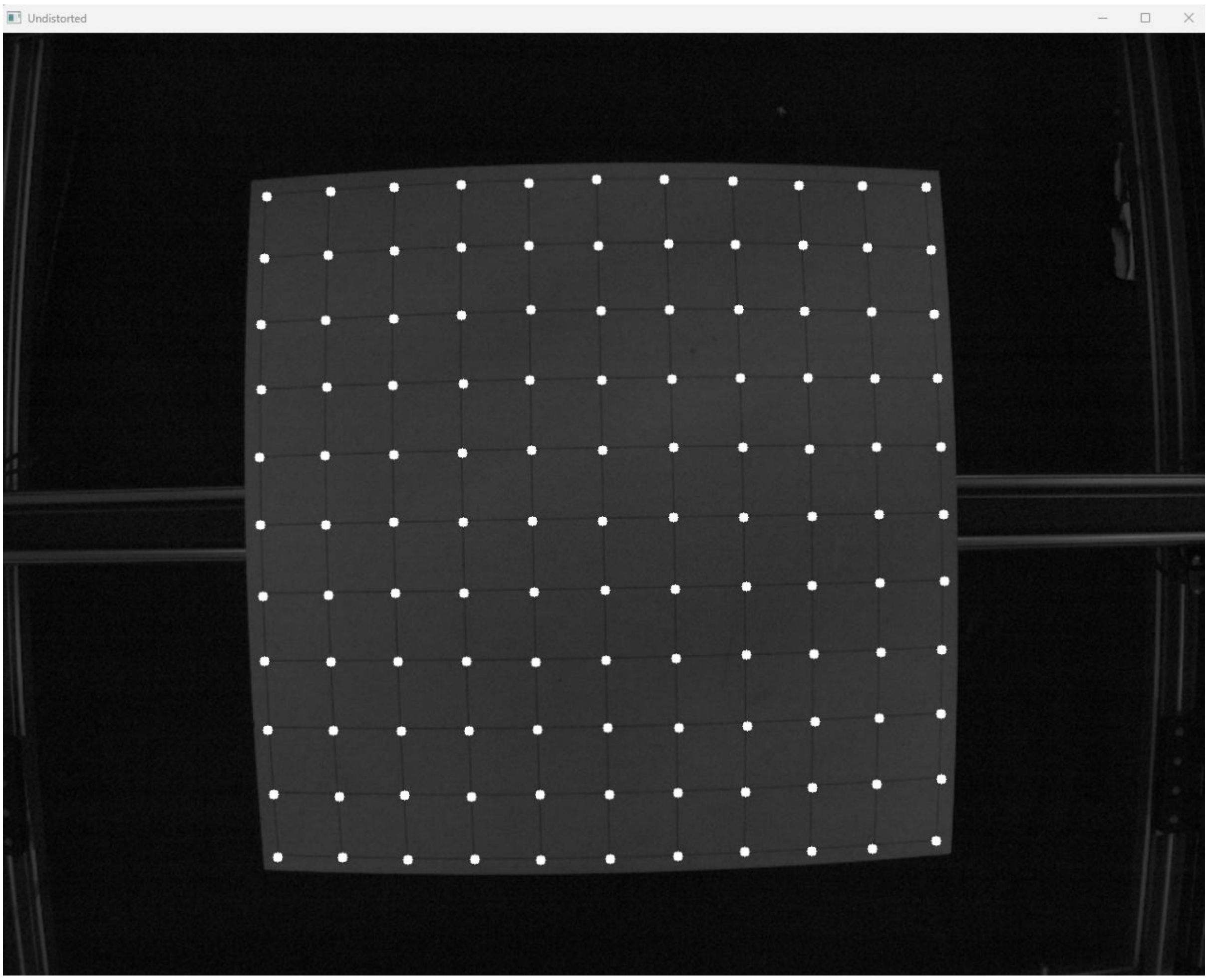
Creating A Calibration

Before any corrections can happen, the program needs an idea of what points should be where. When running for the first time we need to set a calibration. To do this there is a function called "calibrate". It will bring up your image that you have loaded into the program. When the image appears on the screen you will need to click on all the corners of the grid, your clicks will show up as white dots and you should end up with 121 points. Press any key when you're finished.



The image doesn't need to be bright or super sharp but being aligned and clear enough that you can see the corners is important. This one was taken with just the room lights on. There is an option to save these points in the function arguments. The quality of the correction depends on the quality of the placement of your clicks, if your clicks aren't on the corners it won't align the right pieces of the image.

The calibration itself uses the cv2.fisheye module from OpenCV to produce an undistorted image.



If you're happy with the result press enter or space to save the points and camera calibration. Otherwise press any other key to close the window.

The calibration and points save into JSON (.json) files in the Testing Scripts folder that you can then move to wherever is convenient for you.

Using A Calibration

Once you have a calibration made you can use it to correct images either individually or in bulk. The function load_calibration_from_json() takes the path to your "camera_parameters.json" file as a string. From here the apply_calibration_to_image function can use those parameters straight away. The first argument is for the image; it expects it to already be loaded in by OpenCV. The second argument is if there is a calibration loaded. If "False" it will launch the calibration from above, if "True" it will use the one you have loaded. It returns an image that you can display with the display_result function.

```
img_path = Path("Image__2025-09-24__13-00-36.bmp")
cam = Camera_Calibration(img_path)
cam.load_calibration_from_json("camera_parameters.json")
img = cam.apply_calibration_to_image(cam.img, True)
cam.display_result(img)
```

There is another function called bulk_correct. The idea behind this function is that it may not be convenient to do the corrections as you go but if you save your images to a folder, you can do them all at once afterwards. Copy and paste the directory path to your images, remembering to be careful of backslashes, for example mine looks like this:

```
img_folder = Path("C:\\Users\\nb156\OneDrive - The University of Waikato\Desktop\Testing Scripts")
cam.bulk_correct(img_folder, "bmp")
```

It then creates a folder within that folder called “Corrected” then goes through applies the correction to all the files of the format “bmp” and saves all the corrected images there with “corrected_” prepended to the file name. “bmp” can be substituted for other formats if that is what you are using, for example if all your images are saved as PNG you would put “png”.

Troubleshooting

A guide to fixing common issues with the testing rig. The bullet points should be treated like a flow chart, start at the first cause and work your way through.

Common issues

Issue: Motors not running

Causes:

- Power supply
  - Is the electronics box plugged into the power supply and turned on?
  - Is the white adapter for the raspberry pi power supply plugged in and turned on?
  - Open the electronics box, are the LEDs on the raspberry pi on? There should be a solid red one glowing in the bottom right-hand corner.
  - Are the lights on the motor drivers on? If not, check the red and black wires coming from the power supply socket, are they connected? Are they connected into the orange joiners securely? Hold the connector and give the wires a slight wiggle, you do not need to use with much force. They should feel rigid.
- Wiring misconnection
  - If the lights are on for the raspberry pi and the motor drivers, check inside the electronics box for any disconnected cables that may have come loose. There is a table of the GPIO connections on the inside of the lid to help reconnect any wires that may have fallen out.
  - Check the wires for the motor drivers are connected to the correct GPIO pins according to the GPIO table.
  - Take the button box off the plywood panel and open the back of it up, check if any of the soldering has broken.
- Software
  - Plug the mouse and keyboard from the desktop computer into the raspberry pi. Plug the screen into the pi too, you will need a micro-HDMI to HDMI cable, there should be a white one with the raspberry pi logo on it as part of your accessories that come with the testing rig.
  - Open the terminal and enter the following instructions:
    - "cd Documents/test_code"
    - "python motor_control_test.py"

    This will bring up a terminal program for driving the motors manually. Follow the prompt on the screen to drive the motors.

If the stepper motor still does not move, they will need replacing.

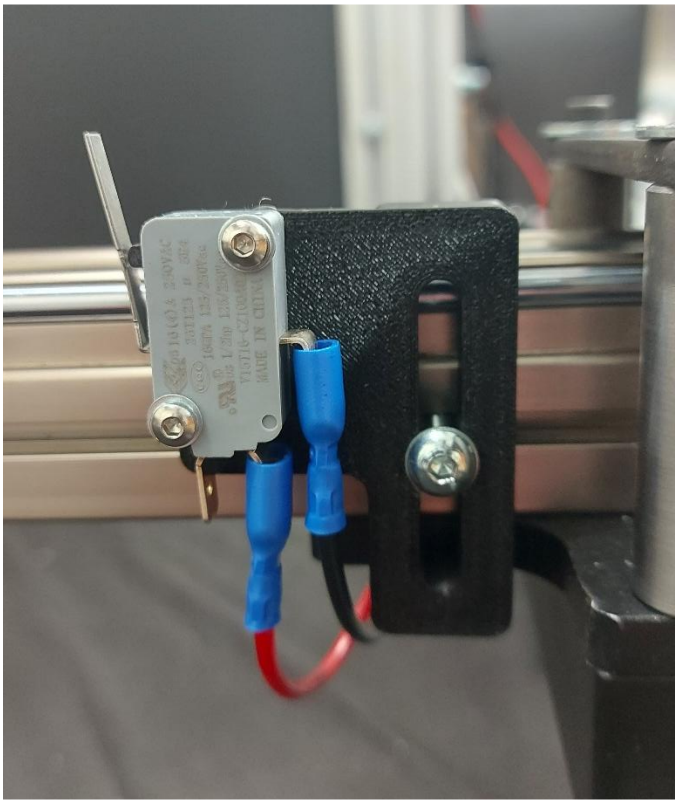
Issue: Motor not changing direction/running over limit switches

Firstly, stop the motors, flipping the switch on the buttons box should do so.
To bring the motor back to the correct part of the railing open the electronics box and plug the mouse and keyboard from the desktop computer into the raspberry pi. Plug the screen into the pi too, you will need a micro-HDMI to HDMI cable, there should be a white one with the raspberry pi logo on it as part of your accessories that come with the testing rig.
Once the pi is showing the desktop screen press ctrl+c to stop the program, it should come up with some kind of error message that you can ignore. Close the currently running terminal. Open a new terminal and enter the following instructions:

- "cd Documents/test_code"
- "python motor_control_test.py"

This will bring up a terminal program for driving the motors manually. Follow the prompt on the screen to drive the motors back to where they need to be. The motors turn clockwise by default.
Causes

- Wiring fault
    - Check the wiring at the bottom of the limit switch, it should look like this:



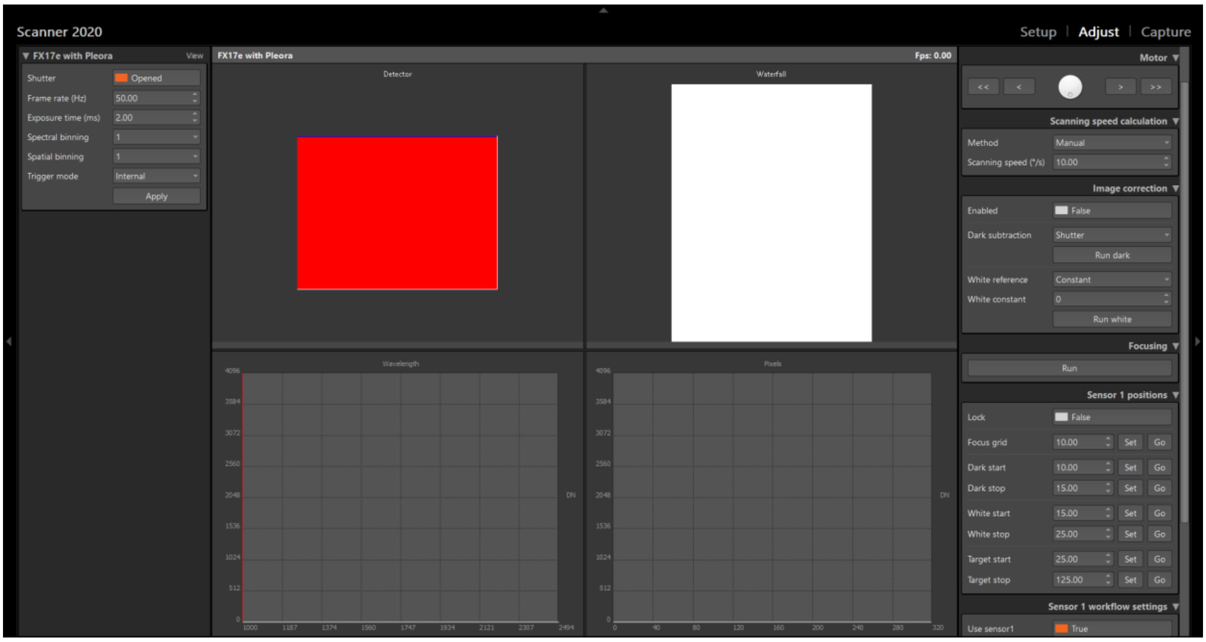
    - Open the electronics box and check the GPIO cables. Refer to the GPIO table to help find where they should be plugged into.
- Broken limit switch
    - To test the limit switch, open a new terminal and enter the following instructions
        - "cd Documents/test_code"
        - "python limit_switch_test.py"
    - Trigger the limit switch manually with your hands, you should get a message pop up that says: "Limit switch x pressed".

- If no message comes up for the limit switch in question, replace the limit switch and try again.
- Press ctrl+c to exit the program.

- Electronics box
    - On the inside of the lid of the electronics box, and on the last page of this guide, there is a table showing a map of all the GPIO connections for the raspberry pi. Check inside the box for any disconnected GPIO wires.

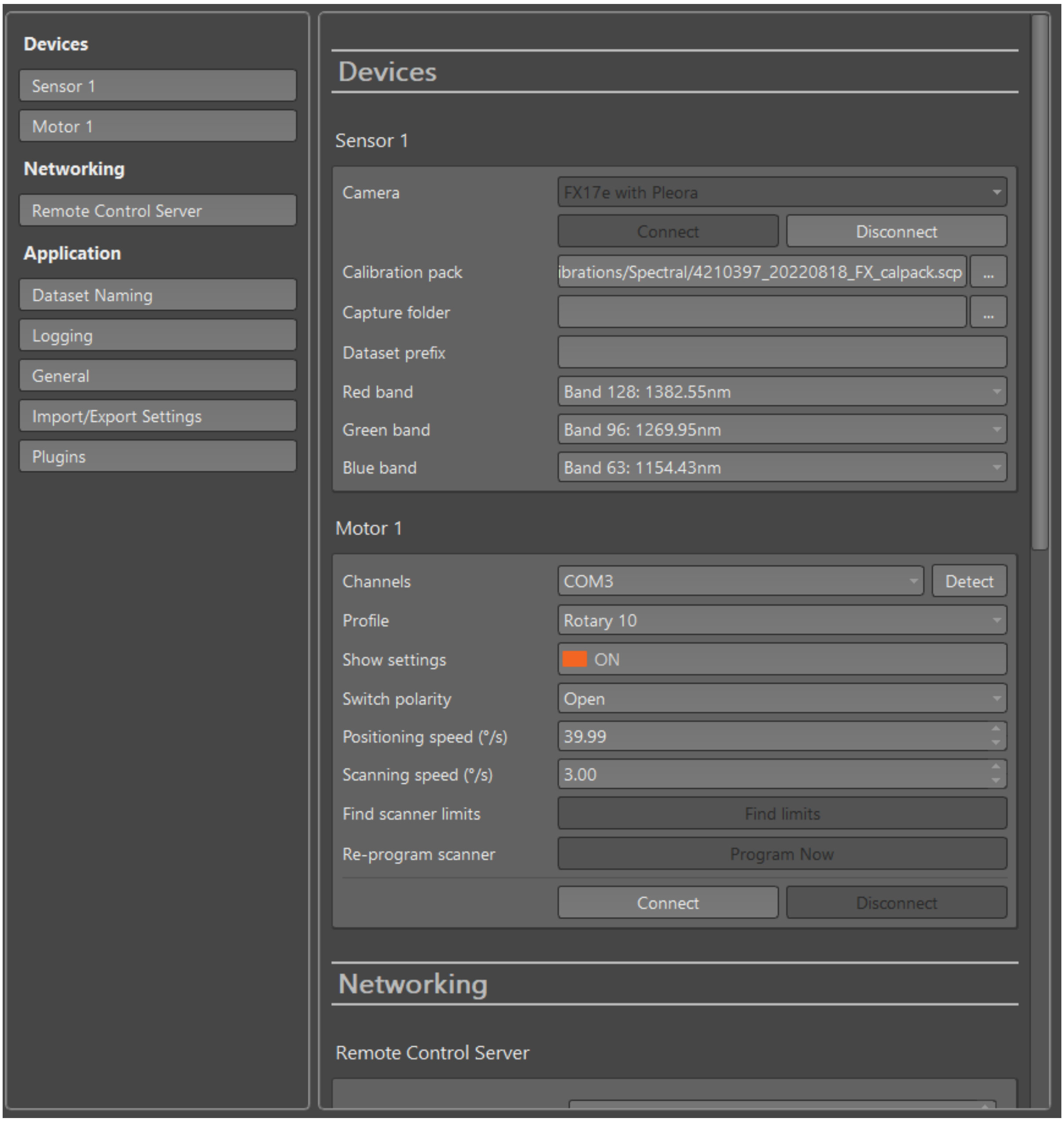
Issue: Specim FX17 not taking images

If the camera is not talking to the computer, you will get a screen like this when going to the Adjust tab.



There are a couple things to check but you will likely need to contact technical support. Often this is the result of a lack of user privileges for your account, if after following the next steps the camera does not return images this will be the cause.

The fact you've made it this far into using the program means the camera is connected properly to the computer, you wouldn't be able to find it in the Setup tab otherwise. One thing to check is if there is a camera calibration loaded.



At the top of the Setup tab after connecting to the camera it should come up with a calibration pack loaded otherwise it will come up blank. You can try loading in a calibration pack by clicking the button next to the label and choose one from there. If it doesn't open to the correct folder the path where they are stored is:

C:\Program Files\Specim\Calibrations\Spectral

If you're not getting the colour bands show up under that another thing to try is to scroll down to the import and export settings section at the bottom and select "Import settings from".

There is a camera settings file on the desktop called "camera_settings.xml", it has the Microsoft Edge logo. This is a copy of the settings used on the HSI laptop where the camera is known to work. Import this file and the colour bands should show up, and when going to the Adjust tab the settings down the right-hand side will be set the same as they are in the first screenshot of this section.

If that has not fixed the problem, you will need to contact technical support and file a Kuhukuhu request to elevate your account privileges to run the camera on the computer.

Issue: Platform not reaching the end of belt before turning around

This is usually caused by a faulty connection between the limit switch, GPIO pins, and motor drivers. Check all the connections are secure in each of those components.

Another place to check for loose connections is inside the buttons box, if the cables have been tugged the solder may have come undone on the backs of the buttons and switch.

Issue: Dim lights

This is likely due to the connections in the terminal blocks in the backs of the lights. Unplug the lights off and wait for them to cool down. Once they are cooled down open the backs of the lights that are dim and check the connections in the terminal blocks. Give each wire a wiggle, if it feels like it is going to come loose it will need to be reseated inside the terminal block. Get a lab technician to assist and ensure it is redone correctly.

GPIO Table

Pin #	Name	Application	Colour	Pin #	Name	Application	Colour
1	3V3	N/A	N/A	2	5V	N/A	N/A
3	GPIO 2	N/A	N/A	4	5V	Limit Switches Power	White
5	GPIO 3	N/A	N/A	6	GND	Limit Switches Ground	Blue
7	GPIO 4	Button 2 signal	Orange	8	GPIO 14	Button 3 signal	Purple
9	GND	N/A	N/A	10	GPIO 15	N/A	N/A
11	GPIO 17	Limit Switch 2 signal	Brown	12	GPIO 18	N/A	N/A
13	GPIO 27	Limit Switch 1 signal	Orange	14	GND	Toggle Ground	White
15	GPIO 22	Toggle signal	Orange	16	GPIO 23	N/A	N/A
17	3V3	N/A	N/A	18	GPIO 24	N/A	N/A
19	GPIO 10	N/A	N/A	20	GND	Motor 2 Ground	Brown
21	GPIO 9	N/A	N/A	22	GPIO 25	N/A	N/A
23	GPIO 11	N/A	N/A	24	GPIO 8	N/A	N/A
25	GND	Buttons Ground	Brown	26	GPIO 7	N/A	N/A
27	GPIO 0	Button 1 signal	Grey	28	GPIO 1	N/A	N/A
29	GPIO 5	Limit Switch 3 signal	Grey	30	GND	Motor 1 Ground	Yellow
31	GPIO 6	Limit Switch 4 signal	Purple	32	GPIO 12	N/A	N/A
33	GPIO 13	N/A	N/A	34	GND	Motor 1 ENA	Grey
35	GPIO 19	Motor 2 PUL pin	Red	36	GPIO 16	N/A	N/A
37	GPIO 26	Motor 2 DIR pin	Orange	38	GPIO 20	Motor 1 DIR pin	Purple
39	GND	Motor 2 ENA	White	40	GPIO 21	Motor 1 PUL pin	Red