

SHIL User Guide

Section Half Imaging Logger: User Guide

Manual Information

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Introduction

The section half image logger (SHIL) takes digital images of the flat face of split cores using a line scan camera and generates RGB data. All 'Archive' section halves are imaged on the SHIL. Sediment cores are imaged as soon as possible after splitting and scraping to minimize color changes that occur through oxidation and drying. The SHIL can also be used to image the outside of a whole round hard rock section (see section 360° Imaging Hard Rock for details).

Theory of Operation

The track system is composed of two slaved linear actuators and a linear encoder that provides precise triggering pulses to a gantry-mounted JAI color line scan camera. The line scan interval is 20 lines/mm (50 microns) and the camera height is adjusted so that image pixels will be square. Light is provided by a number of Advanced Illumination high-current focused light emitting diode (LED) line lights adjusted to precise angles relative to the lens axis in order to evenly illuminate an uneven surface. Motion control is performed using Galil software and hardware coupled to the linear actuators.

Line Scan Camera

Unlike a "normal" distal photo sensor with a square sensor array, similar to a postage stamp, a line scan camera's array consists of a single line of pixels. Whereas a normal camera captures frames, the line scan camera sees only a single line at a time and sends this line image to a capture card on a dedicated computer. Line by line, the computer compiles the final image.

In some applications, the photographic subject may move in front of the camera on a conveyor belt at a specific combination of object speed and shutter speed. In the case of the SHIL, the camera moves across the sample via a motorized gantry. The combination of gantry travel speed and camera shutter speed is critical and is explained in the *Camera Configuration Advanced User Guide*.

The line scan camera images only one line of pixels rather than an area and therefore what happens outside the line of view is of no consequence. The line scan camera effectively masks everything other than the single line of pixels being imaged. This fact is key to the effectiveness of the line lights in providing even illumination at different distances from the lens.

The camera lens on the imaging track, Nikon 60 mm macro, does not have 1/2 or 1/3 stops, only whole F/stops: 5.6, 6.3, 8, 11, 16, 22, and 32. F/16 is the minimum aperture needed to achieve the required depth of field to image the subject at varying heights.

System Operation

SHIL system operation involves a number of processes, some performed only once upon initial installation, some only when lighting or camera equipment is replaced, and some on a routine basis at the beginning of each expedition or at the beginning of each batch of samples. The following procedures are covered in this manual:

- Installing and calibrating light array (see [Light Array User Guide](#)).
- Setting black and white saturation gain levels (see Maximum Dynamic Sensor Range).
- Setting color balance **Author: Where is this covered?**
- Making camera corrections (see Routine Camera Adjustments).
- Setting track velocity (see Track Speed Example).
- Adjusting knee slope, if needed (see Procedure: Iterative Adjustment).
- Performing QA/QC to confirm camera settings (see Quality Assurance/Quality Control).

Apparatus

Hardware

The core imaging track system includes the following hardware components:

- Camera
 - 3CCD (charge-coupled device) line scan camera: JAI model CV107CL
 - Macro lens: AF micro Nikkor 60 mm (1:2.8)
- Light system
 - High-current line lights: Advanced Illumination model LL068
 - Power supply: 24 V/6 A
 - Current source: model CS420-0103 constant (modified)
- Linear encoder: Newall 2 μ m/72 in. model SHG-TT
- Motor system
 - Motors: Galil model BLM-N23-50-100
 - PCI controller card: model DMC-1846
 - Motor amplifier: model AMP-19520
 - Breakout board: ICB-90044-M 44-pin
 - Power supply: CPS 56V/12A
 - Connectors for motor extension cords: AMP 4-pin connectors (172167-1 male, 172159-1 female)
- Robot modules: NSK 2-meter model XY-HRS200-F06246
- PC Workstation
 - NI frame grabber card model PCIe-1429

- NI camera link I/O extension board

Software

Operates with LabVIEW 2017 application.

Maintenance

Before taking images make sure the lights and camera are calibrated properly. See section **Light Array Setup** and **Camera Calibration** for instructions on procedures.

Instrument Settings

- DAQ > Image Capture Motion Setup (Figure 1)

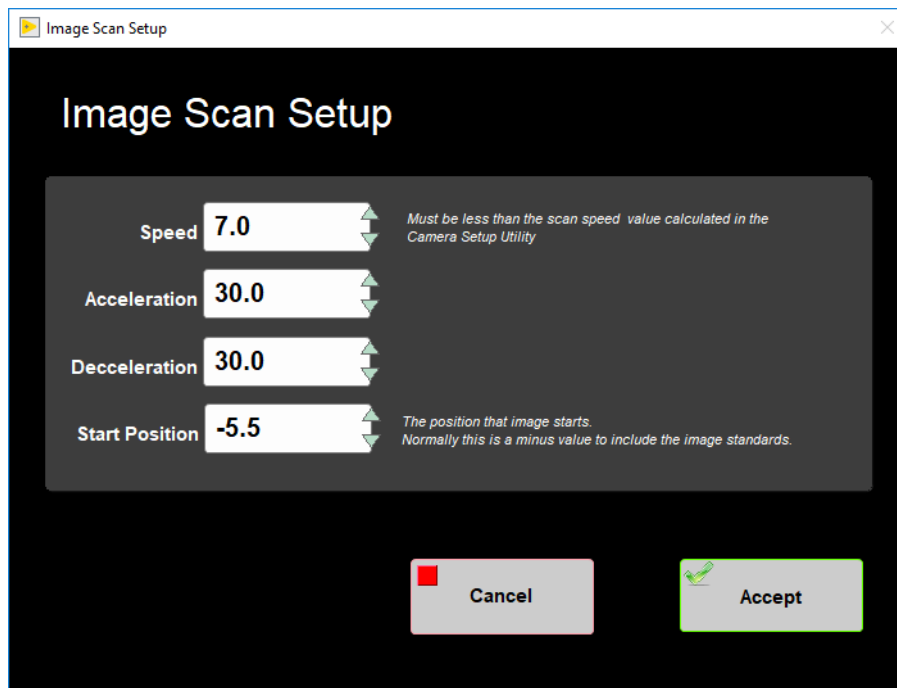


Figure 1. Image Scan Setup window

- Instruments > Camera: General Setup (Figure 2)

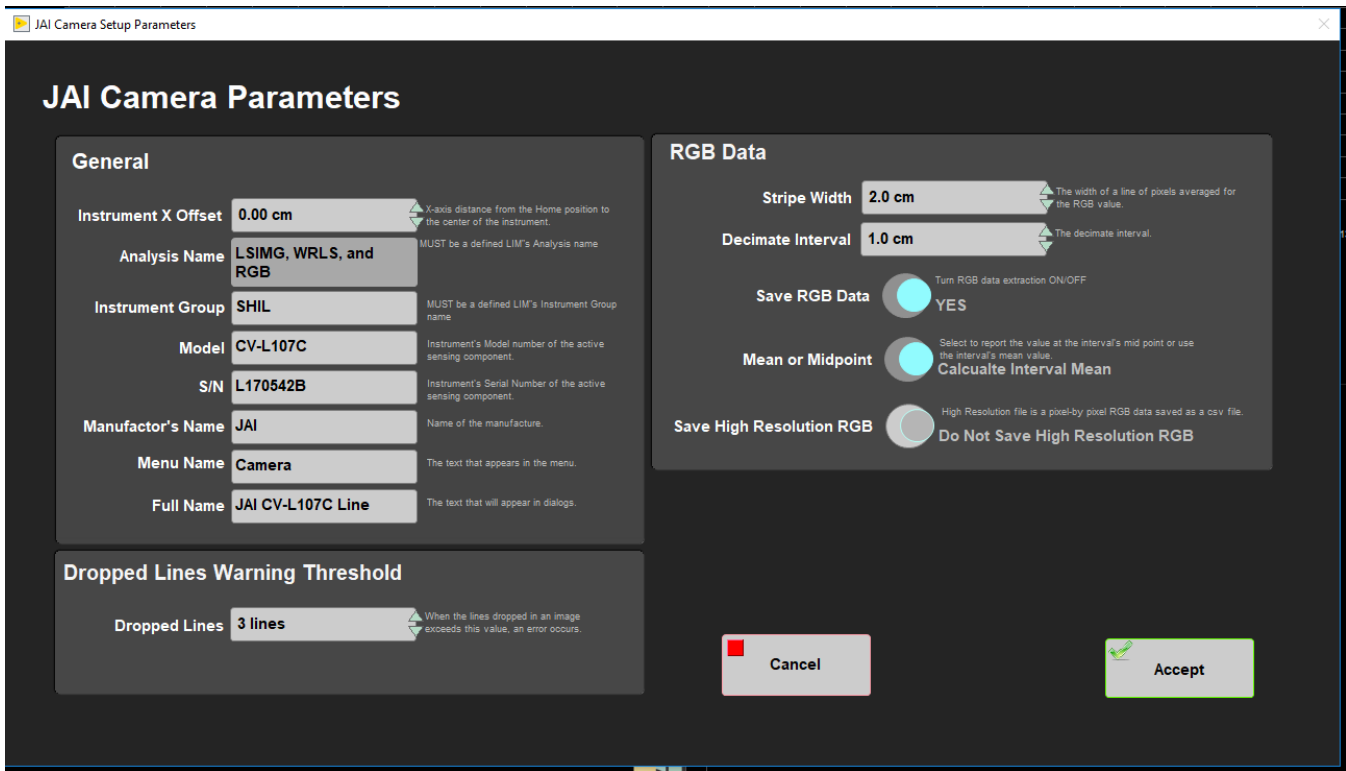


Figure 2. General Camera Setup window

- Instruments > Camera: JAI Camera Setup (Figure 3)

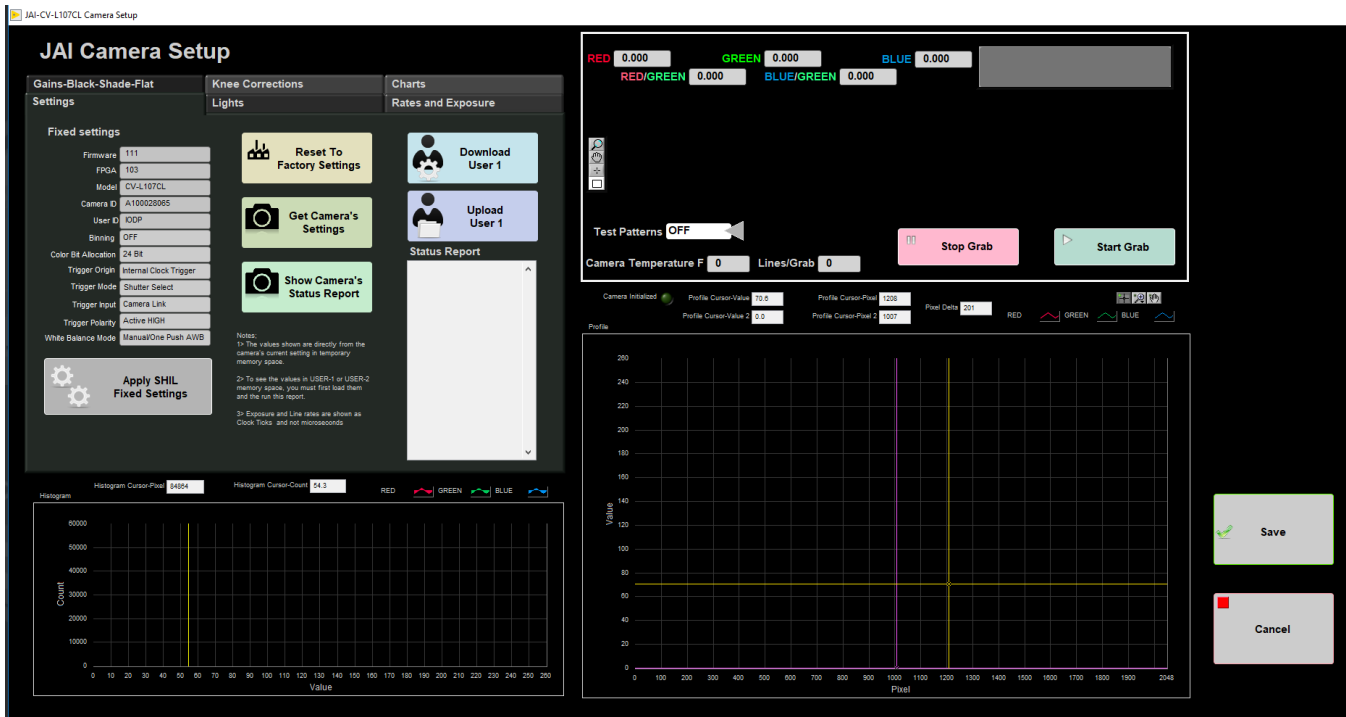


Figure 3. General Camera Setup fixed Settings

Sample Preparation & Imaging

Sample Preparation and Loading

Sediment

If the surface of the archive half is rough use a flat spatula to provide a "clean" surface for imaging to better reveal layering and structures. Sediment cores should be imaged as soon as possible after splitting and scraping are completed to minimize color change through oxidation and drying.

Hard Rock

Rock pieces should be dry and individually rotated such that the split face is approximately perpendicular to the axis of the camera. The lights and lens aperture are configured to give consistent illumination and focus to effectively image rubble bins.

For 360 Imaging of hard rock cores refer to the section **360 Imaging Hard Rock**.

Loading Section

1. Pick up section half and place in the track loading area with the blue end cap forward against the color block. Make sure the section is pushed all the way against the block so the end cap is lined up with 0 cm on the ruler.
2. Bring the endcap for the section to the SHIL workstation for entering sample information.
3. If the section has a whole round sample taken, denoted by a yellow bottom endcap, place a split styrofoam spacer at the end of the section. Cut the styrofoam to same length of the sample taken and write letters on the styrofoam to indicate the type of the sample taken. For example a 5 cm Interstitial Water whole round sample taken. A 5 cm styrofoam spacer with 'IW' written on it would be placed at the bottom. Once a spacer has been made it can be used over the course of the expedition for applicable section halves.

Launch IMS Application

1. First open the IMS Application 'SHIL' on the desktop (Figure 4).



Figure 4. SHIL IMS Desktop icon

2. At launch, the program begins an initialization process:

- Testing instrument communications
- Reloading configuration values
- Homing the pusher arm of the motion control system.

3. After successful initialization, two windows will appear: The IMS Control Panel on the left and the measurement window along the top of the screen (Figure 5)



Figure 5. Main SHIL user interface window

Set Measurement Parameters

Adjust measurement parameters before beginning measurements. Users can adjust the RGB settings and camera speed.

RGB

Users can adjust three RGB parameters: decimate interval, stripe width, and whether to use the mean or midpoint RGB value. For more information regarding how RGB data is calculated please see Appendix A: RGB Calculation.

Adjust RGB Settings

1. Go to **Instruments > Camera: General Setup** (Figure 6). The JAI Camera Setup Parameters window will appear (Figure 7).

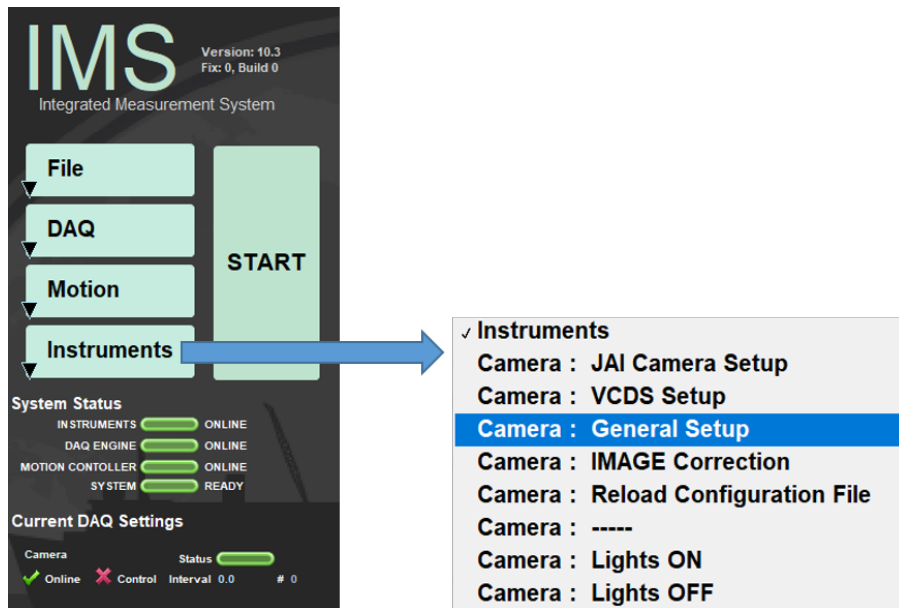


Figure 6. Select JAI Camera Setup Parameters window

2. Adjust values in the 'RGB Data' setting controls.

- **Stripe Width:** Centered in the middle of the core, this determines the width across the core that will be used to calculate RGB data. This is typically set to 2cm. While the value can be changed higher or lower it is commonly at 2 cm. The advantage is this width provides enough material to not exaggerate small disturbances but rather provides RGB data representative of the bulk lithology.
- **Decimate Interval:** The interval that sets the recorded offset along the length of the core. This value can be set between 1 - 2.9 cm
- **Mean or Midpoint:** Can choose how RGB is calculated for the interval. Interval mean calculates the mean RGB values over the interval. Interval Midpoint uses the RGB value at the center of the interval. This is typically set to Interval Mean.

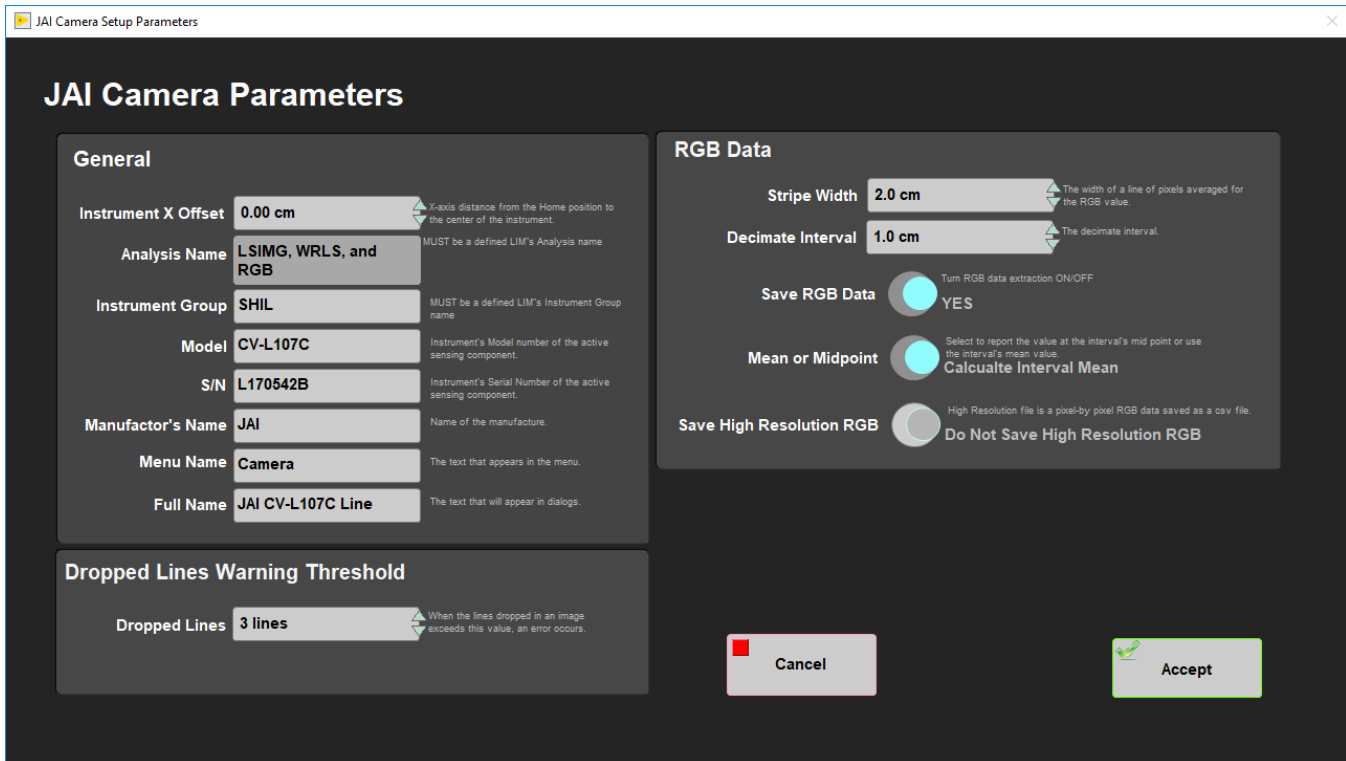


Figure 7. JAI Camera Setup Parameters window

The 'General' and 'Dropped Lines Warning Threshold' should not need to be adjusted. If something needs to be altered talk to the programmers and ALOs.

3. Click 'Accept' to save values. If select 'Cancel' the values will revert back to prior settings and the window will close.

Camera Speed

Camera Speed is calculated during the calibration procedure. The camera speed set must be lower than the speed determined by the calibration or else the camera will start 'dropping lines'. Dropped lines means the camera is moving too quickly to calculate the RGB and offsets at the bottom of the core will return values of '0'.

Adjust Camera Speed

1. Go to **DAQ > Image Capture Motion Setup** (Figure 8).

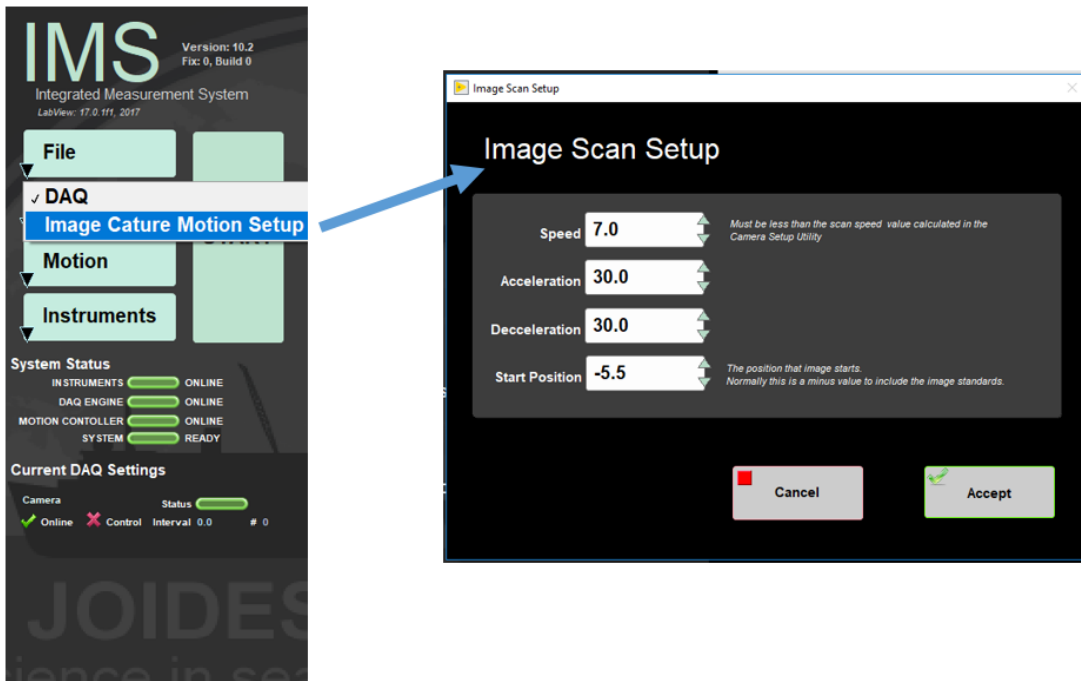


Figure 8. Select Image Scan Setup window

2. The **Image Scan Setup** window appears. There are four settings in this window:

- **Speed:** This is the speed in cm/sec the camera moves while measuring the section. This speed must be set lower than the speed determined by the Camera Calibration.
- **Acceleration:** The rate in cm/sec the camera ramps up to when not measuring a section.
- **Deceleration:** The rate in cm/sec the camera will slow down when not measuring a section.
- **Start Position:** This is the position the imaging begins. Note it will be a negative number. The top of the core starts at 0 cm in order to image the standard gray-scale card in front of the core, that location will be negative.

Start A Measurement

1. Click the green **Start** button in the **IMS Control** panel (Figure 9).
2. The **SHIL Section Information** window will pop up.

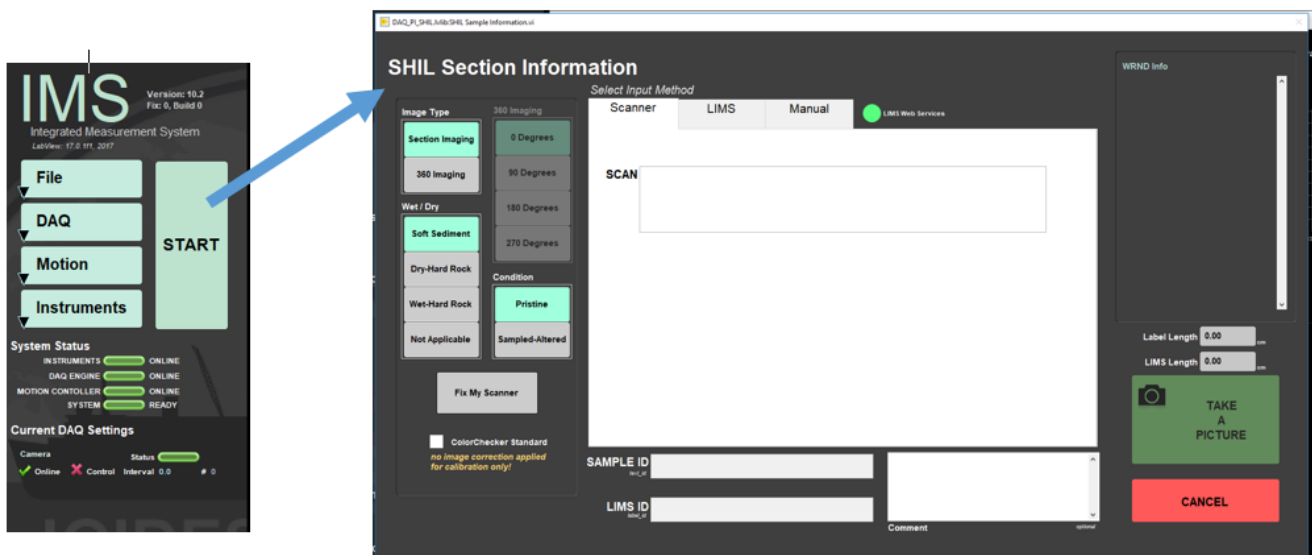


Figure 9. Select SHIL Section Information window

3. The area on the left has four fields to define the condition of the sample measurement:

- Image Type:** 'Section Imaging' or '360 Imaging'. For instructions on the 360 imaging refer to **360 Imaging Hard Rock** section.
- Wet/Dry:** Indicates the type of the material being imaged
- Condition:** 'Pristine' or 'Sampled-Altered'. **Sampled-Altered** could include imaging the working half or a highly disturbed section. Most instances should be **Pristine**.
- 360 Imaging:** This area is grayed out unless '360 Imaging' **Image Type** is selected. For instructions on the 360 imaging refer to **360 Imaging Hard Rock** section.

Select the conditions appropriate for the section half.

4. There are three ways to enter sample information into IMS:

- **Barcode** (most common): Put cursor in the 'Scan' box. Use the bar-code scanner to scan the label on the end-cap. The sample information will parse into the 'Sample ID', 'LIMS ID', and Length fields.
- **LIMS Entry:** Select the 'LIMS' tab at the top of the window. Navigate through the hierarchy to select the correct, expedition, site, hole, core, and section. Length information will automatically populate when the section is selected.
- **Manual Entry:** Select the 'Manual' tab at the top of the window. Click in the box and manually type sample information into the box.

By default the instrument is set for imaging the archive half and will not allow you to scan a working label. If you want to take a picture of a **working half** you need to go to the **MANUAL** tab and select **W** (working) into the **Section Half** label (Figure 10). Once you have selected **W** (working), you will not be able to scan an archive half; in order to do that you need to go back into the **MANUAL** tab and re-select **A** (archive).

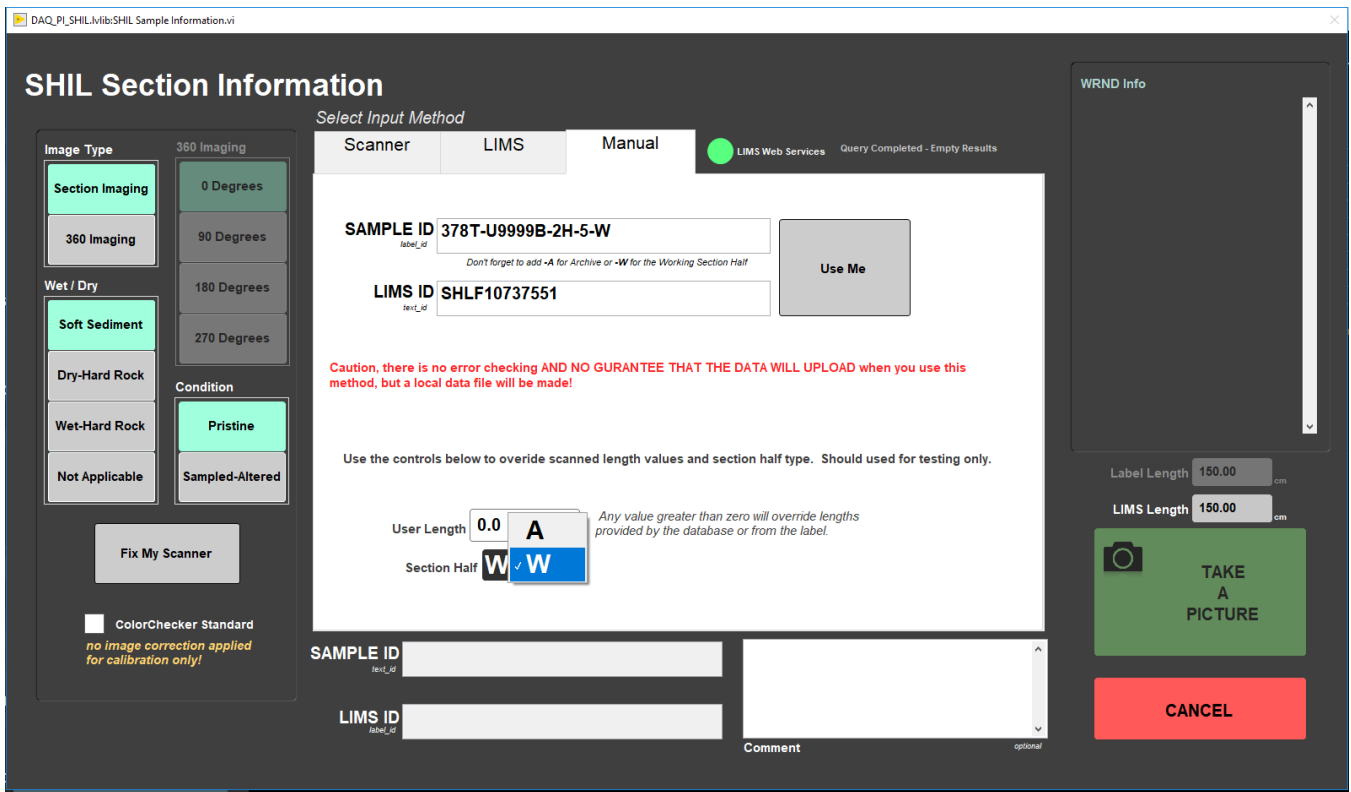


Figure 10. SHIL MANUAL Section Information window

5. Click **Take a Picture**. The lights will turn on and start moving down the length of the core. In the IMS interface the sample information will go away revealing the measurement windows. The image and RGB data is displayed and updates as the measurement progresses.

6. When the measurement is complete, the camera lights will turn off and move back to the home position on the track.

7. The **Image Crop** window (Figure 11) pops up. An image should be cropped to include all material and the inner edge of the end-cap. RGB data will exclude data outside of the Crop area. The green box is the IMS estimation of the crop area. Click and drag the green lines to adjust the cropped area at the top, bottom, and sides of the image. Tools in this window include:

- **Show Bottom of Image:** Takes image down to illustrate the bottom of the image and crop box.
- **Show Top of Image:** Brings image up to show the top of the image and crop box.

- **Crop Image:** Crops the image to show only image inside of the green box.
- **Uncrop Image:** Will undo a crop and allow user to re-adjust the green crop box.
- **Save Image:** Saves the image, RGB data, and writes the upload files
- **Discard Image:** Does not save the image or RGB data.

The Image crop restricts users to limit adjustments to 2cm or less. The message box will indicate if the crop has exceeded allowable limits and the 'WRND Info' message box indicates if and where any whole round samples were taken from the section. If the image needs to be cropped by more than 2cm check the correct section/end cap is being used, a styrofoam spacer is not missing, and the curated length. Cores can expand so if the curated length is incorrect, talk to the curator on shift to correct the length. Note this will also create a need for the curator to re-calculate depth of the hole. If the error is in the curated length of the core a user can check the 'override crop restriction' button to crop the image and upload the data.

8. Click **Crop Image** when satisfied the green box will capture the entire image.
9. If satisfied with the image click **Save Image**. If the image needs to be re-imaged click **Discard Image** and re-start the measuring process.
10. The 'Image CROP' window will go away and the 'SHIL Section Information' window will appear again.

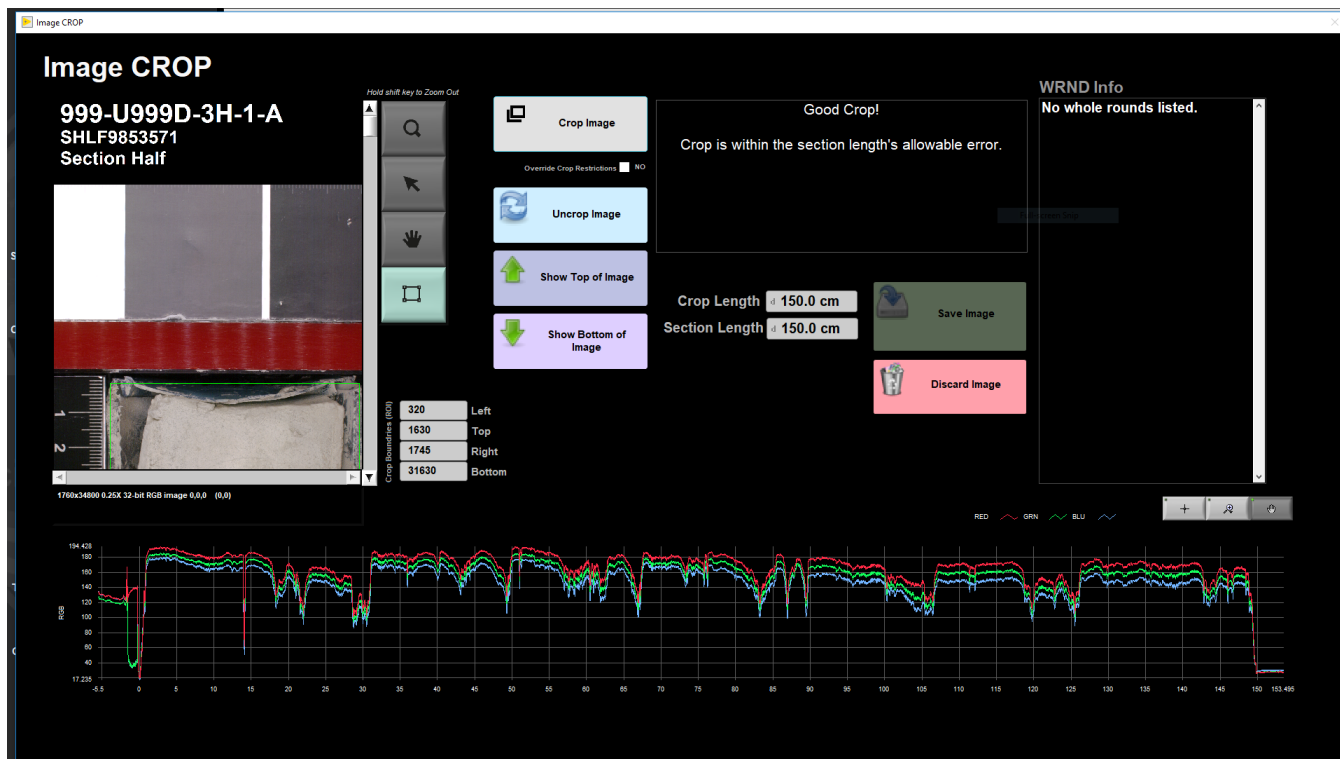


Figure 11. Image CROP window

Uploading data

Data Structure

Two files are uploaded to LORE via MegaUploadTron (MUT):

1. **.roi file** : Contains callouts to the uncropped TIFF , uncropped JPEG, and cropped JPEG images. The images are linked files in LORE as Images > Core Closeup (LSIMG).
2. **.RGB file** : Contains the red, green, and blue values calculated for each offset. The information is in LORE under Physical Properties > RGB Channels (RGB).

The files are independent of eachother, both do not need to be present in order to upload, and often appear in MUT at different times.

MUT and .ini file

Be aware uploaded files have a callout for the .ini file. There is only one .ini file and the files will callout the .ini file currently present at the moment of uploading to LORE. If changes are made to settings that will alter the .ini and there are files piled up that have not uploaded to LORE, those files will upload the current .ini file, not the .ini file settings used for measurement. This implies files could have incorrect .ini files if rapid changes are made and users are not being careful.

How to Upload data

1. Open up MUT (Figure 12). Use LIMS Applications password to login. The LIMS Uploader window will open (Figure 13).

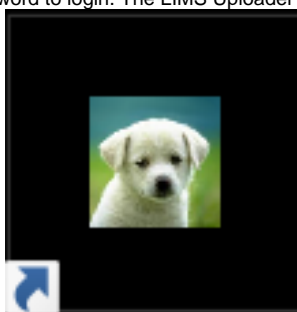


Figure 12. Desktop MUT icon

2. Set 'Project' at the bottom of the screen to either the current expedition or '999' if performing tests.

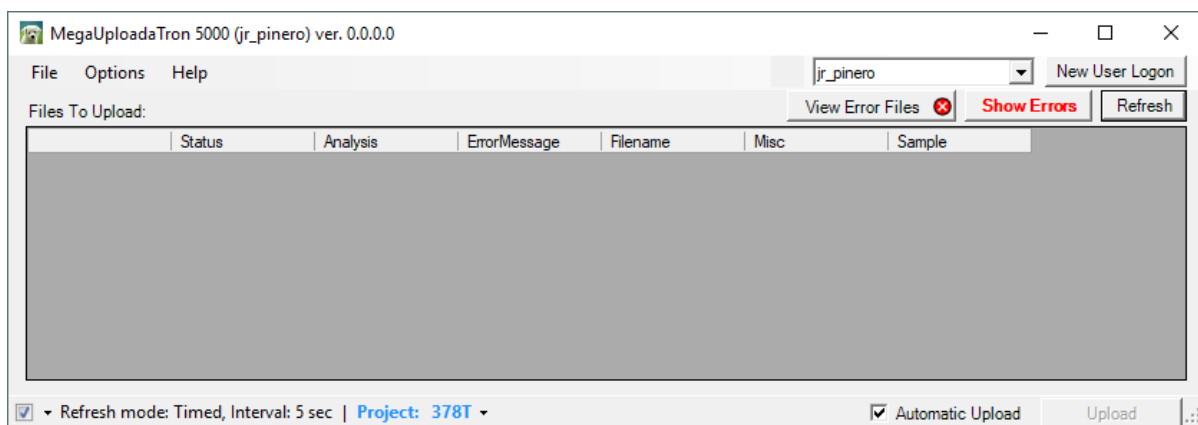


Figure 13. LIMS Uploader window

3. Check 'Automatic Upload' in the lower right hand corner. At the refresh interval the files will upload to LIMS.

4. Files with checkmarks in the right column will upload. A green arrow in the column **Status** indicates it is in process of upload. A purple question mark indicates the file is not recognized by MUT. This could be due to an incorrect sample name or only one file being in the 'IN' Folder.

5. After files are successfully uploaded they move from 'data > in' to the 'data > archive' folder. When the files move they will not longer appear MUT. If a file was unable to upload it will move from 'data > in' to 'data > error' and two new buttons will appear in MUT saying 'Show Error' and 'Show Error Files'.

MUT Configuration

File Path

The file path MUT should look for files to upload is C: > data > IN. IMS writes upload files to C: > data > IN, so ensure the filepath is set correctly. Note the uploaded files are written directly into the 'IN' folder. Images are not directly uploaded and are written to C: > data > IN > Images

Active Analyses

In MUT the 'active analyses' (Figure 14) should be set to Linescan Image, Processed RGB channels, and Whole-round Linescan. Linescan Image and Processed RGB Channels are for section half measurements. The Whole-Round Linescan Image is for 360 Imaging of hard rock cores. All three analyses should be set in the 'Active Uploaders' Column. Note it is ok for analyses to be in the 'Active Uploaders' even if MUT at that instrument host does not generate those files.

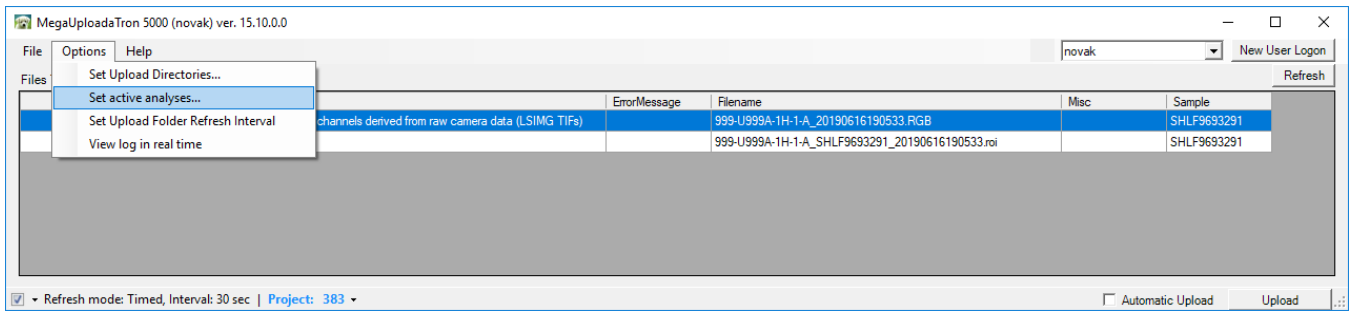


Figure 14. Select Set active analyses on MUT

Auxillary data Produced

The SHIL has the capability to produce two additional file types at the scientist's request:

1. Hi RES RGB
2. VCD-S

These files appear in separate folders in C: > data > in

Hi RES RGB: This file default is turned off and can be turned on in **Instruments > Camera: General Setup** (Figure 7). The Hi-Res RGB file reports a Red, Green, and Blue value for each line of pixels down the length of the core. 1cm is 200 lines of pixels so a 150cm core will yield approximately 30,000 lines of data depending on the exact crop length. The file is not currently uploaded to the database and is instead copied to data1 at the end of the expedition. The files can be put on the server for scientist access to a convenient, shared location such as UserVol.

VCD-S: The SHIL can preserve a digital copy of the VCD-S that is printed out. If a scientist wants to keep a digital copy of the scratch sheet turn on the feature in **Instruments > Camera: VCDS Setup** (Figure 15). Files are then written to C: data > in > VCD-S. These files are not uploaded to LIMS and should be put in data1 at the end of the expedition. The files can be put on the server for scientist access to a convenient, shared location such as UserVol.

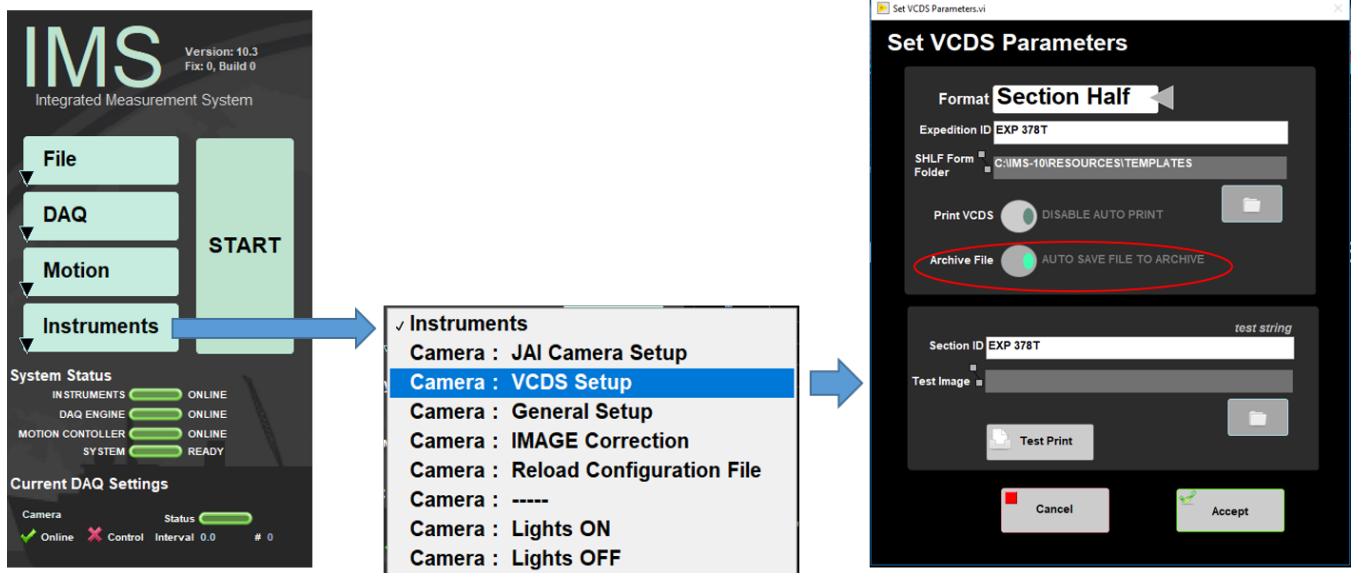


Figure 15. Select to preserve a digital copy of VCD-S

360 Imaging Hard Rock

The SHIL can be used to image the external surface of whole round hard rock cores in order to assemble a 360° composite image of the whole round. Oriented rock pieces are imaged after they have been binned and the structural scientist has marked the split lines on the pieces. Using the custom whole round scanning tray, the whole round core surface is imaged four times at the 0°, 90°, 180°, and 270° orientation from the splitting line. The Imaging Specialist will download the images and assemble a composite image from the four scans and upload the composite separately.

Sample Preparation

1. Remove the section half scanning tray from the SHIL and replace it with the whole round scanning tray making sure to align the blocks correctly. Note that the rotating section of the tray has 0°, 90°, 180°, and 270° markings on each end and that the rotating section will click and lock into each orientation.

2. Place the split liner section with the whole round core on the tray below the SHIL and align the top with the 0 cm on the ruler on the tray (Figure 16).



Figure 16. Whole round core correctly placed on the split liner section.

3. Remove the 0° aluminum strip and another aluminum strip on either side of 0°. Move the dry, oriented pieces into the tray, keeping the pieces at the correct offsets and aligning the split line with the 0° orientation.

4. Attach the not 0° aluminum strip and rotate the tray so that the 0° position is up, facing the camera (Figure 17).

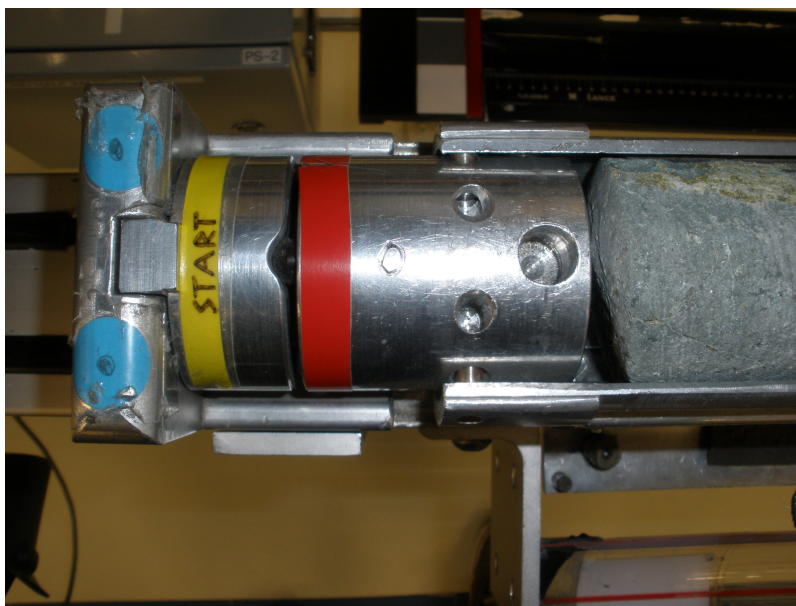


Figure 17. Whole round core correctly placed on the aluminum tray

Take Image

1. Click **START** and the **SHIL Section Information** screen will appear (Figure 18).
2. Scan the section barcode from the endcap
3. Select the **360 Imaging** on **Image Type** and the default quadrant will be **0 Degrees**. Select **Dry-Hard Rock**. Click **TAKE A PICTURE**

DAQ_PL_SHIL.lib:SHIL Sample Information.vi

SHIL Section Information

Select Input Method

Scanner: LIMS | Manual | **LIMS Web Services**

SCAN

Window Smp

WRND Info
999-U999A-1H-1 <SHLF 9693291
WRND 9853121
IW: 145.0-150.0 >IW

Label Length 150.00 cm
LIMS Length 150.00 cm

TAKE A PICTURE

CANCEL

Image Type: Section Imaging | **360 Imaging**

360 Imaging: **0 Degrees** | 90 Degrees | 180 Degrees | 270 Degrees

Wet / Dry: Soft Sediment | **Dry-Hard Rock** | Wet-Hard Rock | Not Applicable

Condition: **Pristine** | Sampled-Altered

Fix My Scanner

ColorChecker Standard
no image correction applied for calibration only!

SAMPLE ID 999-U999A-1H-1-A
LIMS ID SHLF9693291
Comment

Figure 18. SHIL Section Information window for 360 Hard Rock Imaging

4. When the scan is finished, the **Image CROP** window will open. Crop the image and **Save** it.
5. The **SHIL Section Information** window for whole round will open and the rotation angle will default to the next quadrant, in this case **90 Degrees**.
6. Replace the aluminum strip and rotate the tray to the next position, remove the aluminum strip facing up. Ensure that the rotation angle setting in the window is that same as on the tray. Click **TAKE A PICTURE**.
7. Continue the cropping, rotating and scanning process until all quadrants are complete. Once the images are uploaded to the database, the Imaging Specialist will create the 360 composite image and upload it to the database. If an image needs to be discarded, the software returns to the main screen and the user will need to start over, however, the user can select which quadrant to start on.

Maintenance

Instrument Preparation

Preparing the track system for imaging cores requires adjusting the position of the lights and barcode imager for optimal quality and calibrating the system by adjusting camera settings. The position of the lights and barcode imager, once set, should be stable throughout an expedition. The technical staff will calibrate the camera settings (*SHIL: Camera Configuration AUG*) and light array (*SHIL: Light Array AUG*) whenever the camera or light sources have been repositioned or changed.

Setting up the Lights

Initial light installation and fine adjustment procedures are described in the SHIL: Light Array AUG. For routine operation, follow these steps:

1. Rotate the lights to the desired rough angle to the camera (usually ~30° to the camera axis for sediment cores). Fine-tune the light position by observing the camera output using MAX.
2. Manually turn on one line light at a time to full power by pressing the "+" button on the light controller until you reach 100%.
3. Loosen the brackets on both sides of the light mounts and make small position adjustments until the brightest image is achieved.
4. Turn off the light by pressing the "-" button and press **Select** to enable the other light.
5. Repeat Steps 2–4 for the second light.

Calibration

The laboratory technician calibrates the system when needed by adjusting camera settings and analyzing an imaged Kodak Q13 grayscale standard. Calibration adjustments are performed using an iterative process of imaging a ruler placed crosswise on the track then counting the pixels between millimeter marks, moving the camera up or down, and repeating.

Method based on SHIL Calibration Video. BILL! Please review, correct, and update with screenshots during process!

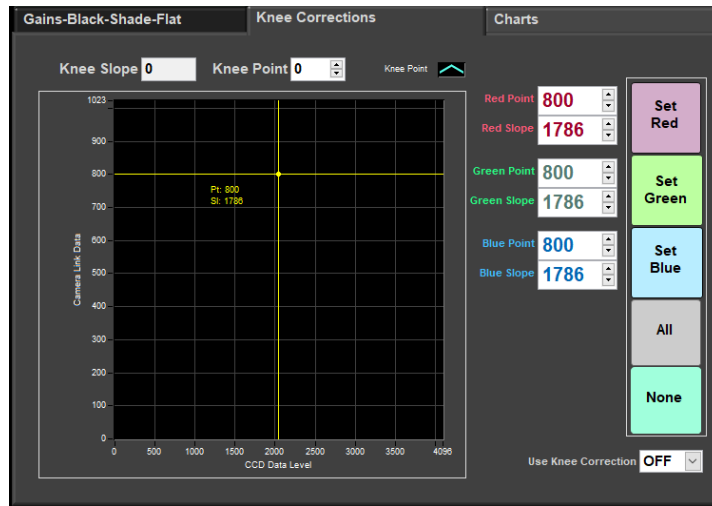
Glossary of terms:

Gain: a digital camera setting that controls the amplification of the signal from the camera sensor. It should be noted that this amplifies the whole signal, including any associated background noise.

Gamma: a digital camera setting that controls the grayscale reproduced on the image. An image gamma of unity (Figures 3a - 3b) indicates that the camera sensor is precisely reproducing the object gray scale (linear response). A gamma setting much greater than unity results in a silhouetted image in black and white.

White Balance: a camera setting that adjusts the color balance of light the you're shooting in so that it appears a neutral white, and it's used to counteract the orange/yellow color of artificial light.

Knee: sets the knee point and slope for video signal compression to prevent over-exposure by limiting signals in high intensity areas of the subject to the dynamic range of your camera, it adjusts the contrast of a picture. Bill Mills: On the SHIL, we tend to not use it. The TIFF correction that gets done on the raw images seems to be good enough.



Before Starting:

- Color Standard values vary based on the standard and the manufacturer of the standard. Verify the values of the MacBeth Color Standard before starting. Check the grayscale card to determine what the percentage of gray. The target calibration values will vary based on the percentage of gray. Target values depend on the percent grayscale card. Max value 255. If using a 50% grayscale card target red and green value is 127, a 25% grayscale card target value is 64, etc.
- The light array should be calibrated before doing the camera configuration. If installing new lights or a new camera this will be an iterative process adjusting lights and camera.

Calibration

Camera Corrections

1. Disable the motor that moves the camera. In the IMS control panel select **Motion** and then **Drive Disable** from the dropdown menu (Figure 20). The user can now manually move the camera to the desired spot.

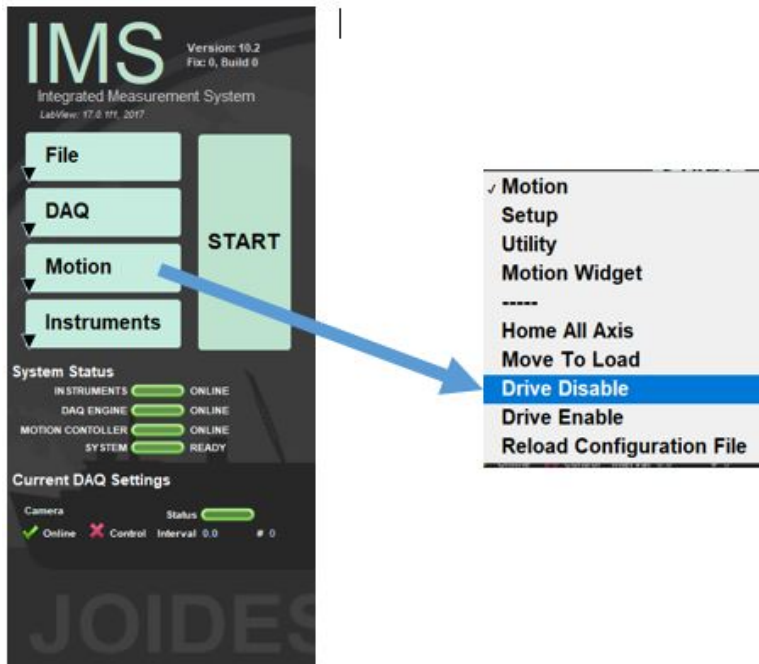


Figure 20. IMS commands to disable the drive

2. Back in the IMS control panel go to **Instruments > JAI Camera Settings** (Figure 21). The lights turn on automatically when the JAI Camera Setup window opens.

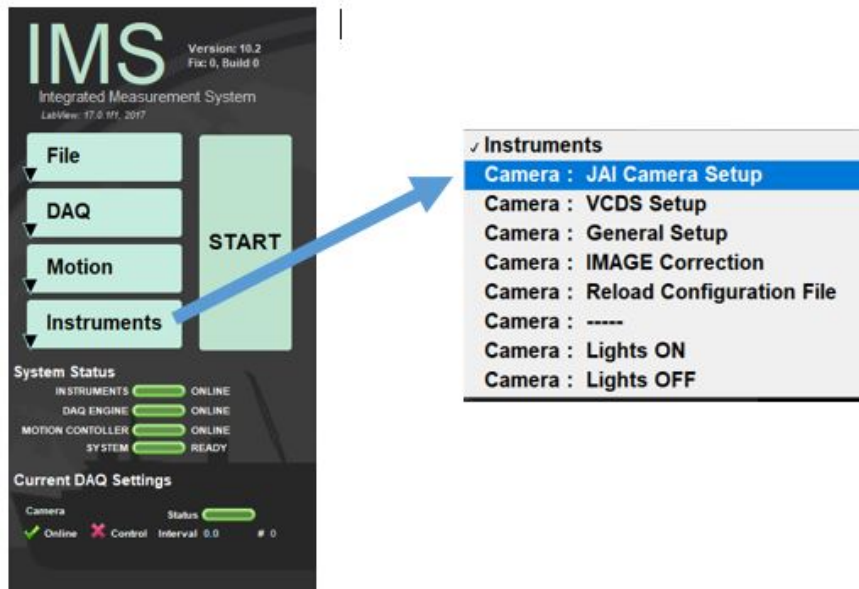


Figure 21. Selecting JAI Camera Setup

3. Select the Rates and Exposures tab (Figure 22).



Figure 22. Rates and Exposure window

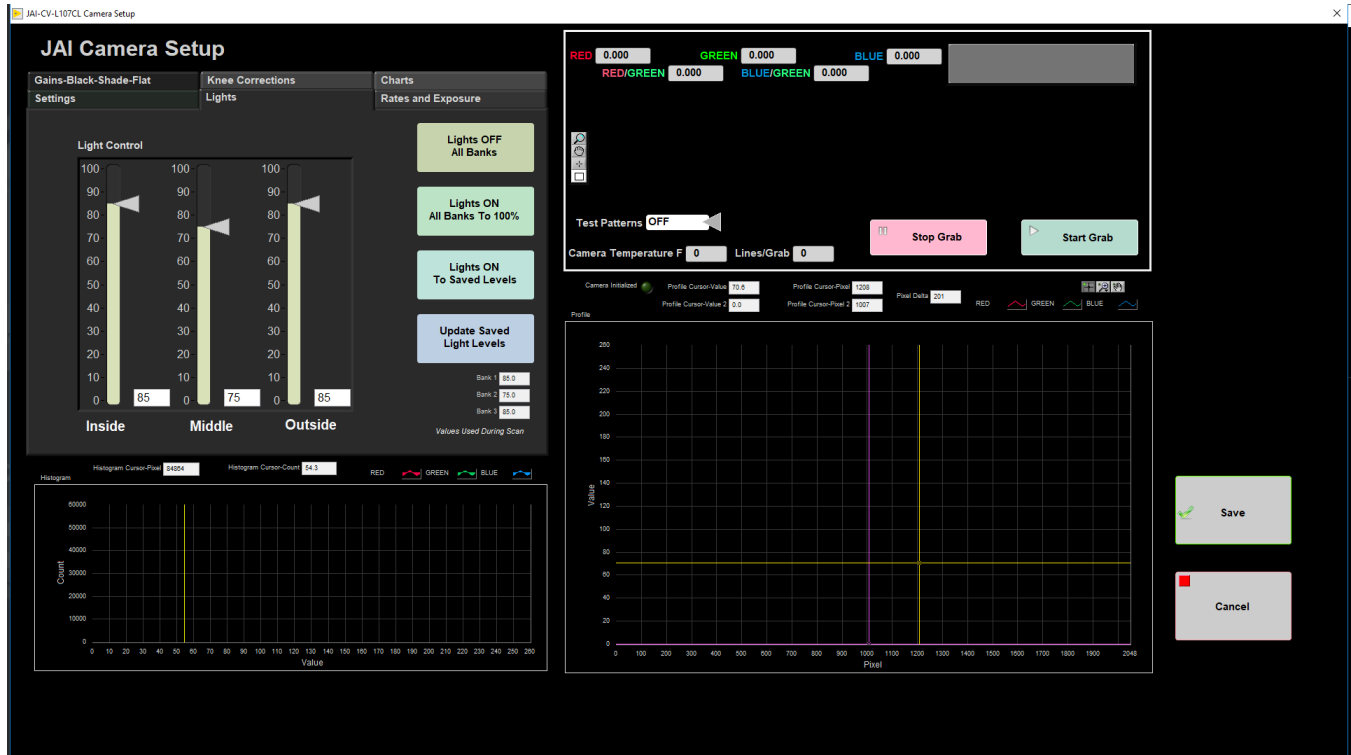
There are four main areas in this window:

- **Left Exposure Interval panel:**
 - Line Trigger Interval: Interval that sets the Max Image Scan Speed. The target Max Image Scan speed is 8.33 cm/sec. Adjust the Line Trigger Values to achieve 8.33 cm/sec
 - Red Exposure Interval: Sets the red exposure level
 - Green Exposure Interval: Sets the green exposure level
 - Blue Exposure Level: Sets the blue exposure level
- **Left Histogram Graph:** Displays histograms of the red, green, and blue curves
- **Right RGB Values panel:** Displays current absolute R, G, and B values of the image and the current image
- **Right Profile Graph:** Displays the profile curve of the RGB values

4. Place a flat (not bowed), clean gray scale card (standard) and place under the lights/camera. Be careful on how long you leave the card under the lights. The intense lights can damage it.
5. Look at the Red, green, and blue values in the right corner. If using a 50% grayscale card the red, green, and blue values should be approximately 127. The 'red/green' and 'blue/green' ratios should be approximately 1. If the values are off adjust the exposure levels in the left exposure interval panel and this changes the value of the pixel in the right hand panel. To make changes:
 - a. Click the **Green Lock** arrow so it displays 'Off'. Now the Red and Blue Exposure Intervals will no longer be grayed out.
 - b. Place the cursor in the white box displaying the Red Exposure value. Use arrow keys on the keyboard or type in values to adjust exposure values. While adjusting the exposure watch the red pixel value in the right panel. Adjust the exposure until the pixel value is 127.
 - c. Repeat step b for green and blue values

You will notice the histogram and profile graphs roughly overlay one another.

6. Select the **Lights** tab (Figure 23). Select **Lights OFF All Banks**. The lights will now turn off



Figure

7. Select the **Gains-Black-Shade-Flat** tab (Figure 24).

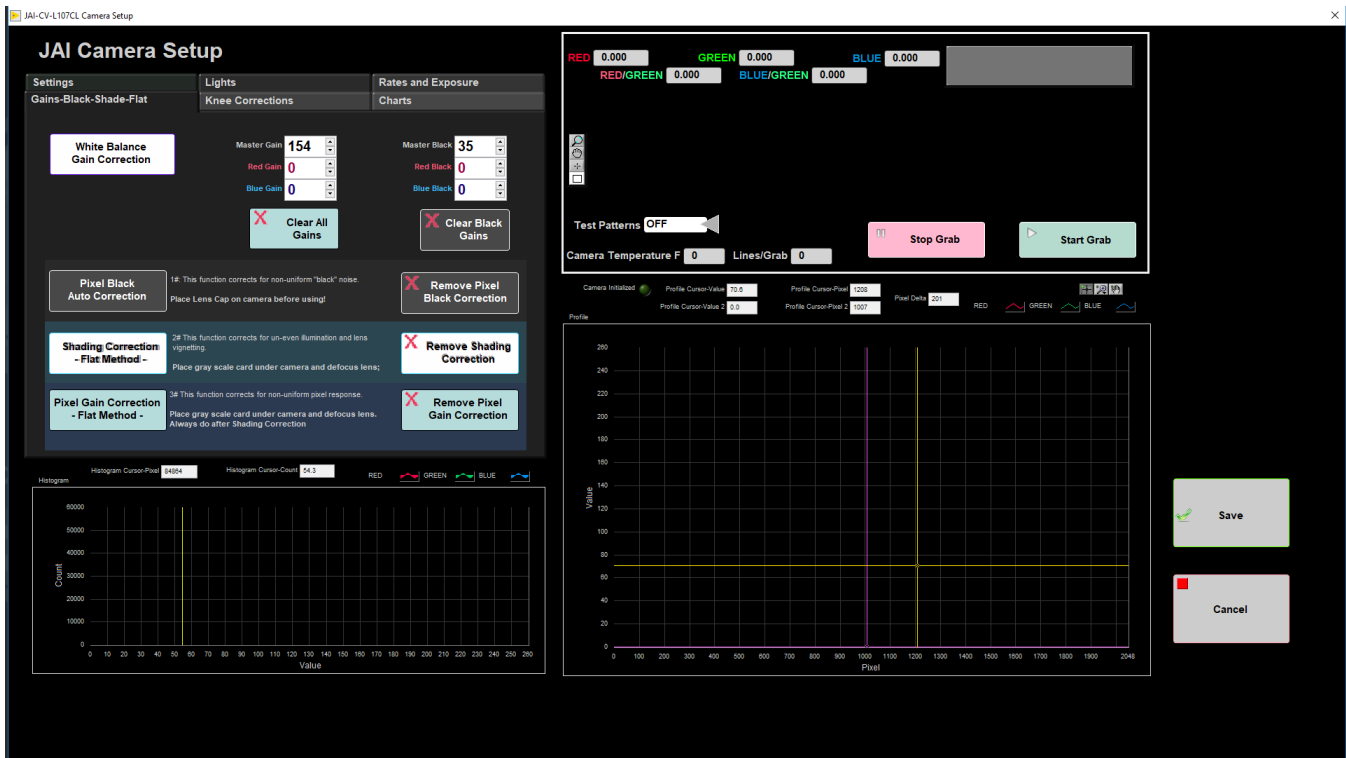


Figure 24. Gains-Black-Shade-Flat Window

- **White Balance Gain Correction:**
- **Pixel Black Auto Correction:** The pixel black level represents extra energy in the camera independent of a light source and is a consistent pattern in the sensor. To correct for this the light source must be turned off, the lens cap put on, and the camera internal correction circuit collects a few lines of data. An average is taken across the line, and pixels are either added to or subtracted from in order for each pixel to have the average value. (Manual Reference)
- **Shading Correction - Flat Method -:** Shading effects can come from an uneven distribution of light and along the outer edge of the camera lens. Shading is corrected for by averaging the signal across a group of eight pixels to represent the line.
- **Pixel Gain Correction - Flat Method -:** Each pixel has a different response to a fixed light source. To correct for this non-uniformity a couple lines of data are calculated (with the lights at no more than 80% of max) and the average response of the pixels are calculated. Then each pixel has a correction factor applied to bring all pixels to the average level. The Pixel Gain Correction also corrects for some shading effects and should be done after the shading correction.

8. Click **Pixel Black Auto Correction**.
9. Go back to the **Lights** tab and select **Lights on to Saved Levels** (For the JAI Camera Setup, use 100% lights.)
10. Place the same grayscale card back underneath the lights as flat as possible. Tilt in the card changes the shape of the pixel value profile and shape /location of the histogram. It is important to use a flat grayscale card to accurately calibrate.
11. Defocus the lens of the camera manually. In the image grab window you will see the card grains go away and the image will become a smooth gray. This changes the profile graph from a relatively straight line to a bowl shape as shown in the camera manual (CV manual, page 12, 6.4.)
12. Then click **Shading Correction - Flat Method -** button. This corrects the bowl-shape to a flat line as seen in the pixel profile graph.
13. Now Click the **Pixel Gain Correction – Flat Method –** button
14. At this point check the red, green, and blue pixel values. If they have jumped around adjust the **Master Gain** Setting to get the values close to 127. When close to 127 click **White Balance**. The lines now completely overlap each other smoothly.

Check Against Macbeth Color Standard

Correcting the White Value

1. Place the Macbeth Color Standard on the track against the top edge. The standard should be flat and level in the track. The color values will change on the degree of tilt.
2. Next, physically move camera/lights over the color standard (Figure 25).



Figure 25. Values changing while over gray-scale card

- Use cursor to draw rectangle around the **white** field in the field of view of the camera (top right window). The red, green, and blue pixel values reflect the values inside the rectangle. If no rectangle is drawn the values will reflect the entire image. In the lower right window, you will see the color lines. If the lines are angled (left to right or right to left), move the color standard to line it up in the holder. The lines might be drifted out of the window/field of view.
- Click on the **Charts** tab (Figure 26). Click on a color box and the manufacturer provided red, green, and blue values will populate. This provides a way to compare expected values with measured values and allows the user to make additional adjustments.

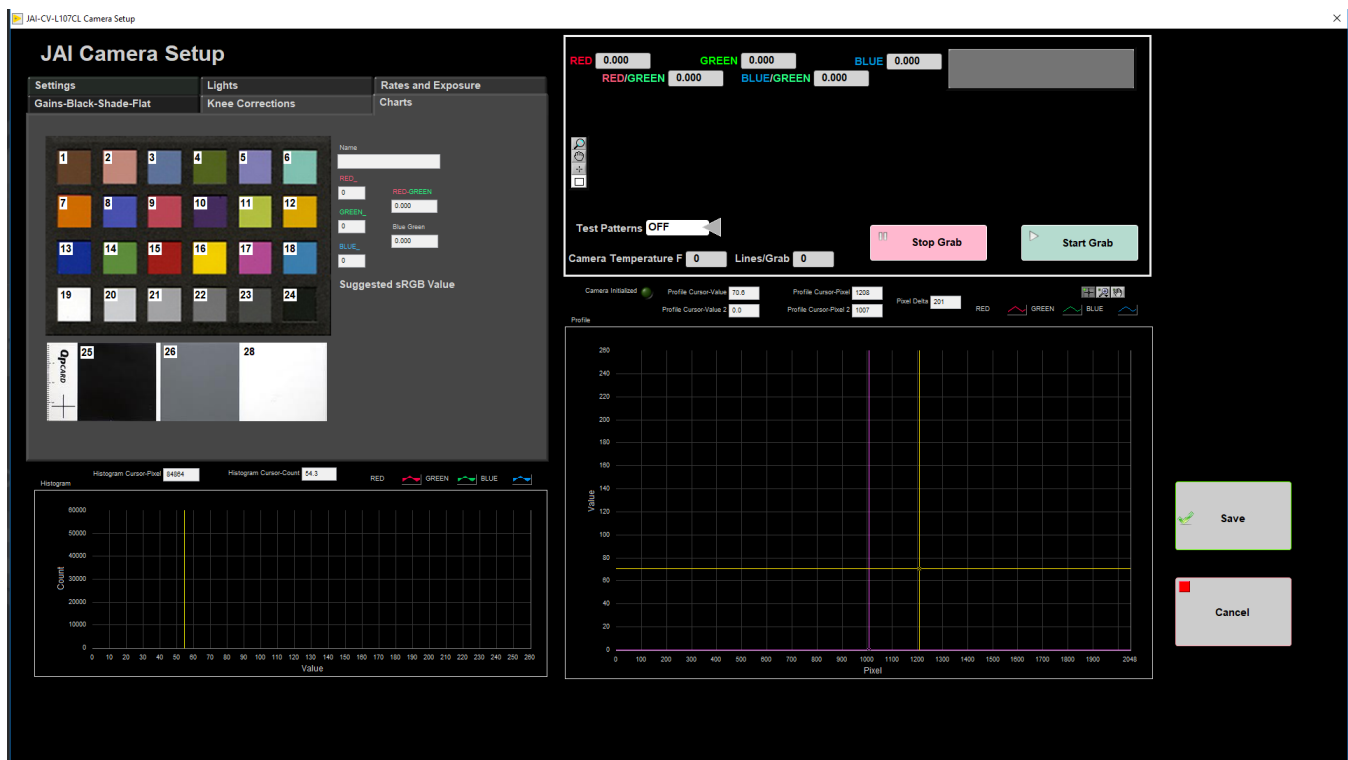


Figure 26. Charts Window

- Click in the white box to see what the values should be. Compare those values with the values recorded by the camera in the upper right window. If the values do not match there are two options to correct:
 - Option 1: Go to the **Gains-Black-Shade-Flat** tab. Adjust the **Master Gain Value** and watch the red, green, and blue pixel values in the upper right window.
 - Option 2: Go the **Rates and Exposure** tab. Adjust the exposure of the color(s) that are not correct until the value is approximately the same as the manufacturer value.

Either option is appropriate. Ideally not more gain than necessary is used

13. Use the "Chart" screen and click on white to see what the values should be. Then use the gain in the "Gains/Black/Shade/Flat screen" to slowly reduce the Master gain for "all gains". When you do that, the color lines in the lower right window will drift back into the field of view. Just like before, you want to adjust the lines of green, red and blue to end up on top of each other by adjusting the values in the "Rates and Exposure" screen.

Correct the Black Value

1. Physically move camera/lights until you see the black square in the image grab window. Use cursor to draw rectangle around in the **black** box.
2. Go back to the **Charts** tab. Click in the black color square and compare the manufacturer red, green, and blue values with the measured values. If the values do not match go to **Gains-Black-Shade-Flat** tab. The target red, green, and blue value are different than the manufacturer values. If adjusted to the manufacturer values the core images tend to be too dark. For this reason we aim for red, green, and blue values of 15.
3. In the **Gains-Black-Shade-Flat** tab adjust the **Master Black** value until the pixel values in the upper right window are approximately 15.
4. When you are done with the black gain, check the white gain again. Move the camera so it is over the white square in the Macbeth Color Standard and draw a rectangle in the white square.
5. In the **Charts** tab click in the white color box. Compare the manufacturer values with the measured values from the camera. If the values do not match follow one of the two methods explained in **Step 5 of Correcting the White Value**
6. Click **Save** in the bottom right corner

TIFF Image Corrections

Setting up for Image Capture

1. With a target underneath the camera, manually refocus the camera lens.
2. In the main IMS Panel select Motion > Drive Enable to re-enable the motor (Figure 27).

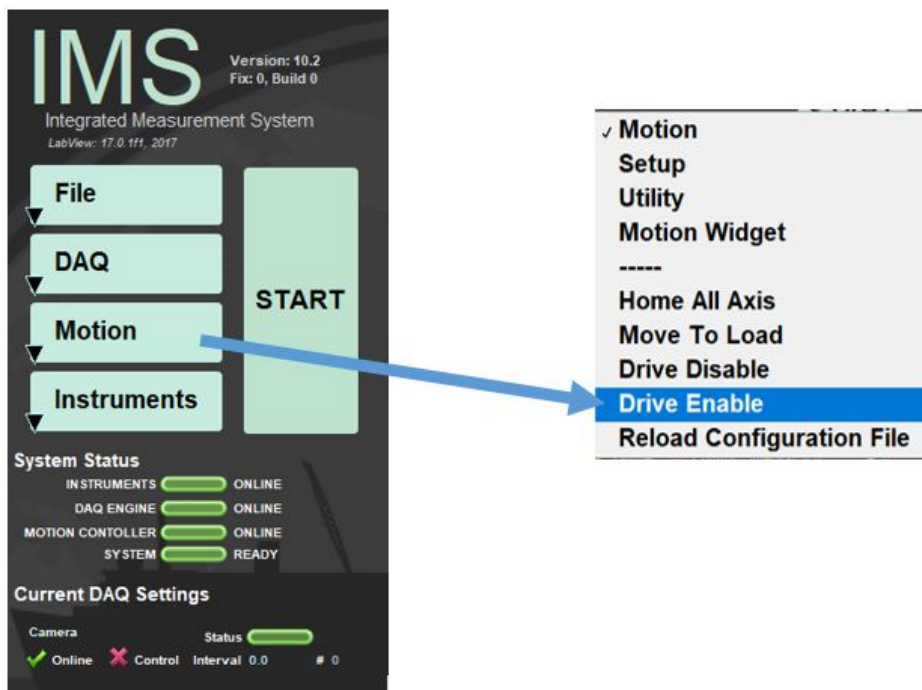


Figure 27. IMS commands to enable motor

3. Go to IMS Main Panel Select DAQ > Image Capture Setup (Figure 28). In this window confirm that speed is set lower than the speed calculated by the **Line Trigger Interval** (typically 8.33 cm/sec). Current speed setting is 7.0 cm/sec

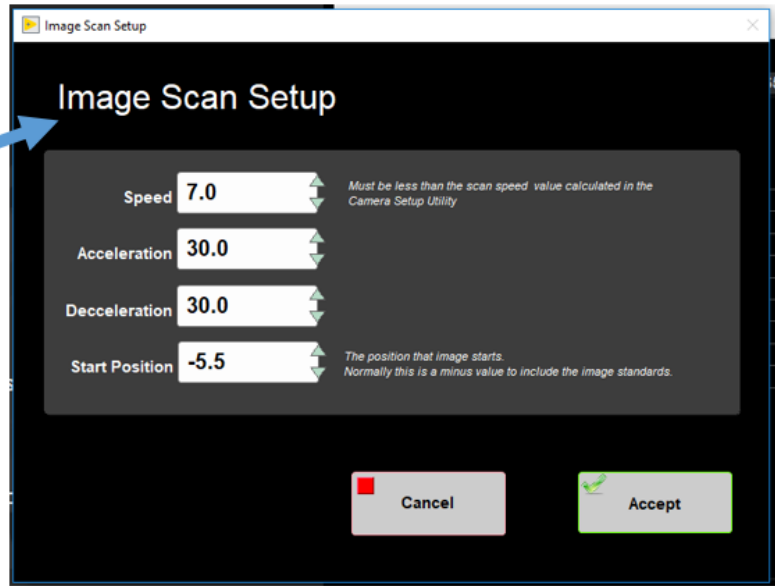
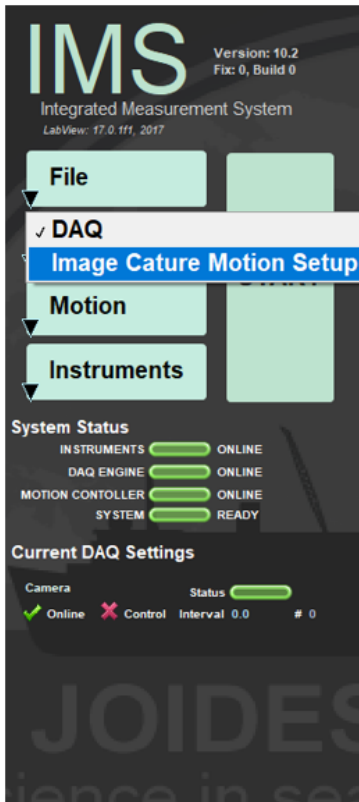


Figure 28. Motion setup

Take an Image

1. In the IMS Main Panel click **Start** and the Sample Information Window will open (Figure 29)

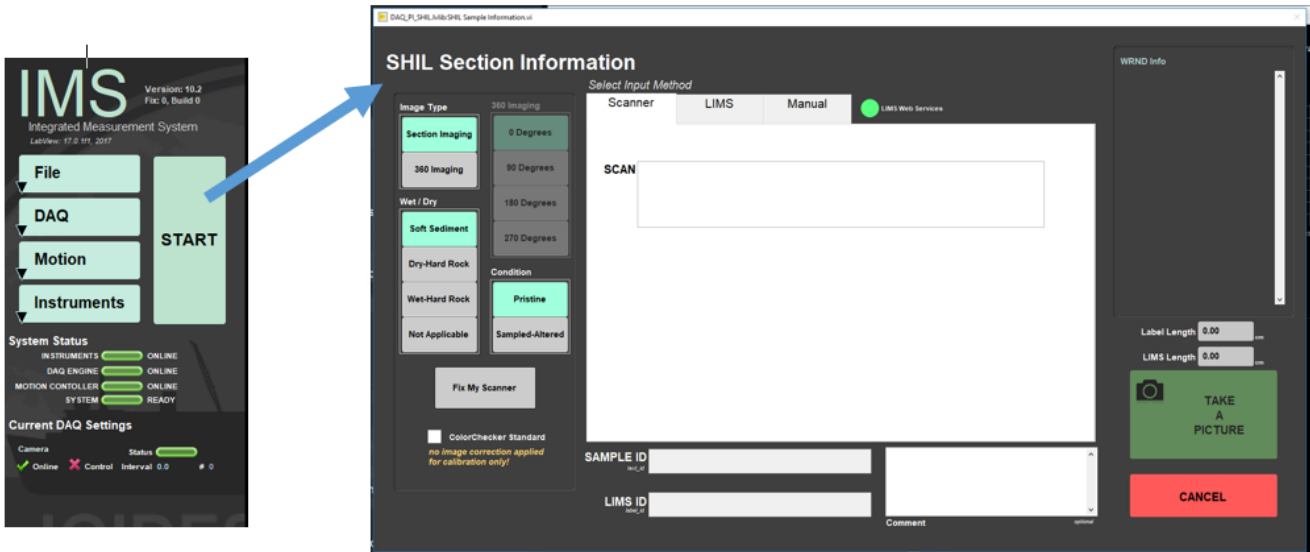


Figure 29. Sample Information window

2. Put cursor in the 'Scan' box and scan the **STND COLOR** and **LIG** label posted on the track above the desk (Figure 30).



Figure 30. Standard label to scan MacBeth Color Checker

3. Check the **ColorChecker Standard** box in the lower left corner (Figure 31). This produces a raw TIFF image without corrections applied.

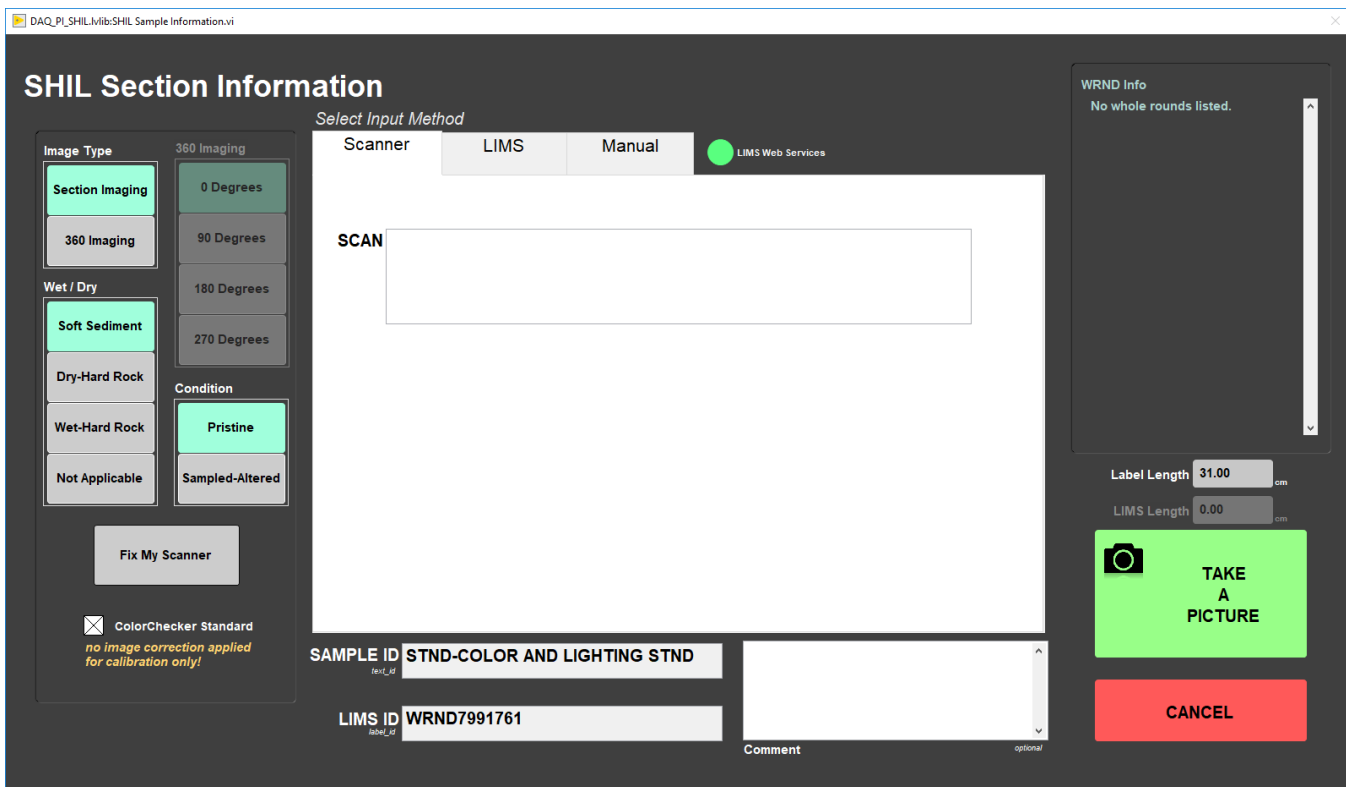


Figure 31. Color Checker Standard box selected

4. Click **Take A Picture** in the lower right corner. The lights will turn and image the standard.

5. Adjust the green crop box the image to include all the ColorChecker color squares (Figure 32).

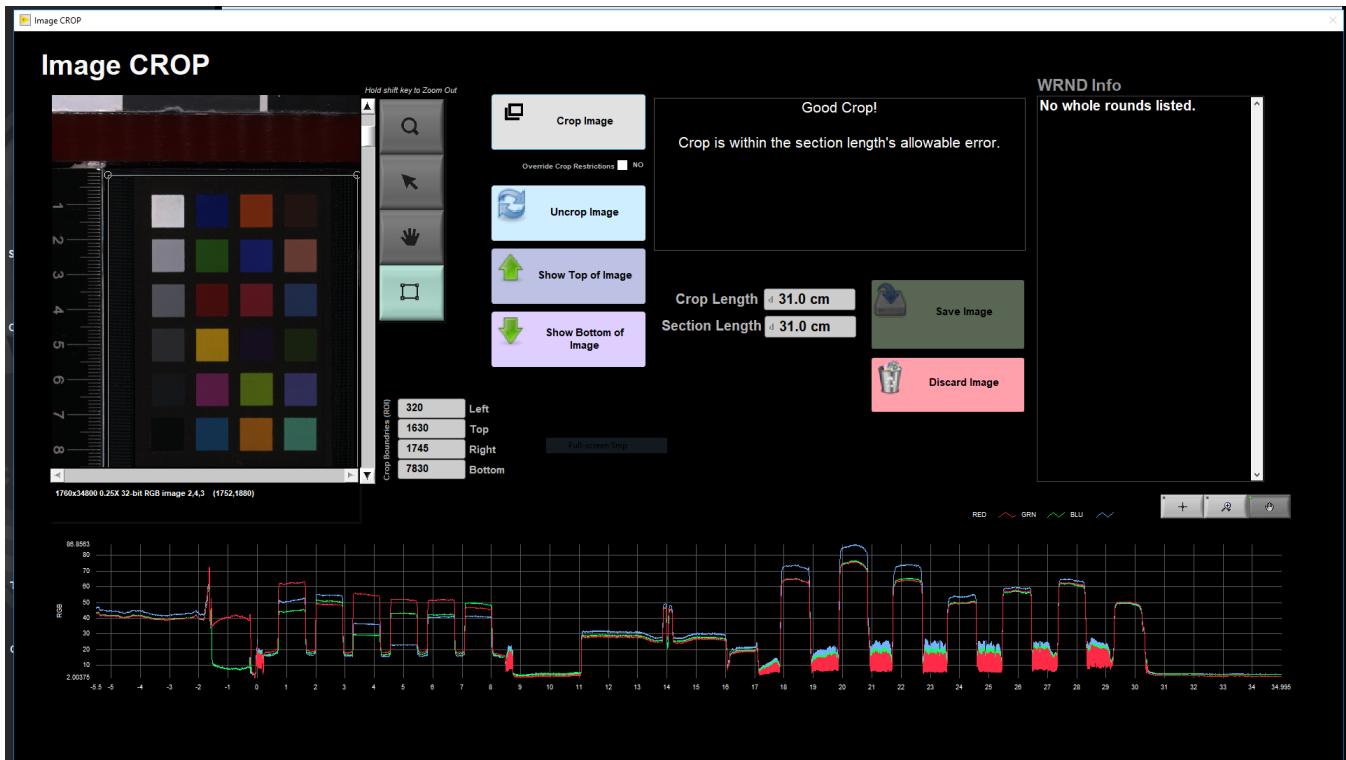


Figure 32. Crop and Save window

6. When satisfied with the crop box click **Crop Image** and then the green **Save** button. A new Sample Information window will pop up. Click **Cancel** to close out of the window.

Image Correction

1. In the IMS Main Panel go to Instruments > CAMERA: IMAGE Correction (Figure 33)

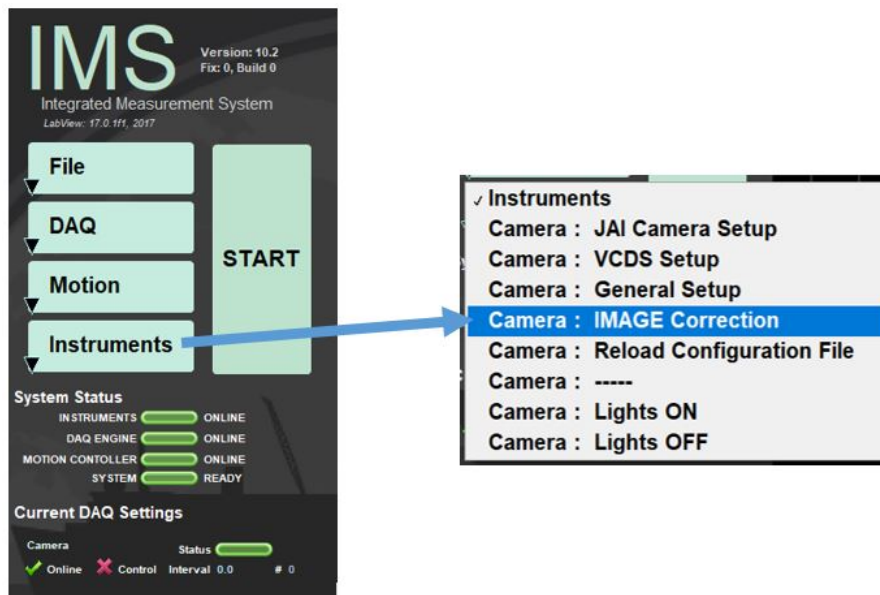


Figure 33. Selecting Image Correction Window

2. The main Image Correction Window opens (Figure 34). Make sure, TIFF correction is selected. Always select and process TIFF before JPEG.

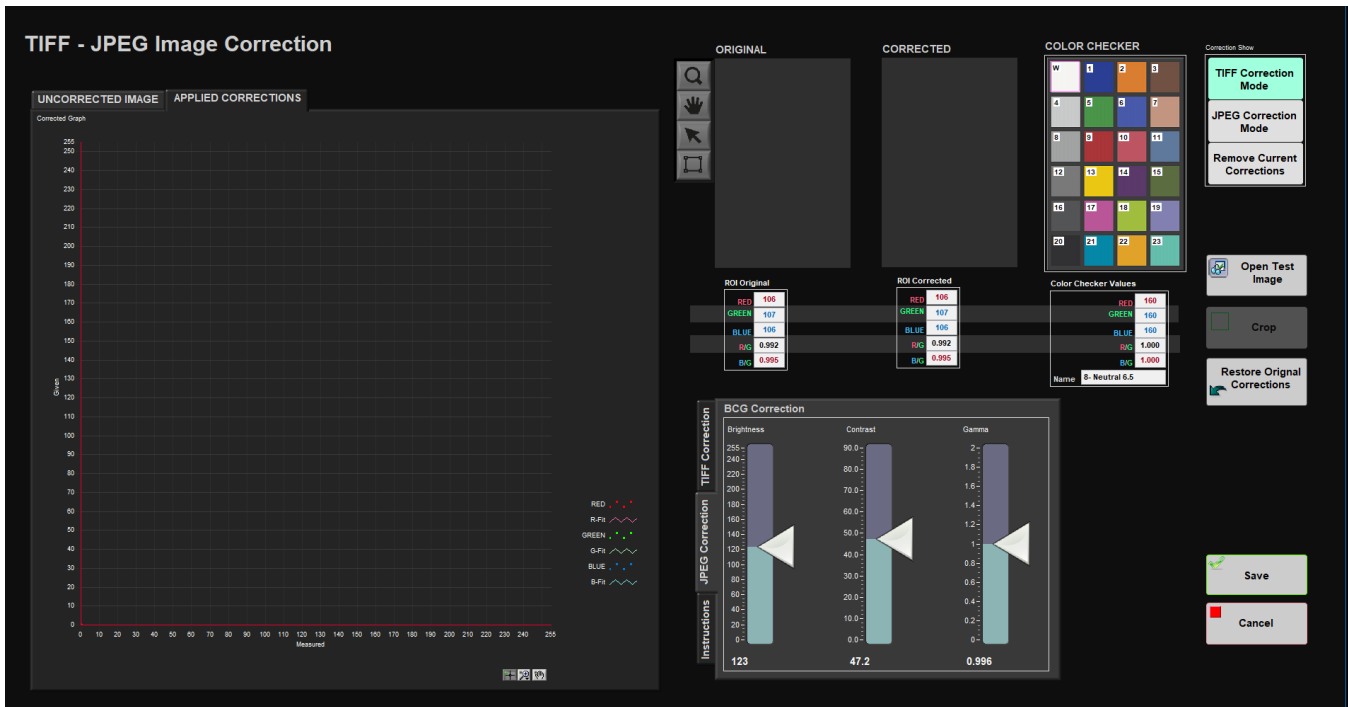


Figure 34. Main Image Correction Window

The Image Correction Window allows users to compare a test image of the standard with known values of the standards. There are three main areas in the window:

- Graph panel: Main graphical viewing area on the left side of the screen.
 1. **Uncorrected Tab:** Shows the measured Red, green, and blue values of the gray scale color squares.
 2. **Applied Corrections Tab:** Applies polynomial fit corrections to the RGB lines.
- Image Viewing Panels: Area in upper right portion of the screen that displays the original and corrected test image and color shecker with RGB values.
 1. **Original**
 2. **Corrected**
 3. **Color Checker**
- Correction Panel: Panel in the lower right portion of the screen that allows user to apply corrections to the image
 1. **TIFF Correction**
 2. **JPEG Correction**
 3. **Instructions:**

2. Click **Open Test Image** and navigate to the ColorChecker Standard Image just taken. Select the TIFF file (Figure 35).

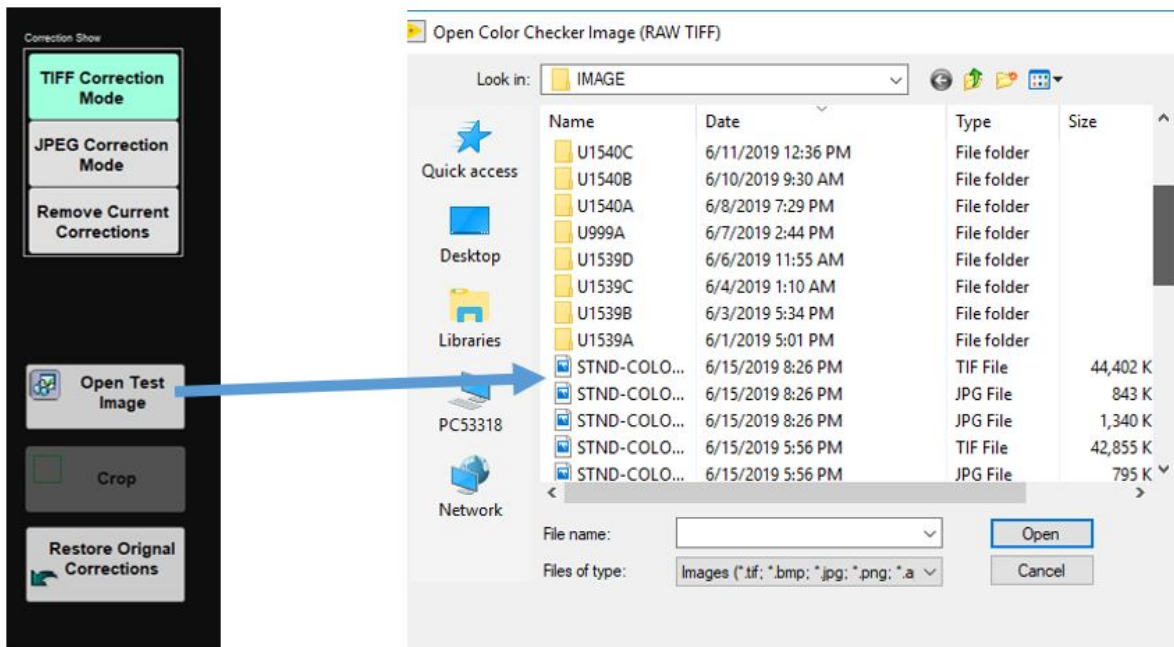


Figure 35. Selecting the test image

3. The entire image will load into the **Original** and **Corrected** panel but for this application we only need the color squares. Click on the square tool next to the **Original** panel and draw a box around the color squares in the image (Figure 36).



Figure 36. Callout to the square tool

4. Click **Crop**. Now just the color squares are seen in the **Original** Panel. The new cropped image will also update in the **Corrected** panel.
5. With the 'Square' tool still selected draw another, tighter box around the image and click **Crop**
6. With the 'Square' Tool draw another box but this time you will see white tick mark boxes over the colored boxes. Adjust the box so the white tick marks are in the center of the squares. The white box should always be in the top left, make sure the color checker is not in the holder upside down.
7. Now we will be using the gray-scale color squares, outlined in red below, to check and compare RGB values (Figure 37). The goal is to get the corrected image grey scale RGB values as close as possible to the ColorChecker Manufacturer grey scale RGB values.

Figure 37. Gray scale color squares in Color Checker box

8. In the **BCG Correction** Window select the **TIFF Correction** tab (Figure 38). In the large graph window on the left select the **Uncorrected Image** tab.

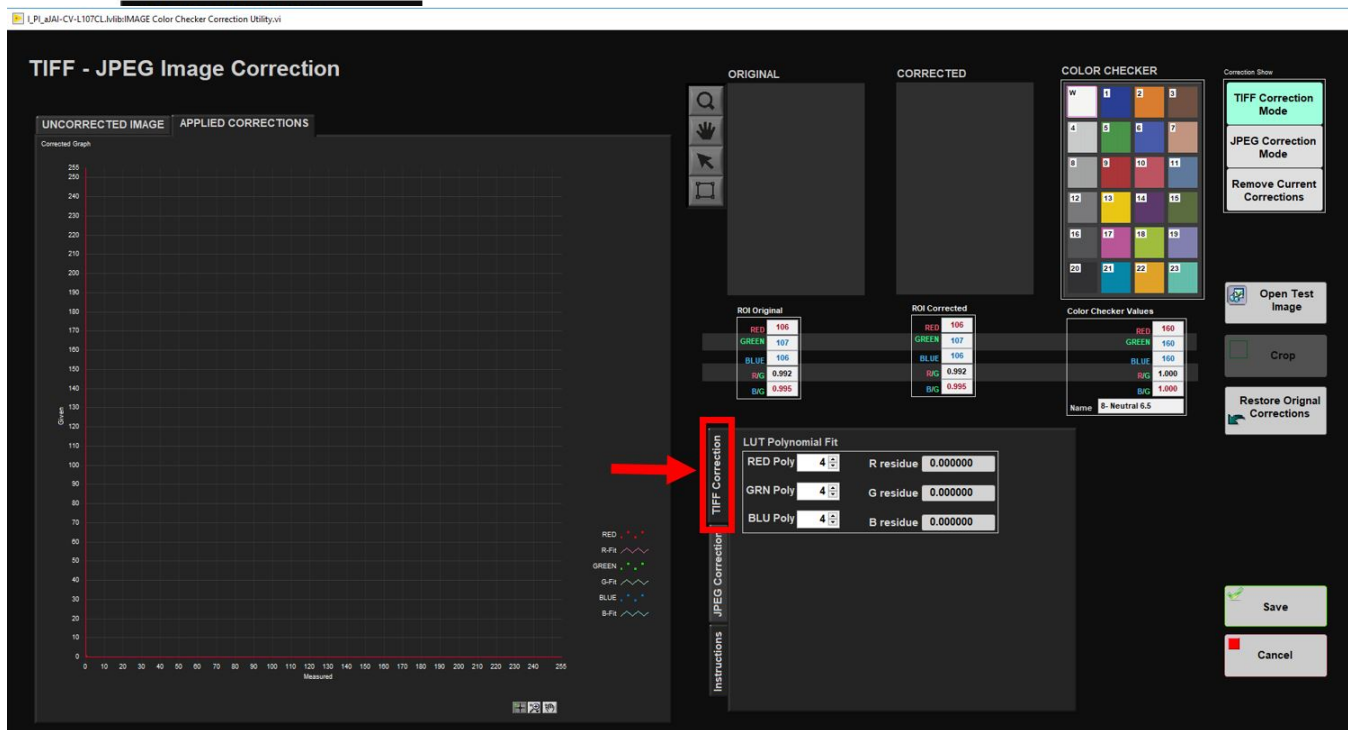


Figure 38. TIFF Correction Window selected, outlined in red

- RED Poly / R residue:
- GRN Poly / G residue:
- BLU Poly / B residue:

9. Try to get the residuals low (the smaller the better), while having a curve fits good as possible (see bad example, good example).

10. In order to line up the TIFF – JPEG Image correction, the end members of white and black cannot be at the extremes (250, 0), otherwise the correction will not be able work.

11. Once the grey/white/black are fitted as close as possible, check that the screen “applied corrections” shows a good linear fit.

12. Then check all the other colors for applied corrections.

13. Original and corrected should be within a couple of values of the number. If that does not work, go back to the previous corrections and tart over (white balance etc.).

Check on Calibrated Computer

1. Take, crop, and save another test image now that all corrections have been applied. Use the same procedure to take an image as described in the section: **Take an Image**

2. Copy the image to a shared network folder to view on a calibrated computer screen in the Imaging Office.

Adjusting JPEG Correction

Situations may arise where a JPEG correction should be applied. In the instance of very white or very dark cores, the TIFF images may look good but the JPEG images may look washed out or too dark to view details. JPEG corrections do not alter TIFF image settings. To apply a JPEG Correction follow the steps below:

1. Take the MacBeth Color Checker Standard and place on SHIL Imaging Track
2. Click **Start** in IMS (Figure 39).

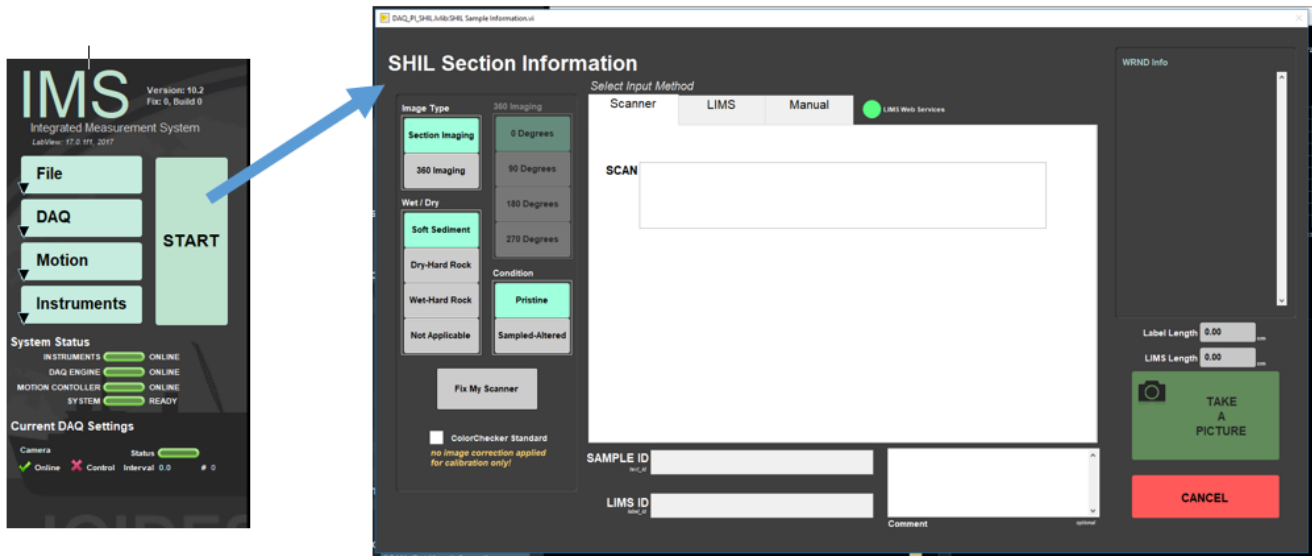


Figure 39. Sample Information Window

3. In the Sample Information window, check the box for Color Checker Standard (Figure 40). Checking this box produces an uncorrected image. Click back in the Sample Information bar and scan the Color Checker Label mounted on the track behind the computer.

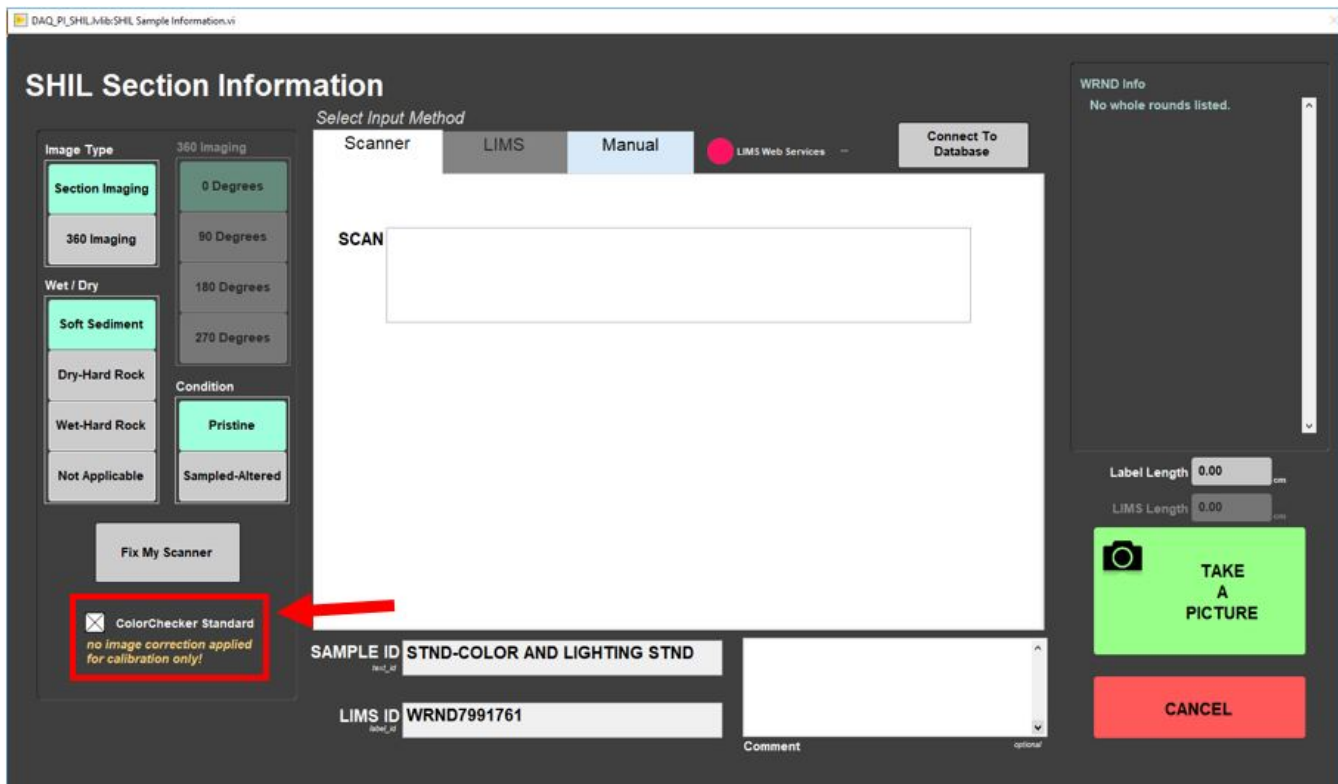


Figure 40. Color Checker box outlined in red and selected

4. Click Take an Picture
5. Adjust green crop box as necessary. When satisfied select **Crop Image** and then **Save Image** (Figure 41)

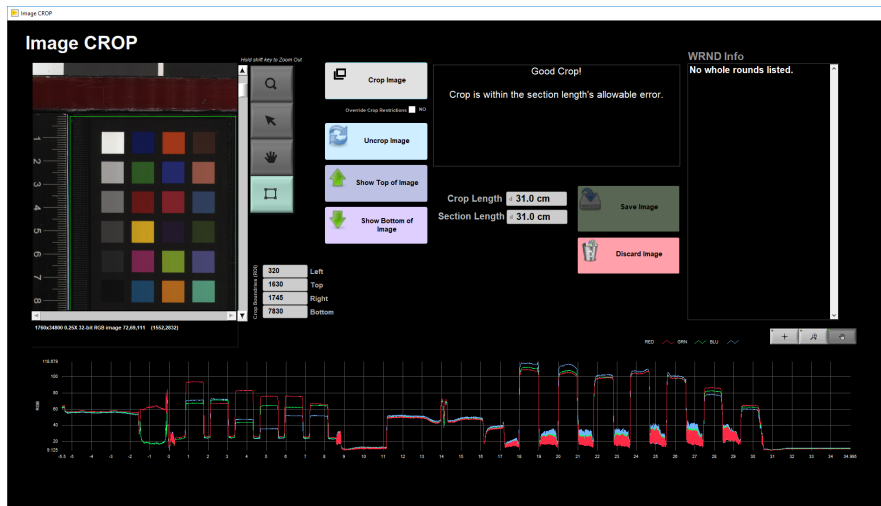


Figure 41. Crop and Save Window

6. Close out of the Sample Information Window. In the IMS start area go to **Instruments > JPEG Correction** (Figure 42)

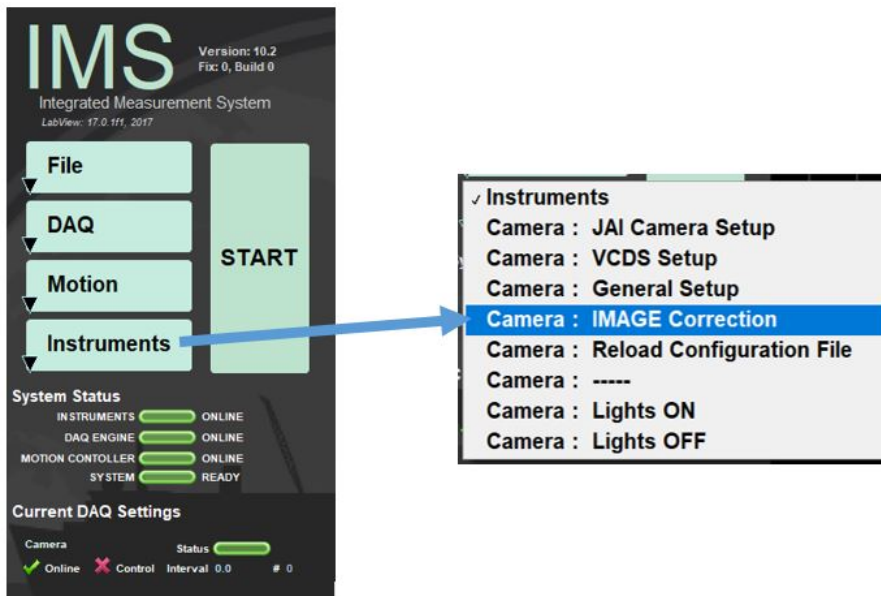


Figure 42. Selecting Image Correction Window

7. The main window opens (Figure 43).

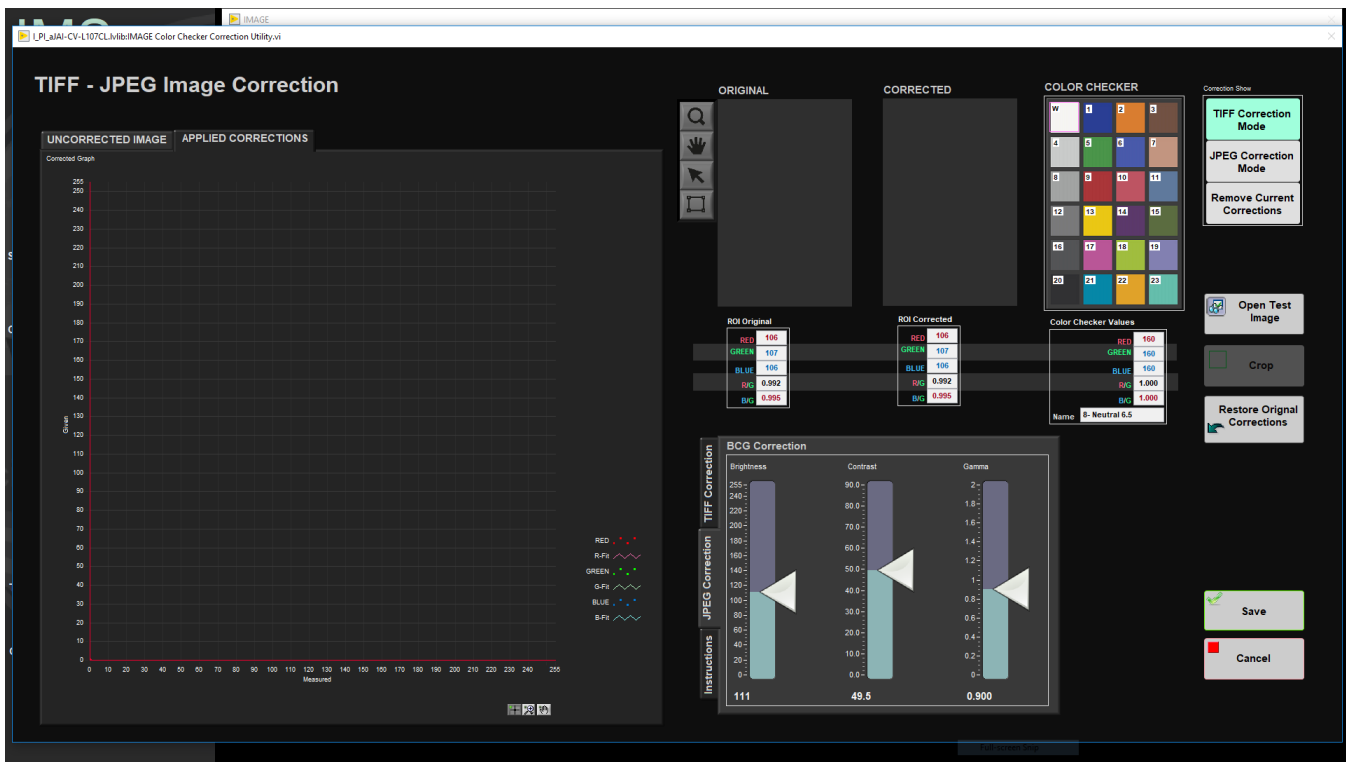


Figure 43. Main Image Correction Window

8. On the right side of the screen select **Open Test Image**. The IMAGE folder will appear. Select the Image just taken. Make sure to select the .tif image and not the .jpg. With the mouse, hover over the file and check the extension is .tif. Select the appropriate file and click **Open** (Figure 44). **As of writing this, keep TIFF Correction selected while opening Test Image, will receive an IMS error message if select JPEG Correction and then try to load in test image**

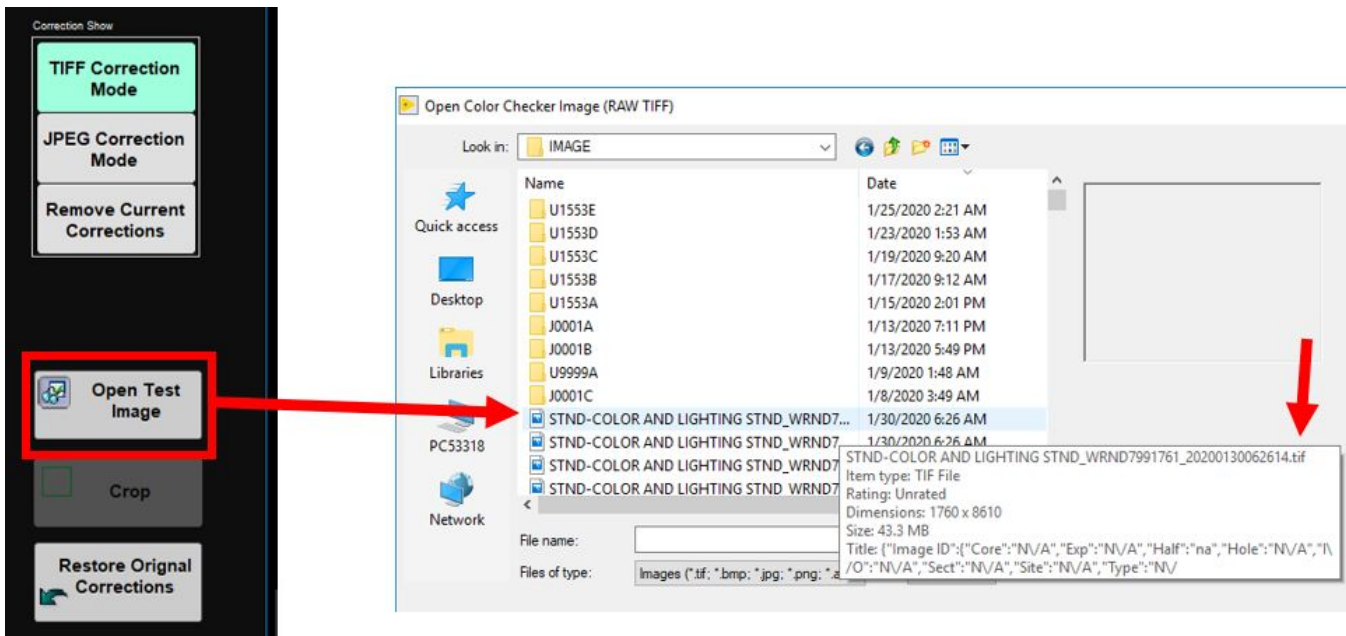


Figure 44. Selecting Appropriate test image. Callouts to button and .tif image

9. The image loads into main window in the **Original** section (Figure 45)

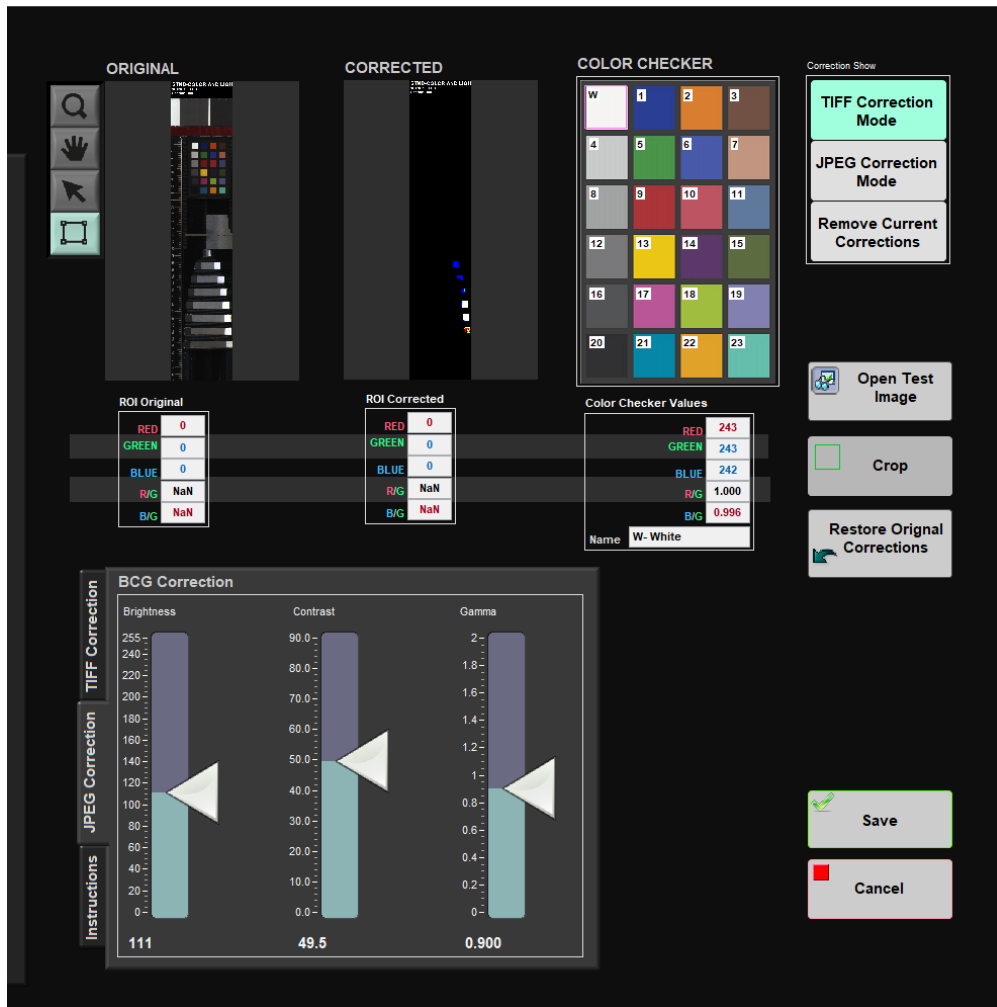


Figure 45. Test Image loaded into Original window

10. Now select JPEG Correction Mode (Figure 46).

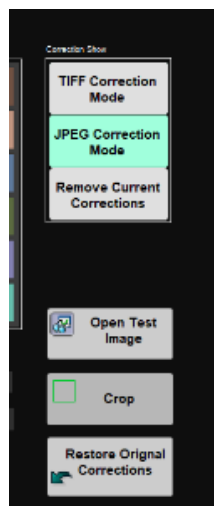


Figure 46. JPEG Correction selected

11. With the square tool selected draw a box around the color squares (Figure 47). This creates a crop area to focus in on the color boxes. Select crop when the box looks about right. For now the box can be approximate.

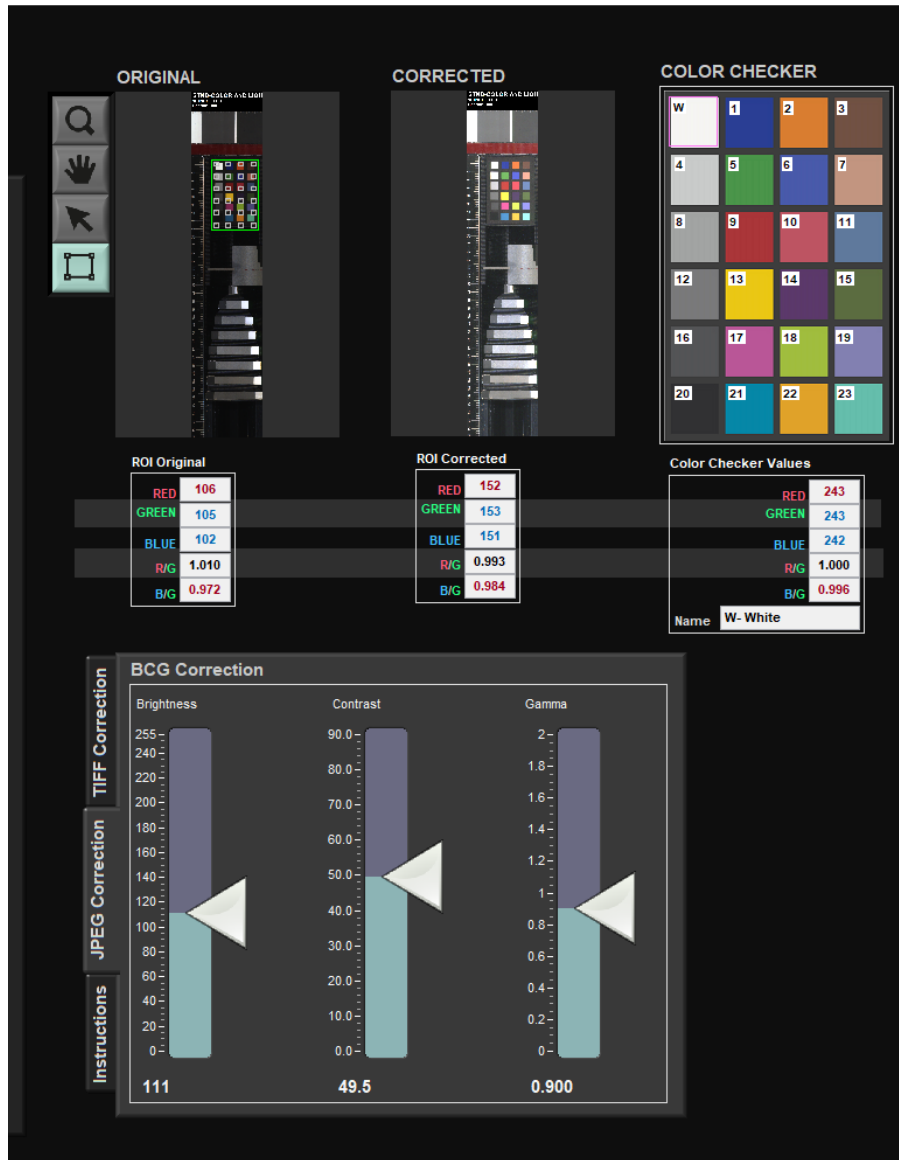


Figure 47. Crop Box drawn around test image

12. With the square tool still selected, draw another box around the squares (Figure 48). This time get the green box very close to the edge of the colored squares. Small white boxes will appear in the color squares. Adjust the green rectangle so the white boxes are approximately in the center of the squares.

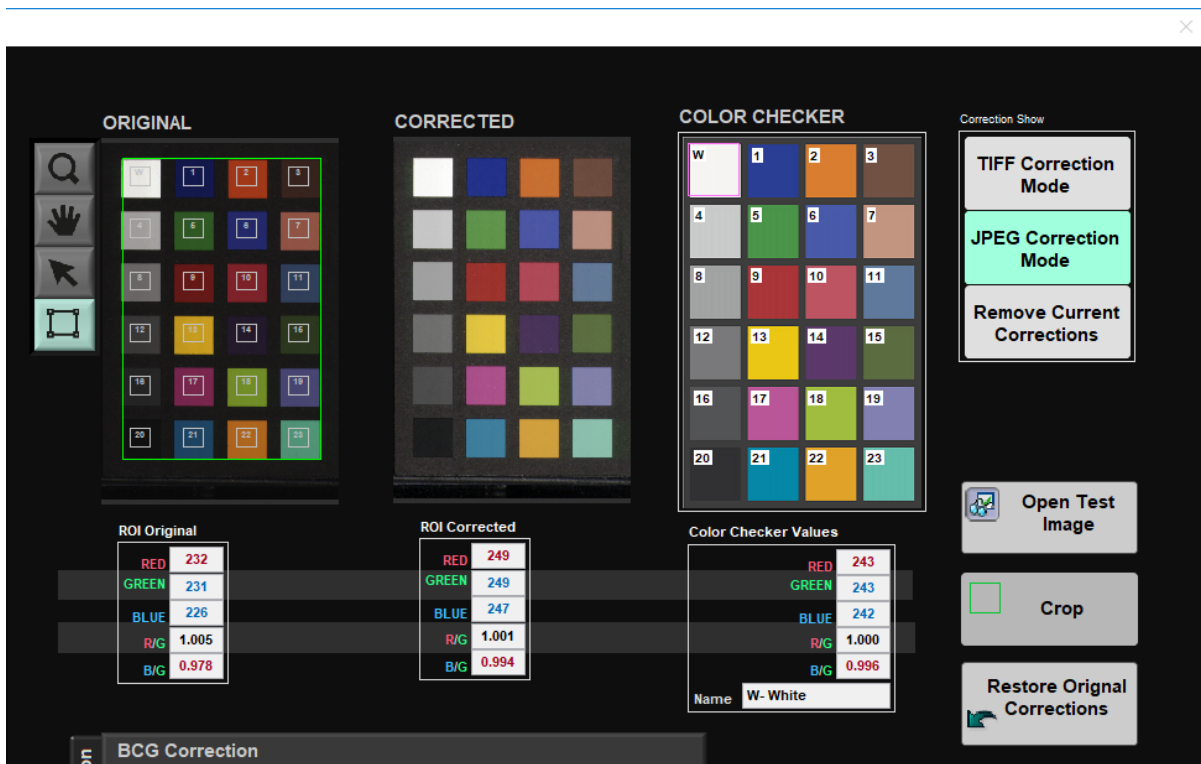


Figure 48. Crop box drawn with white boxes centered in color squares

13. In the BCG Correction Window, make sure JPEG Correction is selected. Adjust the Brightness, Contrast, and Gamma Settings. The Corrected color squares will update as the settings are changed.

14. The Applied Corrections Graph should be a straight line and the ROI Corrected Box should have values near 250. These may change depending on the instance of extreme colors, extremely white or extremely dark cores, in which the settings may have to be tweaked more to get a user friendly consumer image.

LIMS Integration

Sample and Analysis Components

Analysis	Component	Definition
LSIMG (Core Section)	Exp	expedition number
	Site	site number
	Hole	hole number
	Core	core number
	Type	type indicates the coring tool used to recover the core (typical types are F, H, R, X)
	Sect	section number
	A/W	archive (A) or working (W) section half
	Top Depth CSF-A (m)	location of the upper edge of the section expressed relative to the top of the hole.
	Bottom Depth CSF-A (m)	location of the lower edge of the section expressed relative to the top of the hole.
Top Depth (other) (m)	location of the upper edge of the section expressed relative to the top of the hole. The location is presented in a scale selected by the science party or the report user.	

Bottom depth (other) (m)	location of the lower edge of the section expressed relative to the top of the hole. The location is presented in a scale selected by the science party or the report user.
Display Status (T/F)	"T" (true) indicates that this image has been selected as the core section image to display in core descriptions and core composites. "F" (false) indicates that this image will not be displayed. (All images prior to Expedition 349 are designated as display images.)
Uncropped image (JPG) link	link to URL of JPG version of core section image that shows the ruler and external space at the top and bottom of the section.
Uncropped image filename	filename of uncropped image provided for identification purposes.
Cropped image (JPG) link	link to URL of JPG version of core section image with the ruler and external space at the top and bottom of the section cropped.
Cropped image filename	filename of cropped image provided for identification purposes.
Timestamp (UTC)	point in time at which an observation or set of observations were made. Precise meaning of the value varies between systems due to variation in capability and/or implementation.
Instrument	line-scan camera (e.g., JAICV107CL).
Instrument group	Section Half Imaging Logger (SHIL).
Text ID	automatically generated unique database identifier for a sample, visible on printed labels.
Test No	Unique number associated with the instrument measurement steps that produced these data.
Comments	observer's notes about the sample.

Analysis	Component	Definition
RGB Channels (RGB)	Exp	expedition number
	Site	site number
	Hole	hole number
	Core	core number
	Type	type indicates the coring tool used to recover the core (typical types are F, H, R, X).
	Sect	section number
	A/W	archive (A) or working (W) section half.
	Offset (cm)	position of the observation made, measured relative to the top of a section.
	Depth CSF-A (m)	location of the observation expressed relative to the top of a hole.
	Depth (other) (m)	location of the observation expressed relative to the top of a hole. The location is presented in a scale selected by the science party or the report user.
	R	average of digitized red (R) channel over a user-defined rectangle along the core section. Values range from 0 to 255 (8-bit color digitization).
	G	average of digitized green (G) channel over a user-defined rectangle along the core section. Values range from 0 to 255 (8-bit color digitization).
	B	average of digitized blue (B) channel over a user-defined rectangle along the core section. Values range from 0 to 255 (8-bit color digitization).
	Timestamp (UTC)	point in time at which an observation or set of observations was made on the logger.
Instrument	line-scan camera (e.g., JAICV107CL).	
Instrument Group	Section Half Imaging Logger (SHIL).	

	Text ID	automatically generated unique database identifier for a sample, visible on printed labels.
	Test No	Unique number associated with the instrument measurement steps that produced these data.
	Comments	observer's notes about a measurement, the sample, or the measurement process.

Troubleshooting

Common problems encountered when using the core imager and their possible causes and solutions:

Issue	Possible Causes	Solution
Actuator squeal	NA	Lightly tap the actuator housing to silence the noise
Image too dark	Manual F-stop on the camera closed down	Have technician adjust F-stop aperture
	Exposure time is too low	Increase exposure time
	Focused lights are not aimed at the correct spot	Adjust lights
Track is "stuck"	Run was aborted with the software abort switch	Reset software and run sample again
	Run was aborted with the hardware abort switch	Reset hardware and run sample again
	Gantry flag has tripped the end-of-travel limit switch	Adjust gantry flag and run sample again
	Current limit on motors was exceeded	Check the Galil AMP-19520 for LED error indicators. Call track technician or ET to reset the motor controller
	Torque limit on motors was exceeded. <i><we need to check how Labview handles this!>[djh1]</i>	
Image indicates that camera was triggered erratically OR no image acquired	Camera was left in Free Run mode in MAX	Set camera to Externally Triggered for normal operation
	Linear encoder head has failed	Call an ET to verify/repair
	Lens cap is on	Remove cap and repeat image capture procedure.

Scheduled Maintenance

Frequency	Task
Daily	Ensure that the color standards, ruler, and barcode imager lens are free from dust, smudges, and crumbs.
Weekly	Using a mirror, ensure that there are no fingerprints or smudges on the camera lens. <u>Call the imaging specialist if the lens needs cleaning. Do not attempt to clean it yourself!</u>
Monthly	Check socket head cap screws in the camera and lights mounting plates for looseness.
Every Expedition	<ul style="list-style-type: none"> At the beginning of each cruise the track technician should verify the camera corrections and settings by imaging a Kodak Q13 grayscale standard. Adjust camera configuration as needed. At the end of the expedition the technician should verify with the MCS that all image data have been accounted for and backed up, then delete any remaining images and discards from the local hard drives to comply with moratorium policy. Note that if a large number of images are acquired in an expedition, this may have to be done mid-cruise.
Annually	<ul style="list-style-type: none"> The technicians should remove the end covers on the linear actuators and check if the motor belts need tightening. Examine the cable management system for abraded cables or other indications of wear. Remove the top covers of the linear actuators and check the ball screws to see if they need cleaning or additional lubrication.

Standard Replacement Parts/Spares

Spares are available for the following parts:

- camera
- camera lens
- frame grabber card
- linear encoder head
- lights power supply

Non-camera-specific items are part of the shared spares pool for all the track systems. See a technician for the location of the shared spares.

Health, Safety, and Environment

Safety

- Avoid staring into the line lights, as they produce 90,000 lux each at full power. This is roughly equivalent to staring directly into the sun.
- Do not put your hands in or near the moving equipment. The actuators will torque out when impeded but injury could occur before that happens. Hardware abort buttons are located at both ends of the system for an emergency stop.
- Take care when working inside the electronics enclosure to avoid shocks from the power supply terminals.

Vendor Information

Galil Motion Control

270 Technology Way Rocklin, CA 95765 800-377-6329 galil@galilmc.com www.galilmc.com

JAI Inc., USA

625 River Oaks Parkway San Jose, CA 95134 800-445-5444 www.pulnix.com

Microscan

800-251-7711 helpdesk@microscan.com www.microscan.com/index.htm

Advanced Illumination, Inc.

24 Peavine Drive Rochester, VT 05767 800-767-3830 info@advancedillumination.com www.advancedillumination.com/

NSK Corporation

4200 Goss Road Ann Arbor, MI 48105 800-521-0605 www.npa.nsk.com/public/enu/1001_102.asp

Newall Electronics, Inc.

1778 Dividend Drive Columbus, OH 43228 800-229-4376 www.newall.com/LEDs/leds.htm

Digi-Key

www.digikey.com is a good source for small quantities of AMP hardware

Related Documentation/Links

The following documents contain more detailed information on the logger system components:

- LabVIEW: NI-IMAQ3_error_codes.xls
- JAI camera: CV-107CL manual.pdf
- Microscan barcode imager: MS4manual.pdf
- Advanced Illumination
 - Controller: Alcontroller.pdf
 - Lights: LL068.pdf
- Galil
- Motors: Blm_n23.pdf
- Software: wsdk.pdf
- Controllers: man19540.pdf
- Amplifiers: man18x-6.pdf
- Newall
 - Linear encoder: Newall_linear_encoder.pdf
 - Wiring diagram: Encoder_Connections.xls
 - ImCheck manual: Imcheck_Guide_V1.pdf

APPENDIX A: RGB Calculation

APPENDIX B: VCD-S Configuration:

"Scratch sheets" are printouts of section half images produced by SHIL. The sheet is a LabVIEW VI with embedded images that can print automatically when a user 'saves' an image. The VI is scaled to print SHIL images correctly on 11x17" paper in portrait orientation. The scratch sheet can be customized to include various columns to capture descriptions or drawings on paper. The goal of this guide is to instruct how to use and customize scratch sheets.

Data Structure

Each scratch sheet template is its own VI. Each VI has to have the same root name "VCDS_SHLF". You may add any additional naming after this root name as long as the root remains unmodified.

- Files must be located in C: > IMS10 > RESOURCES > VCD-S_TEMPLATE on the SHIL computer. *Do not alter this file path, it is currently hard-coded in the software.*
- To temporarily temporarily disable a scratch sheet version, simply put some characters in front of the root name. These files can be moved to C: > IMS10 > Resources > Templates Old

IMS Configuration

1. To access the scratch sheet configuration options, click the **Instruments** button and follow the menu down to **Camera: VCDS Setup**. The parameter screen will then display (Figure 19).

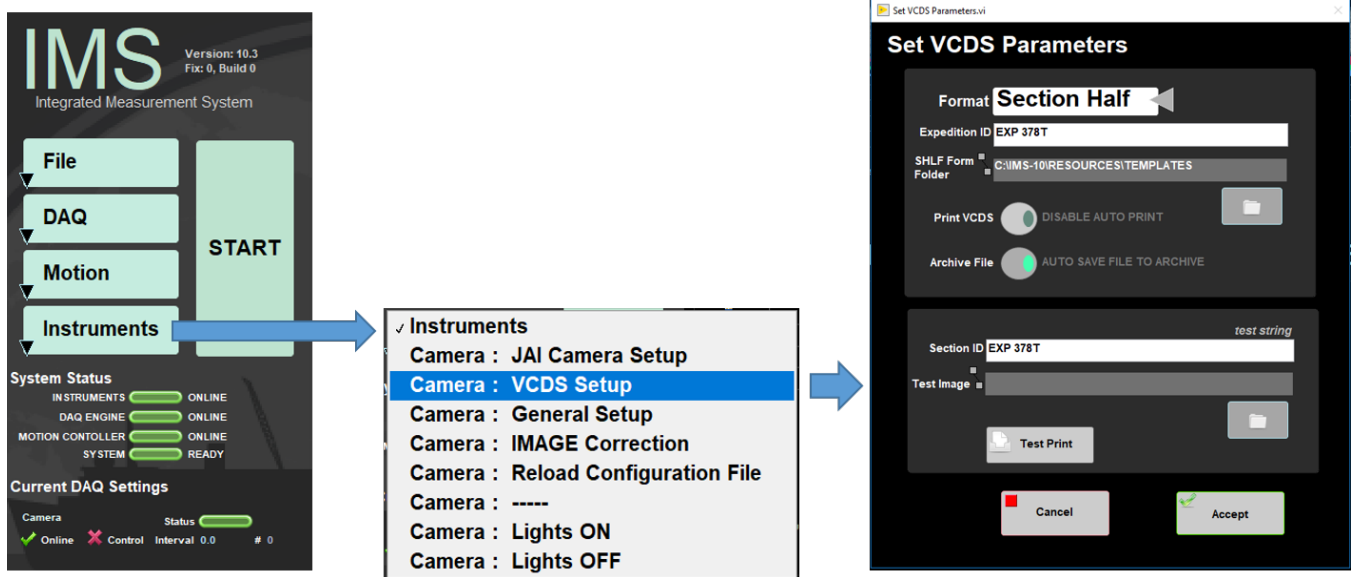


Figure 19. Select VCDS Setup

Several configurable options appear:

- **Format:** Choose between Side by Side or Section Half scratch pages.
- **Expedition ID:** Enter the name of the Current Expedition. This prints on the scratch sheet.
- **SHLF Form Folder:** Currently hard-coded to C:\IMS10\RESOURCES\VCD-S_TEMPLATE.
- **Print VCDS:** Enables or disables automatic printing of the scratch sheet. When the button says 'enable auto print' scratch sheets will automatically print when an image is saved.
- **Archive File:** Button enables disables saving scratch pages to the hard drive. All files are saved in .PNG format. If button says 'Do not save file to archive' files will not be saved.
- **Section ID:** Insert your expeditions name here which will appear in the top right corner of every scratch sheet along with the Text ID of the section half.
- **Test Image and Test Print:** Allows prints of images already on the computer or in the database to see the scratch sheet. Use the folder icon to the right of 'Test Image' to browse to a section half image of your choice. This image will be embedded into your chosen scratch page mode. Click the 'Test Print' button to send it to the printer.
- **Accept:** Saves any modifications to parameters.
- **Cancel:** Does not save parameter modifications and reverts back to prior settings.

Editing Scratch Sheet in LabVIEW

1. Navigate to C: > IMS-10 > Resources > Templates and double-click a VI to open it in LabVIEW.
2. The front panel will open. Edits can be made to the objects on the white space. Editing the white or gray areas could affect scaling of the image, ruler, or print layout
 - The main layout consists of an outermost borderless white box that indicates the printable area that is available.
 - The leftmost gray column is a control for the section-half image and the ruler; do not make alterations in this area. There are two additional controls that feed the scratch page titles on the top left and right sides. These are not immediately visible when editing the layout on the front panel though. If you are not very familiar with LabVIEW please see a developer for help. The title controls can be moved, but it is up to you to remember where you put them!
3. All other column widths and headers are available for editing/resizing. If you need more columns simply select one, then copy/paste as you would in any standard graphics program and resize things to fit within the outermost white box. Maintain the vertical scaling of all columns to match that of the ruler/image column on the left. Header blocks are just boxes that can be copied and resized as well.

How to Make Edits

1. Navigate to the 'View' button on the toolbar. Select the 'Tools Palette' Option (Figure 20).

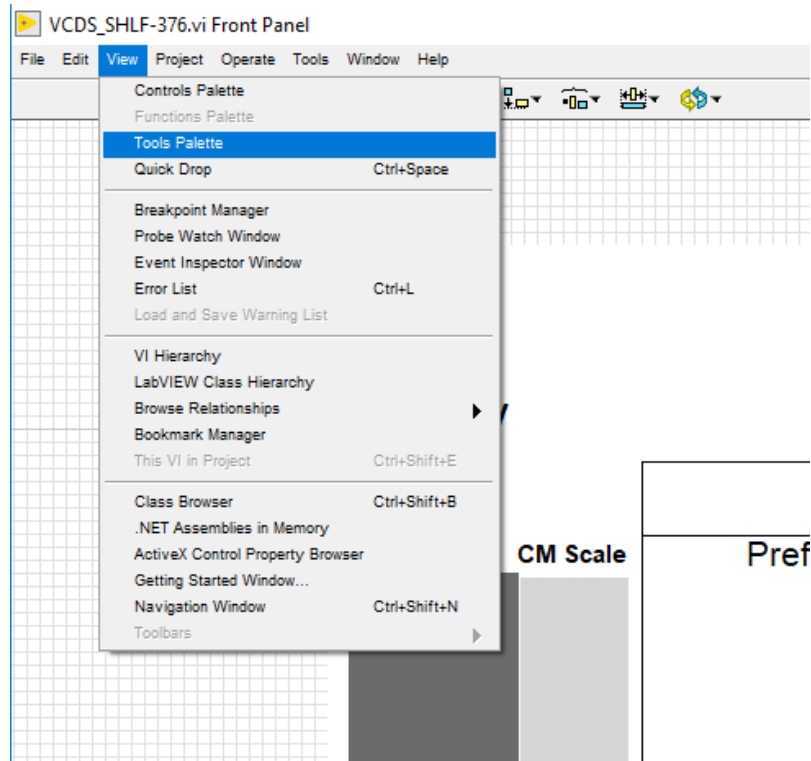


Figure 20. Select Tools Palette on LabVIEW

2. The Tools Palette window will appear (Figure 21). This allows you to select objects.

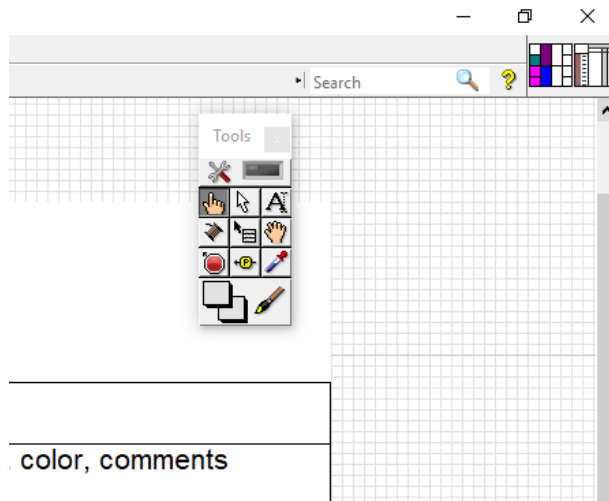


Figure 21. Tools Palette window

Communication and Control Setup

Data communication and control is USB based and managed via National Instrument's Measurement & Automation Explorer (NI-MAX). When you open NI-MAX and expand the Device and Interface section. The correct communications setup can be found at [IMS Hardware Communications Setup](#).

Archive Versions

[LMUG-SHILUserGuide-240220-2338-322.pdf](#)