SHIL User Guide

Contents

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.

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)
- LED Light system
    - 6 Cree XLamp CXB3590 LEDs
- Linear encoder: Newall 2 µm/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 set up and calibrated properly.

Instrument Settings

- **DAQ** > **Image Capture Motion Setup** (Figure 1)

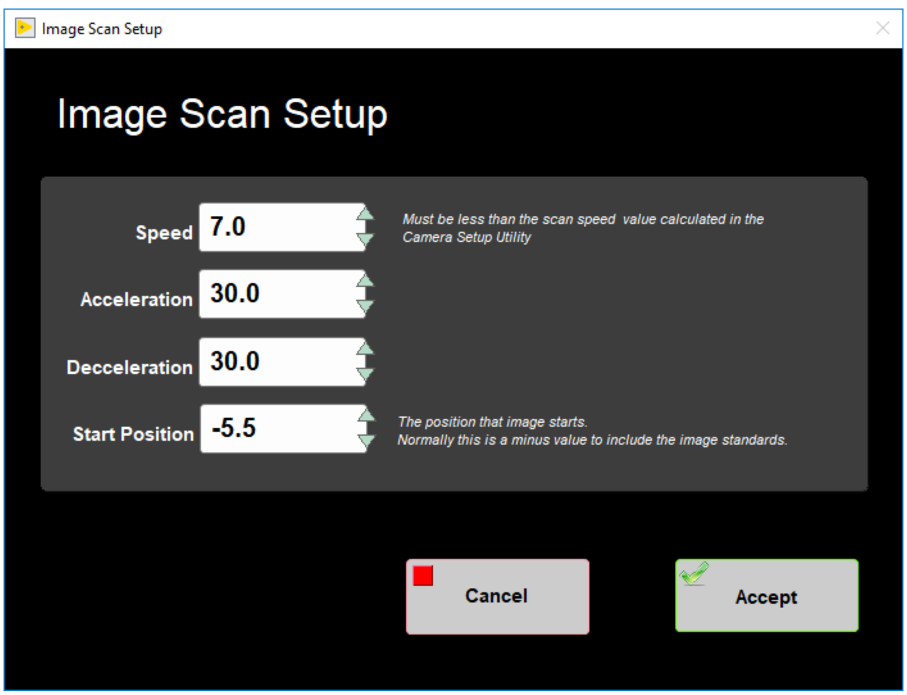


Figure 1. Image Scan Setup window

- **Instruments** > **Camera: General Setup** (Figure 2)

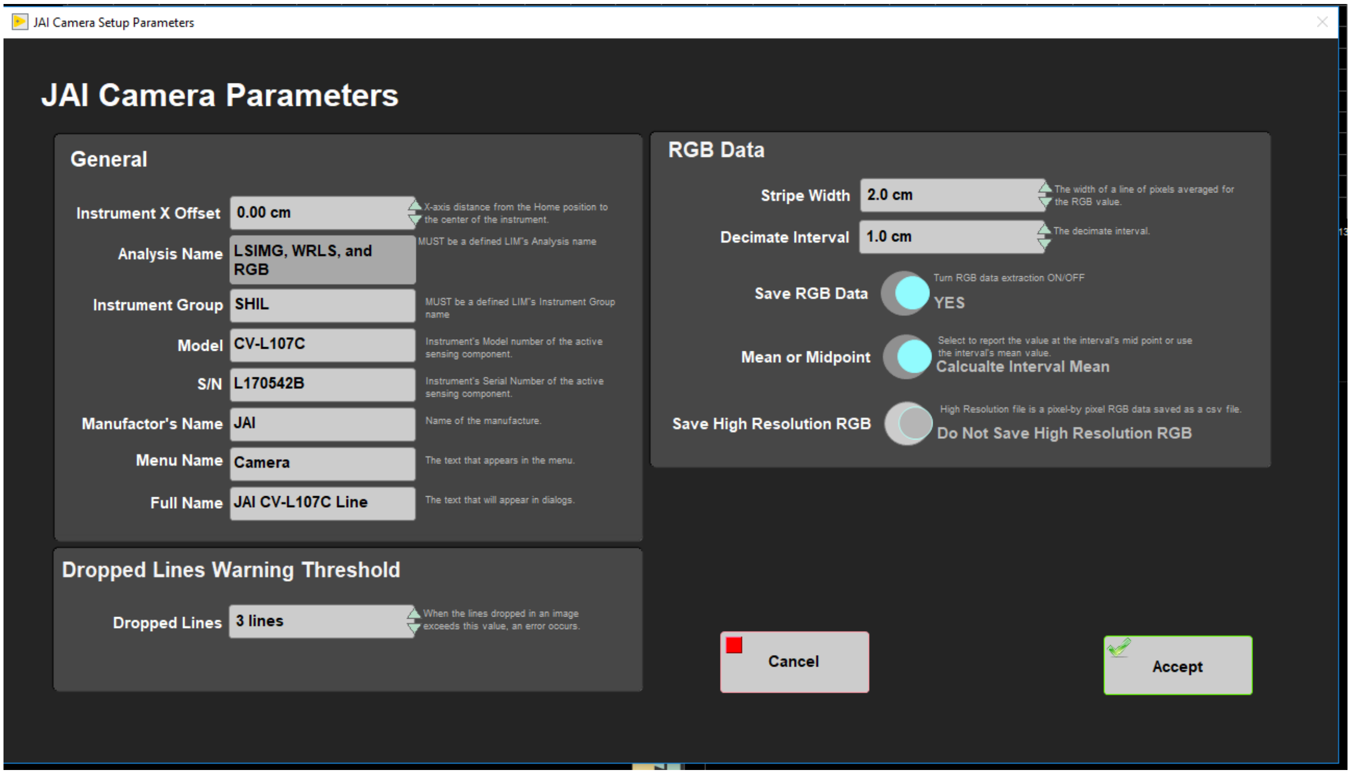


Figure 2. General Camera Setup window

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

Figure 3. General Camera Setup fixed Settings

Sample Preparation & Imaging

Sample Preparation and Loading

Sediment

The surface of the archive half generally needs to be scraped after splitting to clean the sections and 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).

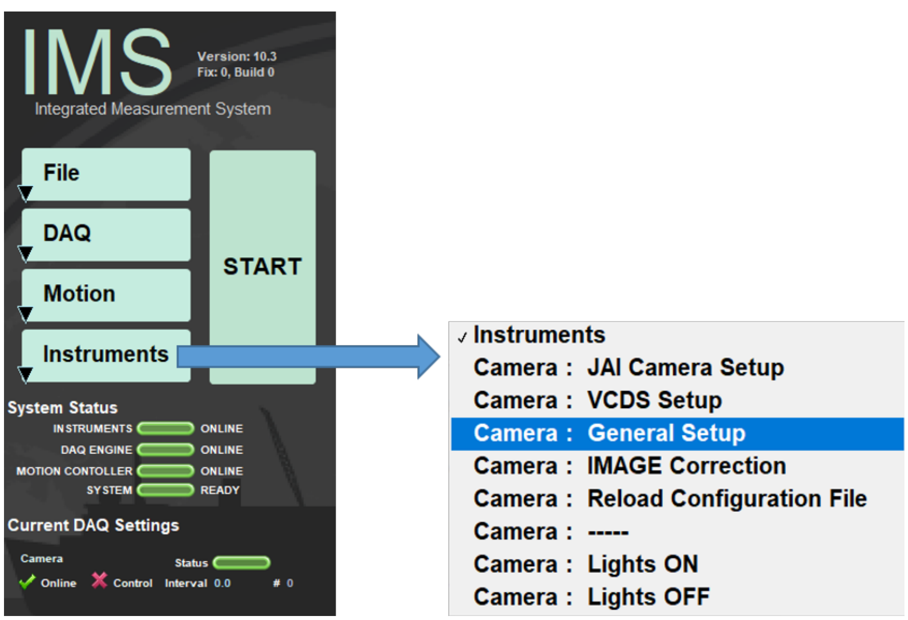


Figure 6. Select JAI Camera Setup Parameters window

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.

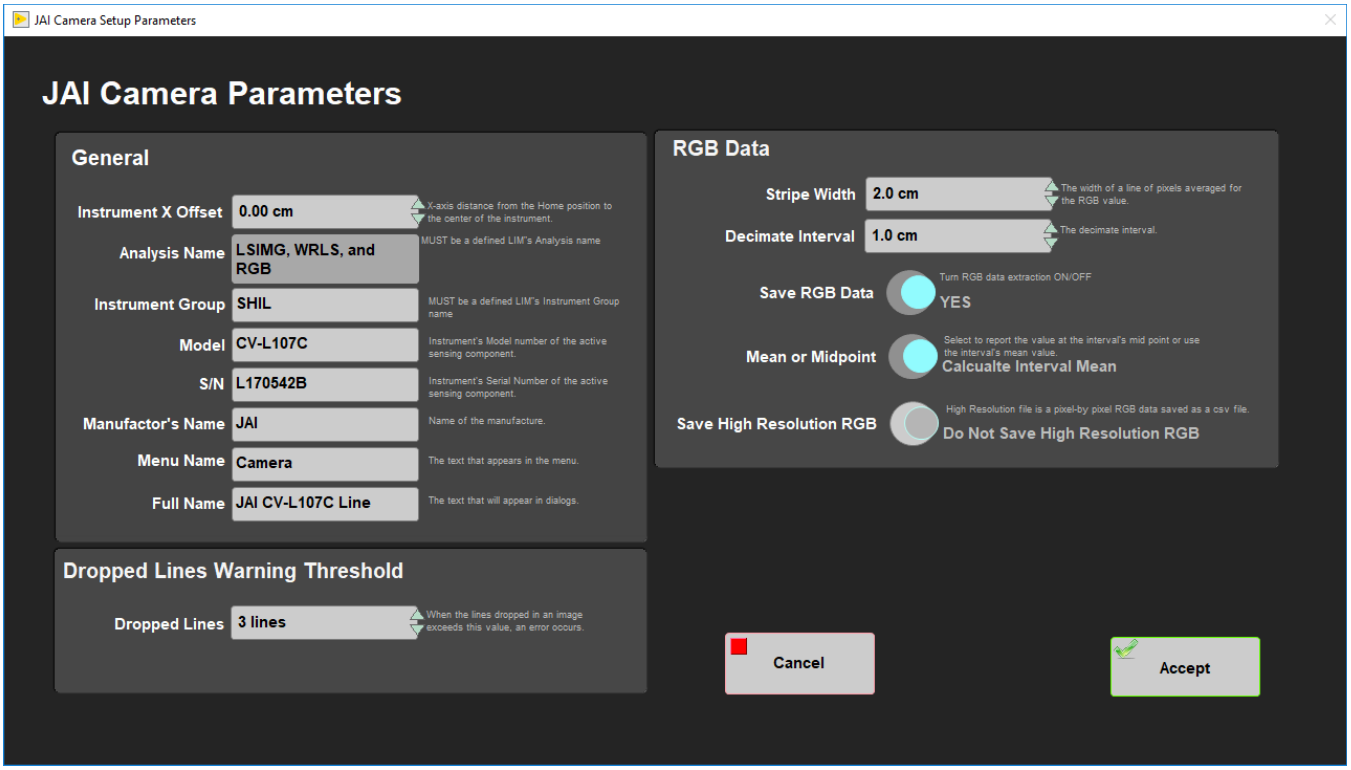


Figure 7. JAI Camera Setup Parameters window

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).

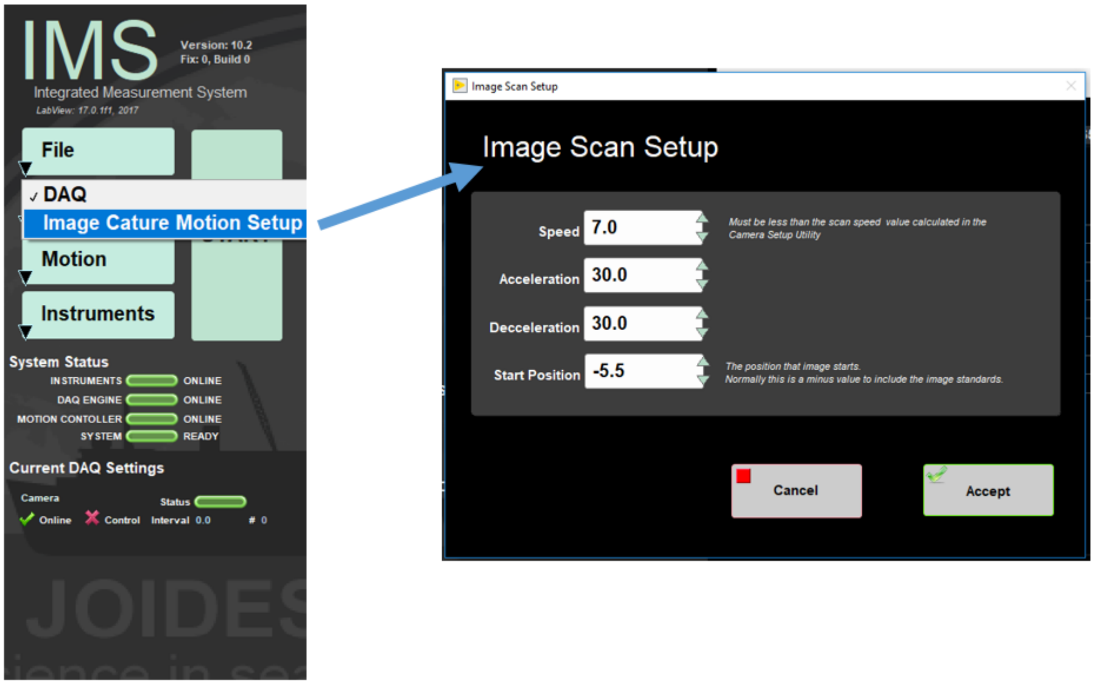


Figure 8. Select Image Scan Setup window

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 or equal to the speed determined by the Camera Calibration.
- **Acceleration**: The rate in cm/sec the camera ramps up to when not measuring a section.
- **Deccelaration**: 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.

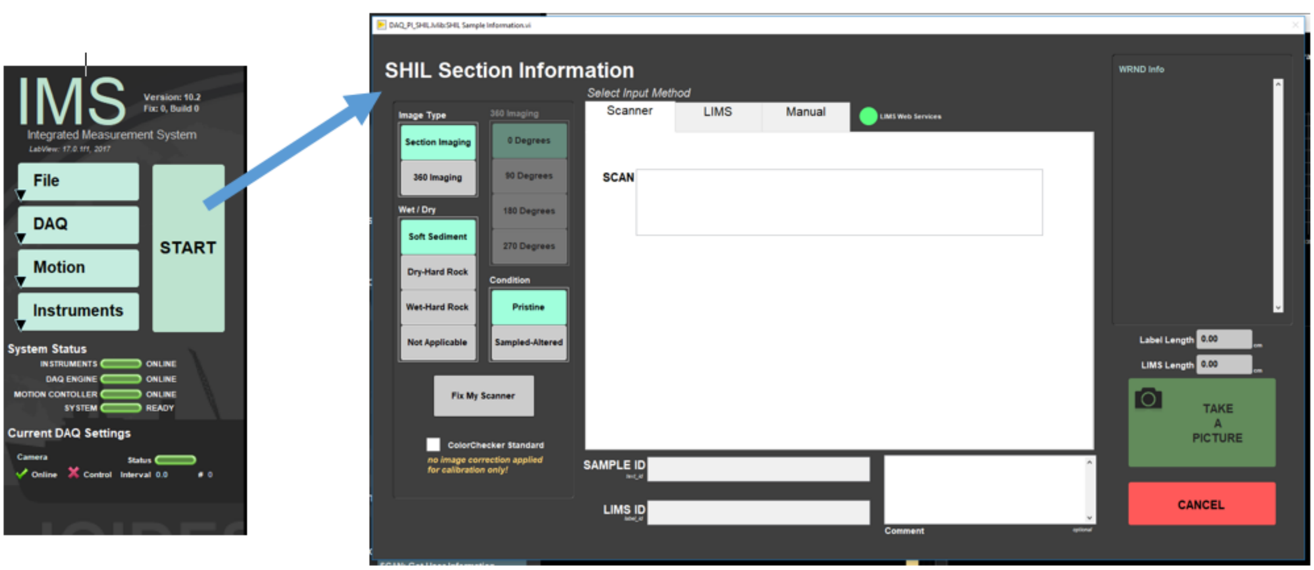


Figure 9. Select SHIL Section Information window

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

   a. **Image Type**: '**Section Imaging**' or '**360 Imaging**'. For instructions on the 360 imaging refer to ***360 Imaging Hard Rock*** section.
   b. **Wet/Dry**: Indicates the type of the material being image
   c. **Condition**: '**Pristine**' or '**Sampled-Altered**'. **Sampled-Altered** could include imaging the working half or a highly disturbed section. Most instances should be **Pristine**.
   d. **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 <u>**working half**</u> 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).

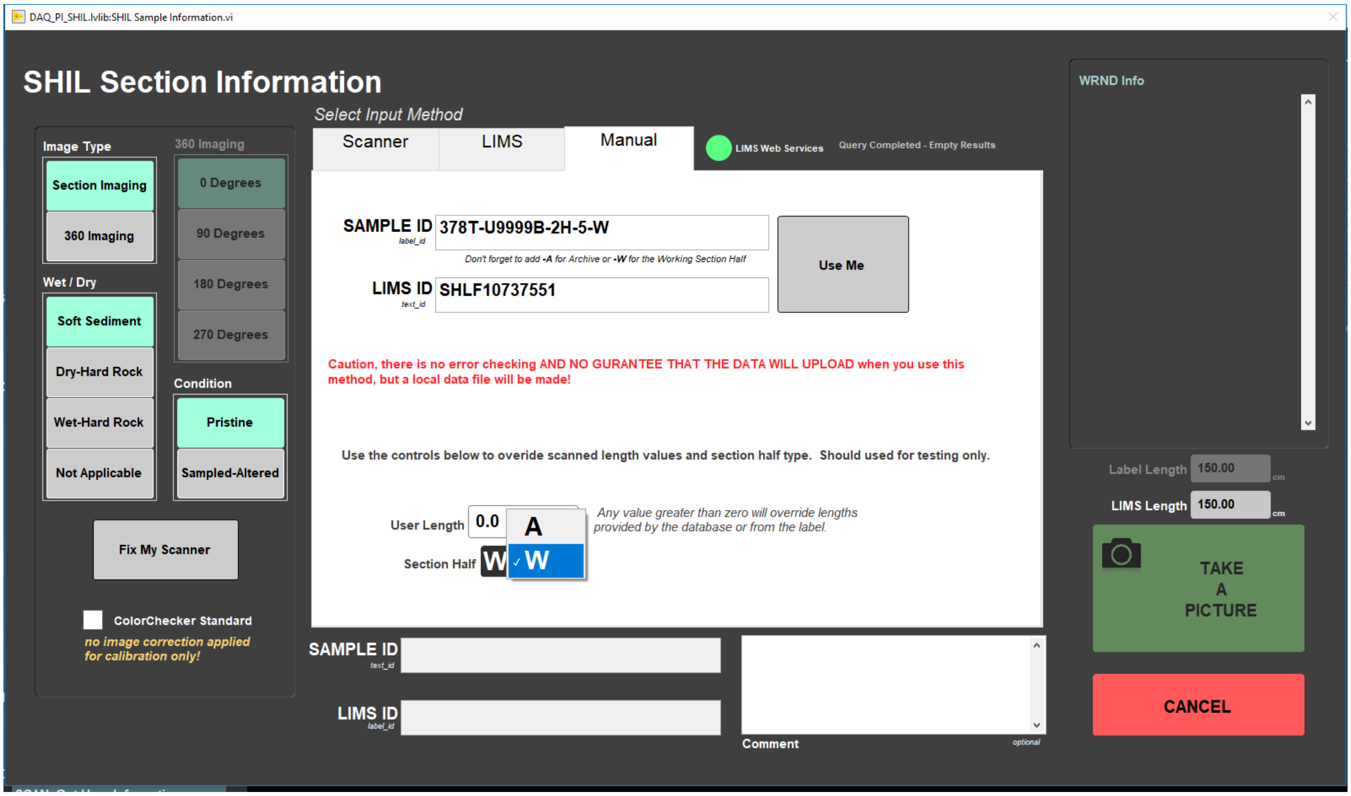


Figure 10. SHIL MANUAL Section Information window

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 cropped by more than 2cm check the correct section/end cap is being uses, 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-calcuate 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.

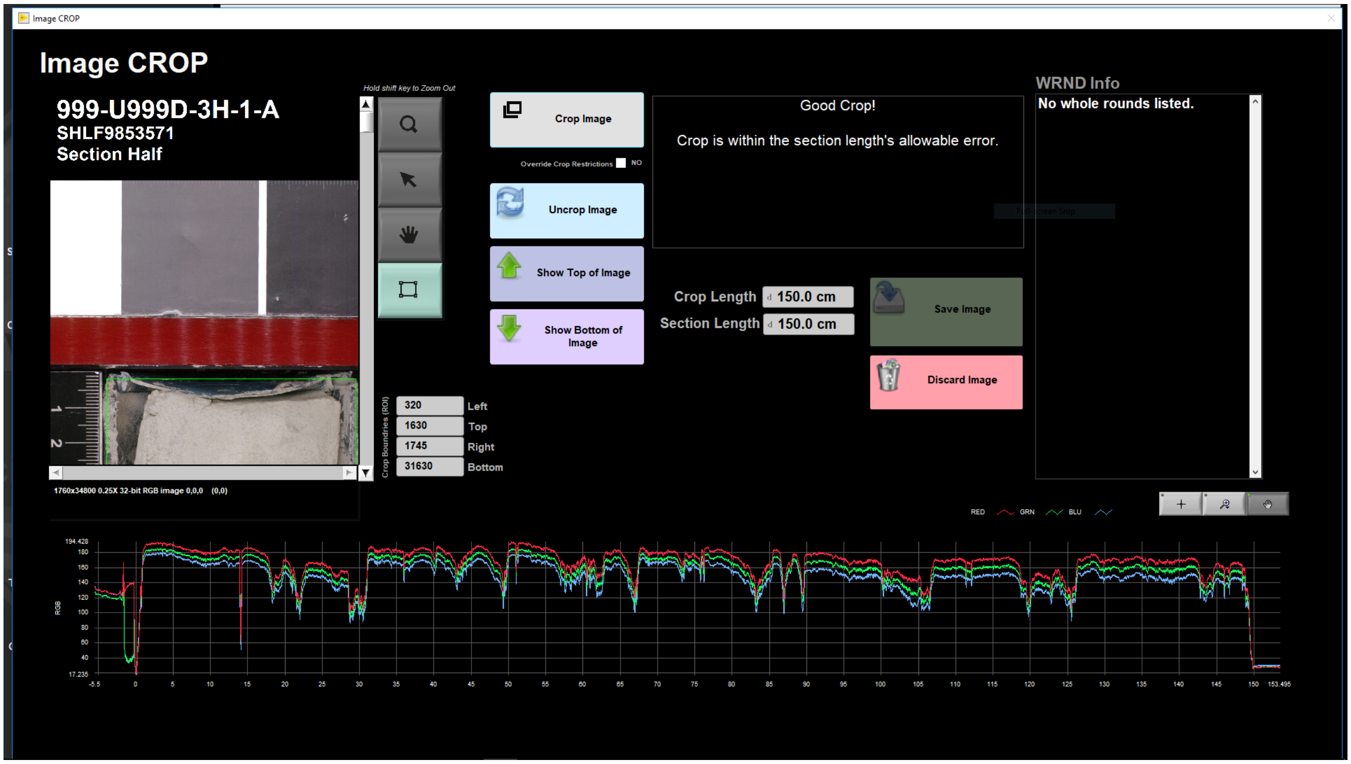


Figure 11. Image CROP window

Uploading data

Data Structure

Two files are uploaded to LORE via MegaUploadaTron (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).

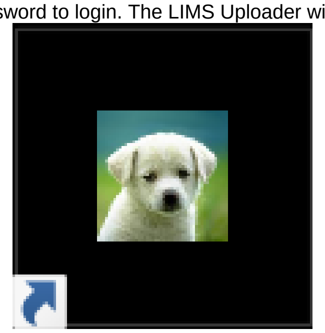


Figure 12. Desktop MUT icon

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

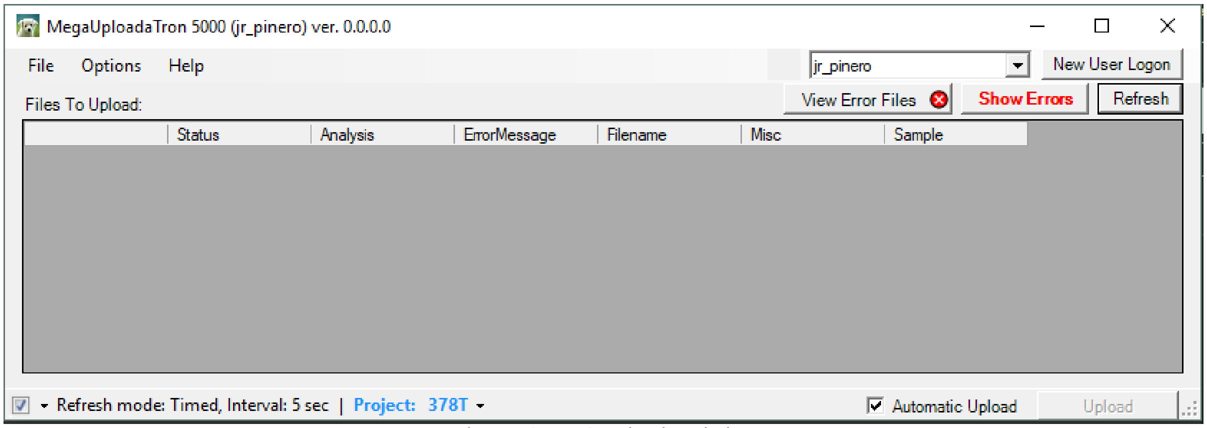


Figure 13. LIMS Uploader window

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.

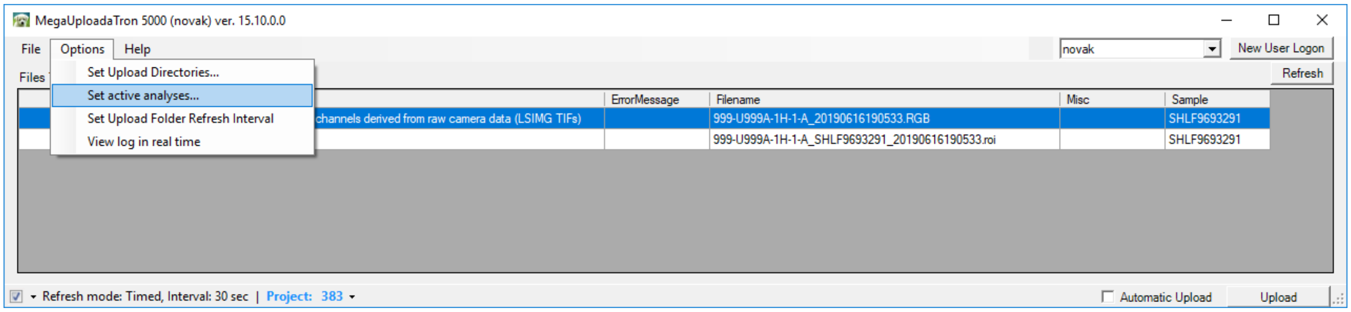


Figure 14. Select Set active analyses on MUT

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.

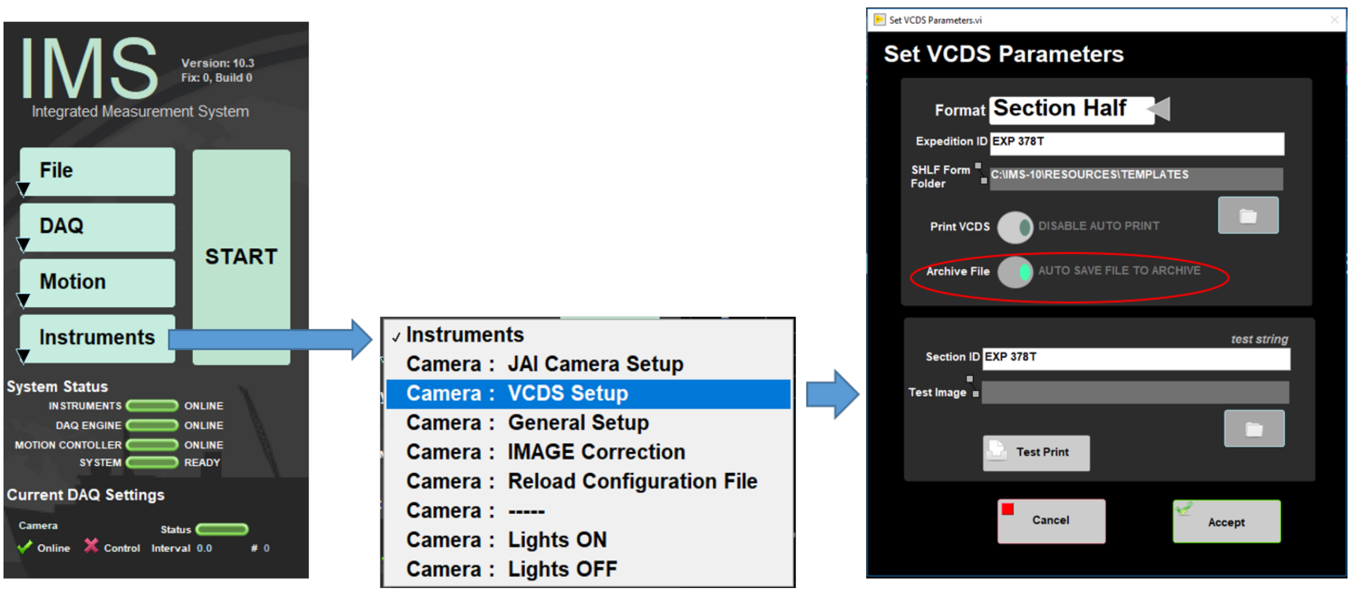


Figure 15. Select to preserve a digital copy of VCD-S

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).

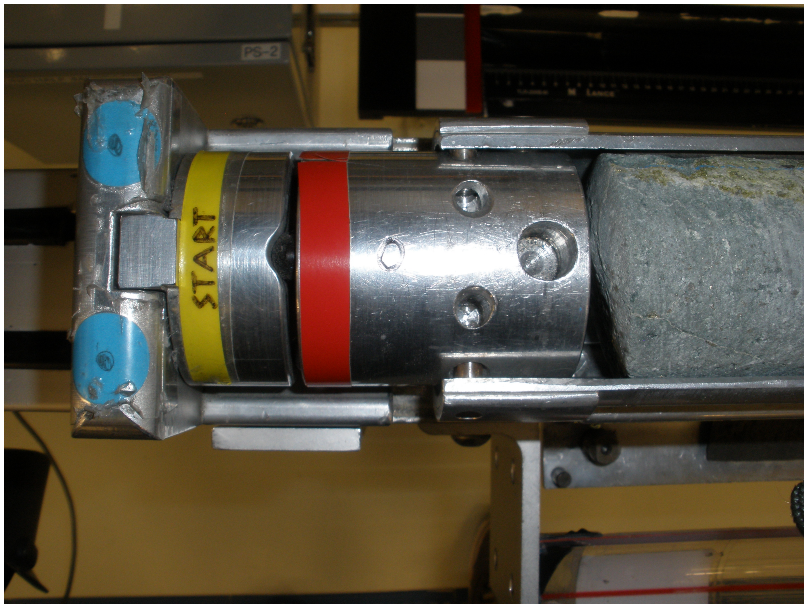


Figure 17. Whole round core correctly placed on the aluminum tray

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***

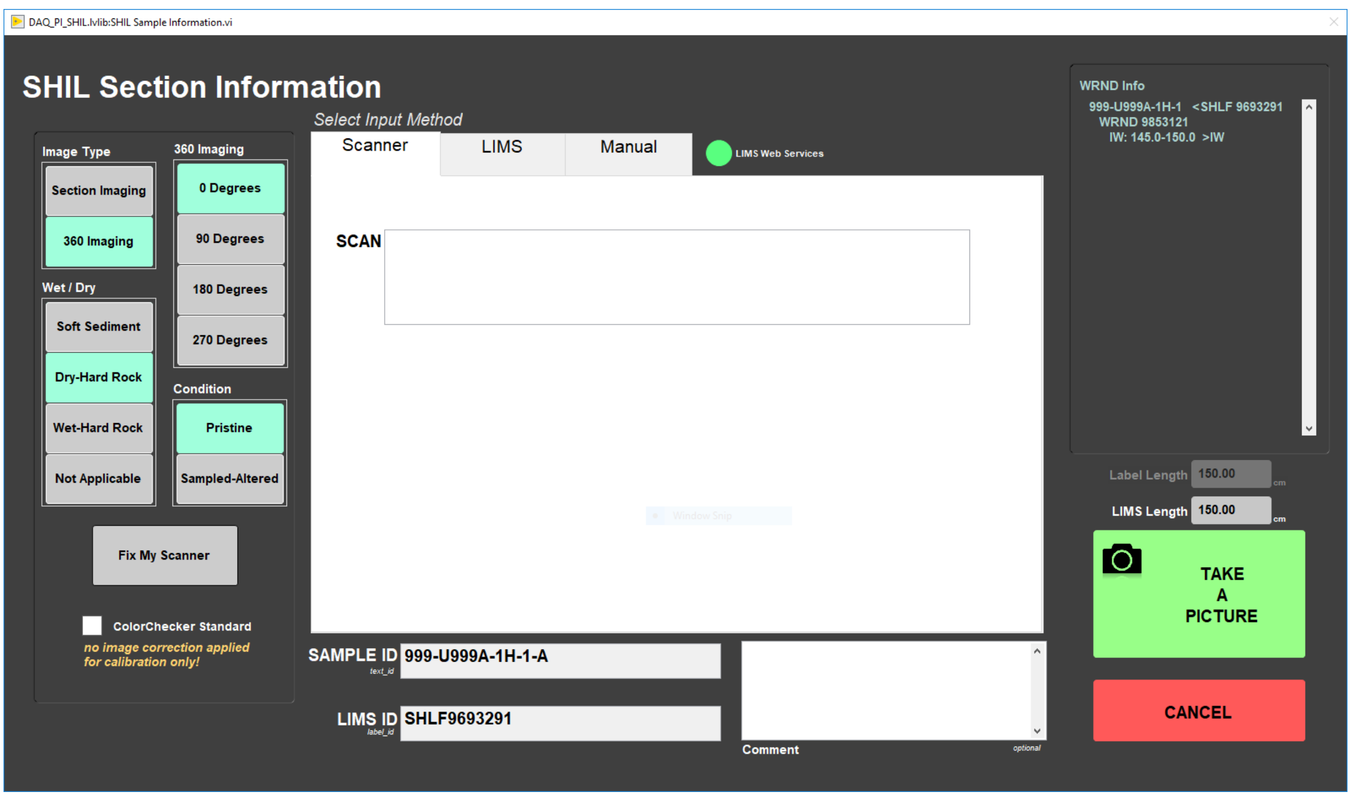


Figure 18. SHIL Section Information window for 360 Hard Rock Imaging

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.

Calibration

The laboratory technician calibrates the system when needed by adjusting camera settings and analyzing an imaged XRite Color Checker Standard (MacBeth card) or a QP 101 V4 Color Standard. The current light system obtains nearly uniform illumination intensity from the core's surface (half or whole round) to the bottom of the liner by a combination of high intensity, overlapping large diameter light source, close coupling to the imaged surface and the "line" image plane. The bottom edge of the brass led mount should be set between 2 and 4cm from the image surface. For uneven hard rock cores the height can be set higher but illumination intensity will drop, exposure times lengthen, f-stop opened and scanning speed reduced. Note, any height change to the lights requires re-calibration. Heat is removed from the LEDs and transferred to the surrounding air via the copper heat pipes and is cooled with mini fans. While the copper rods can get hot they are not a burn hazard. However they are very delicate and bend at the slightest touch, so use care when working with the camera lens. For more detailed information on the theory behind the calibration please refer to the Understanding the SHIL Calibration for further reading. Maintain temperature of the lights at 30-35 °C during calibration.

Note: the following instructions are divided into 2 sections. Calibration Check and Calibration.

Safety Concerns

- These lights can get hot if the cooling fans are not used (cooling fans work automatically when lights come one). The temperature is shown on the LED read out above the camera and is set to maintain a temperature of 30 °C. During a section scan, the temperature will range between 30 and 35 °C. If Temperature goes above 50°C an alarm will sound. Caution is needed during the calibration process because the lights are stationary and remain on for much longer (during calibration the user controls Lights On/Lights Off). You can use the manual power switch to turn the lights on and off or the buttons in the software (the calibration procedure below uses the buttons in software). Use the heat resistant grey silicone mat for the shading and pixel corrections. Do not use the plastic Gray card. Make sure the temperature is maintained between 30 and 35°C for calibration (to match temperature of lights during imaging of a section).
- Never look at the LEDs directly. Even the reflected light can be painful. When working under the track make sure that the power is off.
- NOTE: if you are concerned with the heat dissipation on the core surface, you can use our FLIR cameras to confirm that the temperature is ok.

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 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 so that it appears a neutral white, and it is used to counteract the orange/yellow color of artificial light.

Before Starting:

- Note which version of standard you are using. Each color standard values vary based on the version and the manufacturer of the standard. The XRite Colorchecker 2019 (MacBeth standard, Figure 20) is the preferred card to use for calibration. The program is set up to use the White and Black squares on the XRite Colorchecker (MacBeth standard). On the MacBeth standard the RGB values of White and Black are listed here. White RGBs are 242, 242 and 236 and black RGBs are 49, 49, 50. For the QP 101 v4 card, the RGB values are 235, 111, and 80 (Figure 21). All SHIL calibration standards are found in drawer PP-2B.
- Obtain the 3D standard (Figure 20), the gray silicone mat standard and the lens cap from PP-2B.
- Set camera f/stop to either F/16 or F/22 (Figure 22). The manufacturer suggested F/22 as the preferred for scanning with the current light set up however we have found F/16 works well for our section halves and is the most used F/stop for calibration and scanning sections. For hard rock cruises, where 360° whole round scanning is required, a larger F/stop number is required.
- If you haven't set the camera's height, now is the time to do so! See the section Camera Height Adjustment at the end of the calibration section.

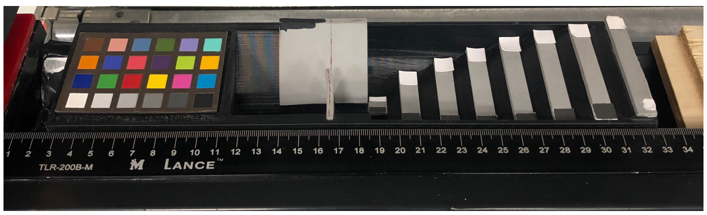


Figure 20: 3D standard with Xrite Color checker (MacBeth Color) standard on the left.

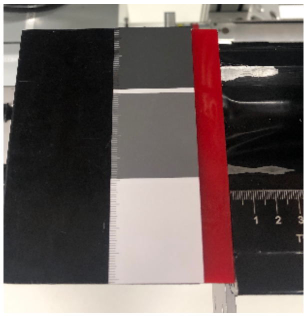


Figure 21: QP card 101 v4 grey scale standard.

Figure 22: Setting the F Stop on the Camera. Note that F/22 was recommended by the camera manufacturer but that value is debated. F/16 is the preferred value by the imaging specialists onboard. Darker cores may need F/22.

Calibration Check

The following calibration check is designed for technicians to check the SHIL's calibration. The calibration check is required to be done at the start of every expedition prior to receiving the first core. If adjustments to the calibration are needed, please see the **Calibration** section below.

Determine the Scan Rate for the Expedition

Talk to your science party to determine what scanning parameters (scan rate) they wish to use. A typically scan rate has been between 8-10 cm per second. Note, with the new, brighter LED lighting system, faster scan rates can be achieved compared to expeditions prior to Expedition 390C.

1. Launch **IMS** on the SHIL computer

2. Click on **DAQ** and click **Image Capture Motion Setup**

3. Compare the current scan rate (**Speed**) to the requested rate. The **Speed** (Figure 23) of the camera will be in the first box. If the values need to be changed to match the requested values by the science party, please proceed to the **calibration** section below as you will need to do a full calibration. If the values match, close the 'Image Scan Setup' window and proceed with the following checks. Speed of 8 to 10 is the most common value and must be less than the scan speed value calculated in the JAI Camera Setup utility.

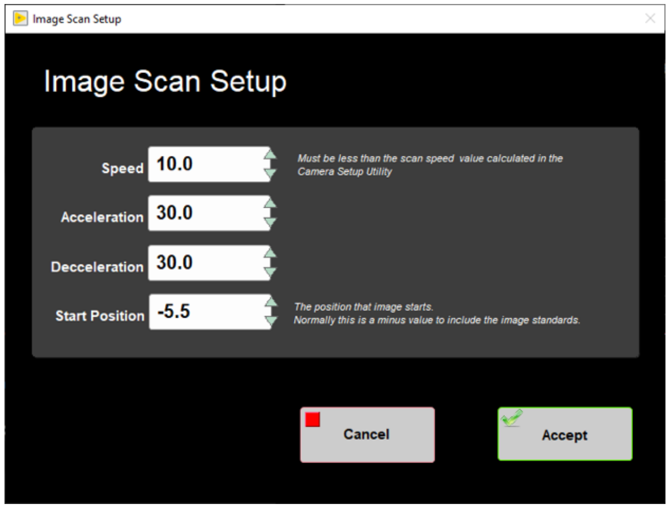


Figure 23: Checking the Image Scan Speed.

Check the Line Trigger Interval rate

The **Line Trigger Interval** dictates the **Max Image Scan Speed.**

1. Click on **Instruments** and open the **JAI Camera Set-up** window.

2. Turn the lights off **IMMEDIATELY** by clicking **Lights OFF**. Remember the lights produce a lot of heat and we want to maintain the calibration at temperatures between 30-35 °C.

3. Click **Rates and Exposure** tab (Figure 24).

4. Check that the **Max Image Scan Speed** is equal to, or slightly more than the designated scan rate **(Speed,** Figure 23**)**. The Max Image Scan Speed is usually between 8 to 10.

5. Again, if the values need to be changed to match the requested values by the science party, please proceed to the **calibration** section below. If the values match, close the **JAI Camera Set-up** window and proceed.

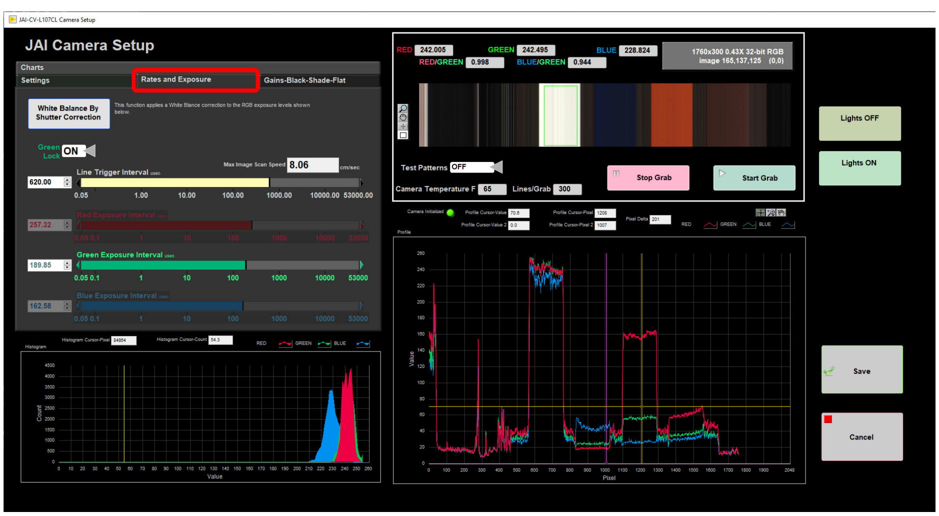


Figure 24: Checking the Max Image Scan Speed.

Assess the SHIL scan

Prepare the scan to assess the current image correction values. If you can achieve a good image by either adjusting, or better yet, keeping the same, values in the following steps you will not need to adjust any of the camera settings in the **JAI Camera Set-up** window in the calibration instructions below (**Calibration** section).

Take an Image

1. Place the 3D calibration standard on track as shown (Figure 25). Be sure to use the XRite Color checker 2019. The color squares must be oriented as pictured below, butted against the red reflection bar.

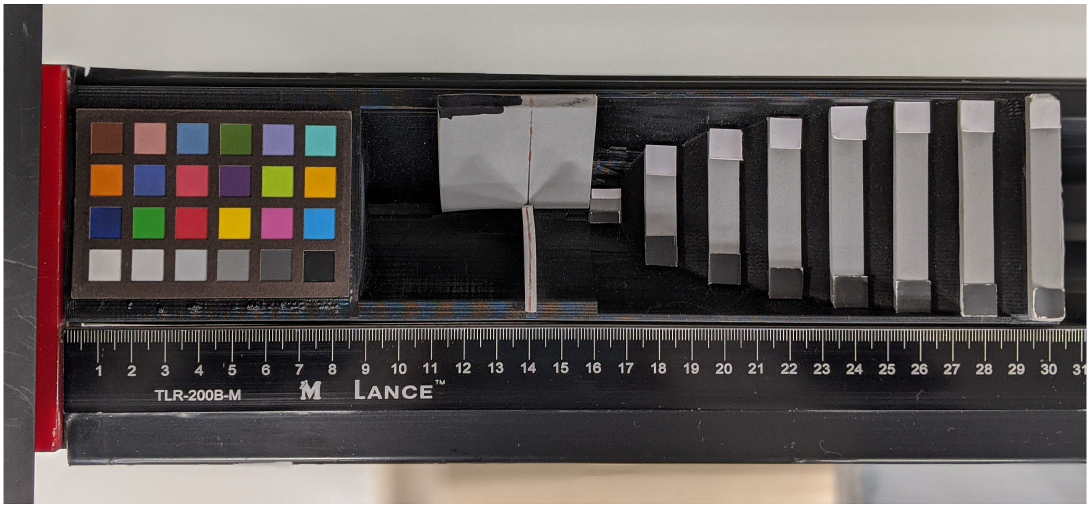


Figure 25: Color standard in track in correct orientation.

2. Open IMS and Click **Start**.

3. Scan the STND Color barcod label (Figure 26b). Check the **ColorChecker Standard** box (Figure 26a). With this box selected no corrections are applied to the image so we are able to assess the raw image quality.

4. Click **Take A Picture**.

5. When the image has finished click **Crop** and then **Save**. We use the uncropped image so the crop here is not important.

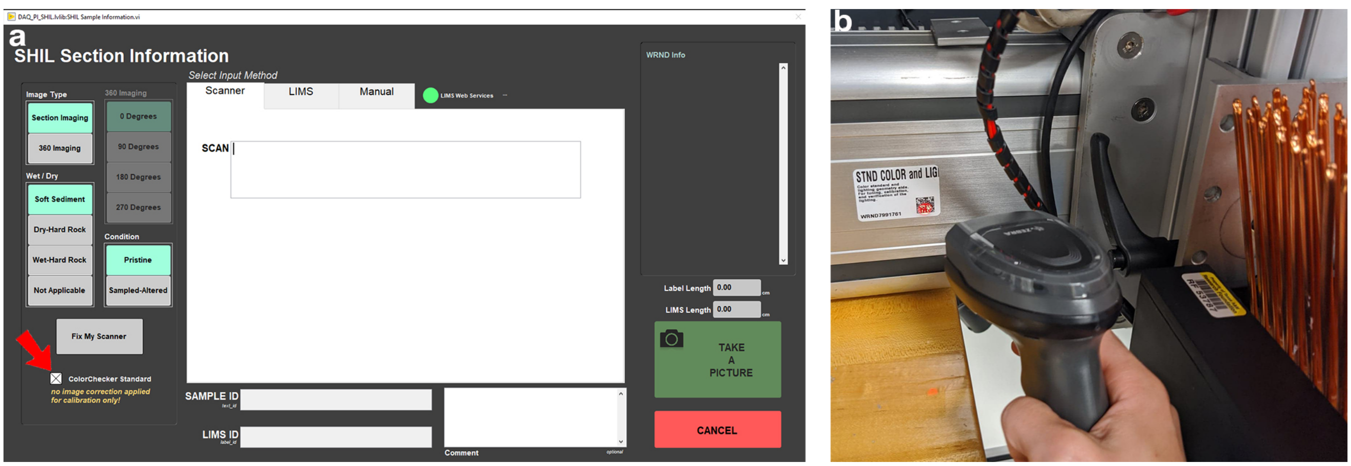


Figure 26: a) sample information screen with ColorChecker box checked, b) standard barcode being scanned.

6. On the main IMS panel select **Instruments** and **Camera: Image Correction** (Figure 27).

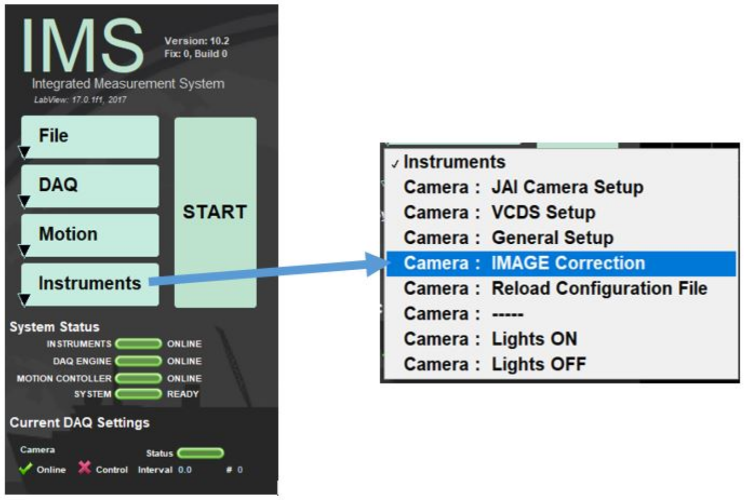


Figure 27: Image Correction command selection.

The main Image Correction window displays three main areas:

A. **Graph panel**: Main graphical viewing area on the left side of the screen.

Uncorrected Tab: Shows the measured Red, green, and blue values of the gray scale color squares.

Applied Corrections Tab: Applies polynomial fit corrections to the RGB lines.

B. **Image Viewing Panels**: Area in upper right portion of the screen that displays the original and corrected test image and color checker with RGB values.

Original: Displays the uploaded tiff.

Corrected: Displays the uploaded tiff with corrections applied.

Color Checker: Displays the known values of the MacBeth Color Checker values

C. **Correction Panel:** Panel in the lower right portion of the screen that allows user to apply corrections to the image

TIFF Correction: Shows tiff red, green, and blue polynomial fit.

JPEG Correction: Shows brightness, contrast, and gamma settings.

Instructions: Shows instructions to follow in this window.

7. Select **Open Test Image** and select the image you just took (Figure 28-1), located in C:/DATA/IN/IMAGE. It does not matter if the JPEG or TIFF file is loaded. The image loads into both the Original and Corrected windows.

8. Draw a ROI box loosely around the color checker in the **Original box** (Figure 28-2)

9. Click **Crop** (Figure 28-3).

10. Draw another ROI box around the Color Checker squares and this time making sure to only have XRite MacBeth color checker in the box. White squares will appear inside each square. Adjust the box to get those white squares close to the center of the color squares. Do not click **Crop** again.

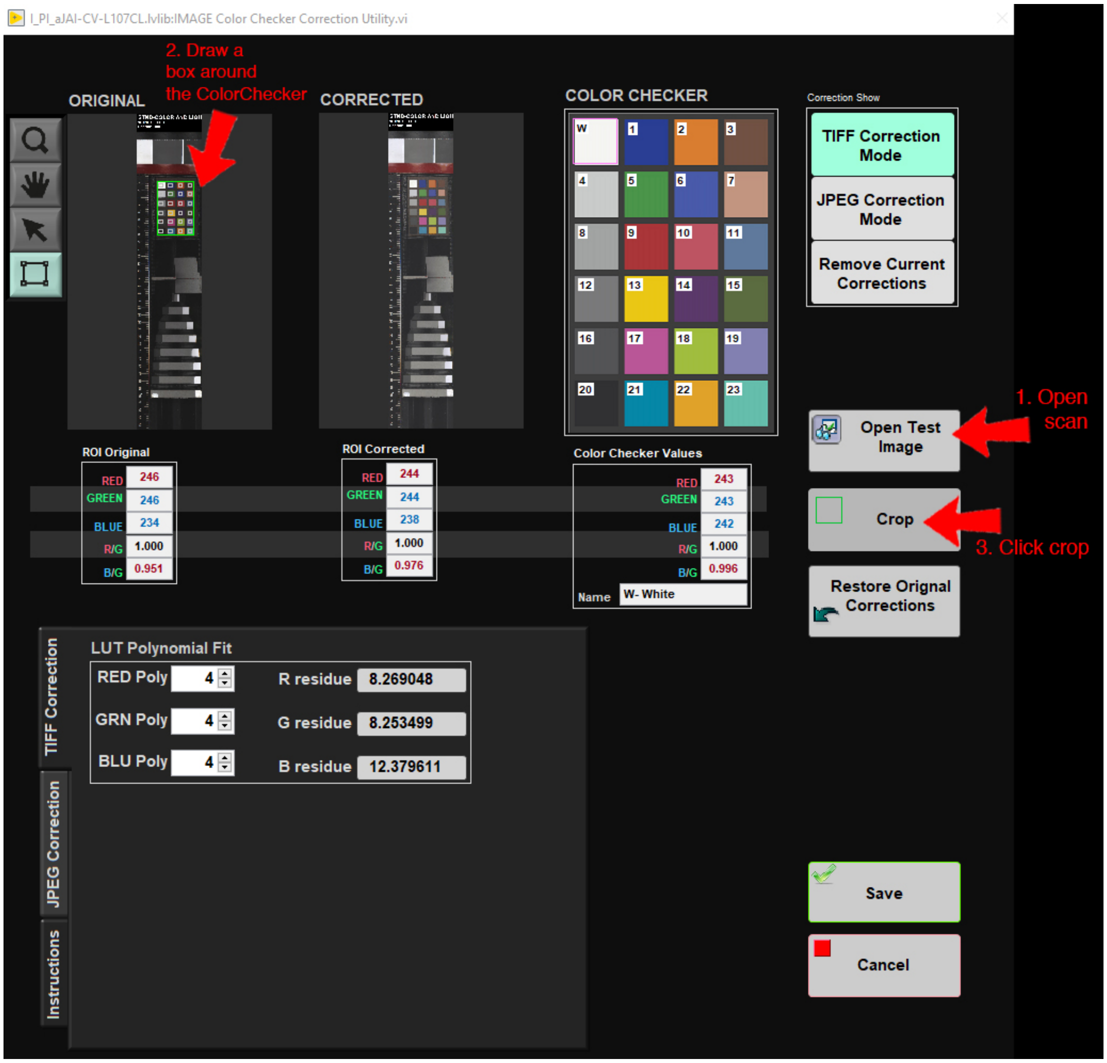


Figure 28: Image Correction Window. Steps are indicated in the figure.

Check TIFF and JPEG Corrections

Here we check and adjust, if needed, our TIFF and JPEG Corrections. You may find you only need to slightly tweak the values and the calibration is good. However if the image appears streaky, a physical change has happened to the Camera or lights, the RGB values between corrected and expected are far off, or the graphs of either the tiff or jpeg don't look good, you will need to re-calibrate following the full calibration discussed below.

TIFF Correction Check

1. Click **TIFF Correction Mode** (Figure 29-2).

2. Click **Uncorrected Image** tab (Figure 29-3). This graph shows the measured red, green, and blue values of the color squares.

3. Click **TIFF Correction** tab to adjust the shape of the graph (Figure 29-4). The goal is to have line as straight as possible.

4. In the **Tiff Correction** tab adjust the **LUT polynomial order values** for the **Red, Green, and Blue** channels (Figure 29-5). Adjust these values to create the lowest residual error with the smoothest curve in the **Uncorrected Image** tab. Poly values should be around 4. Make sure that the curve does not wave about. If it does, the values need to be lowered. Also check that the corrected ROI and MacBeth values should be very close. Make sure that the white does not exceed the MacBeth values (RGB = 242. 242. 236). If you are unable to produce a reasonable correction curve, it is necessary to redo your white balance correction in the **Calibration** section below.

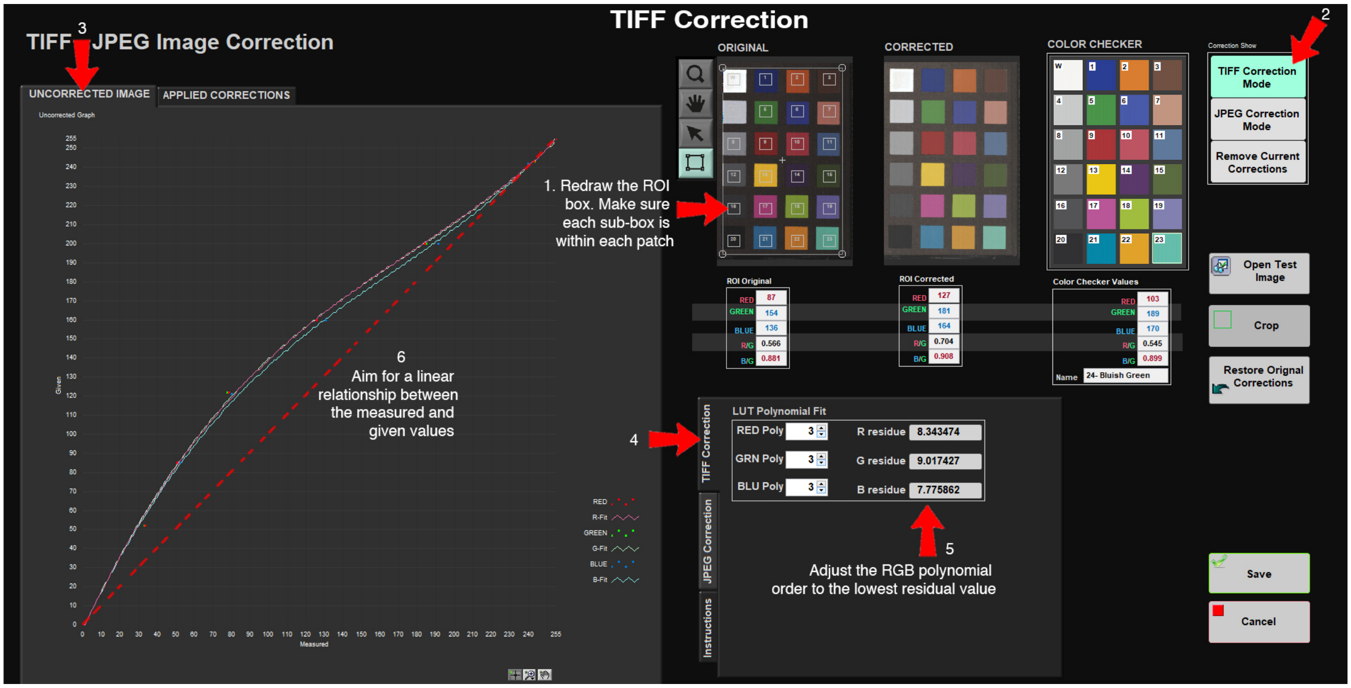


Figure 29: Steps for Tiff Correction illustrated on image. 1. Redraw box on color squares. 2. Select Tiff Correction Mode. 3. Put graph on Uncorrected Image. 4. Select Tiff Correction to view polynomial order. 5. Adjust polynomial order. 6. Check graph for linear relationship.

Note: the **TIFF correction** is applied to both the TIFF and JPEG image but for the JPEG image you can also apply a Brightness, Contrast and Gamma (BCG) correction (See JPEG Correction section below). This is done at the photographer's discretion. With better balanced LEDs on the new light system you may not have to use the BCG corrections (leave the values at their mid-points. Figure 30-4).

JPEG Correction Check

In JPEG correction you will check and adjust if necessary the brightness, contrast and gamma (BCG) of the image. Situations may also 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. As mentioned above, with the new lights the BCG values may not need to be adjusted and to be kept at the mid values (Figure 30-4).

1. Click **JPEG Correction Mode** (Figure 30-1)

2. Click **Applied Corrections** tab (Figure 30-2)

3. Click **JPEG Corrections** tab (Figure 30-3). Adjust the Brightness, Contrast, and Gamma levels (Figure 54-4) to achieve a straight line in the **Applied Corrections** tab and the **ROI Corrected** box should have values near 242 for the white square and near 50 for the black. We want a linear relationship between the measured and given values. Each BCG setting adjusts the line in different ways and there are many different ways to adjust the values to achieve a linear relationship. You want to achieve a good image with good brightness, where the image has good saturation and not too washed out. (see JPEG corrections cheat sheet in SHIL lab notebook, to be added). The Applied Corrections Graph should be a straight line and the ROI Corrected Box should have values near the RGB values of 242. 242. 236. These may change depending on the instance of extreme colors, extremely white or extremely dark cores, in which the settings may have be tweaked more to get a user friendly consumer image.

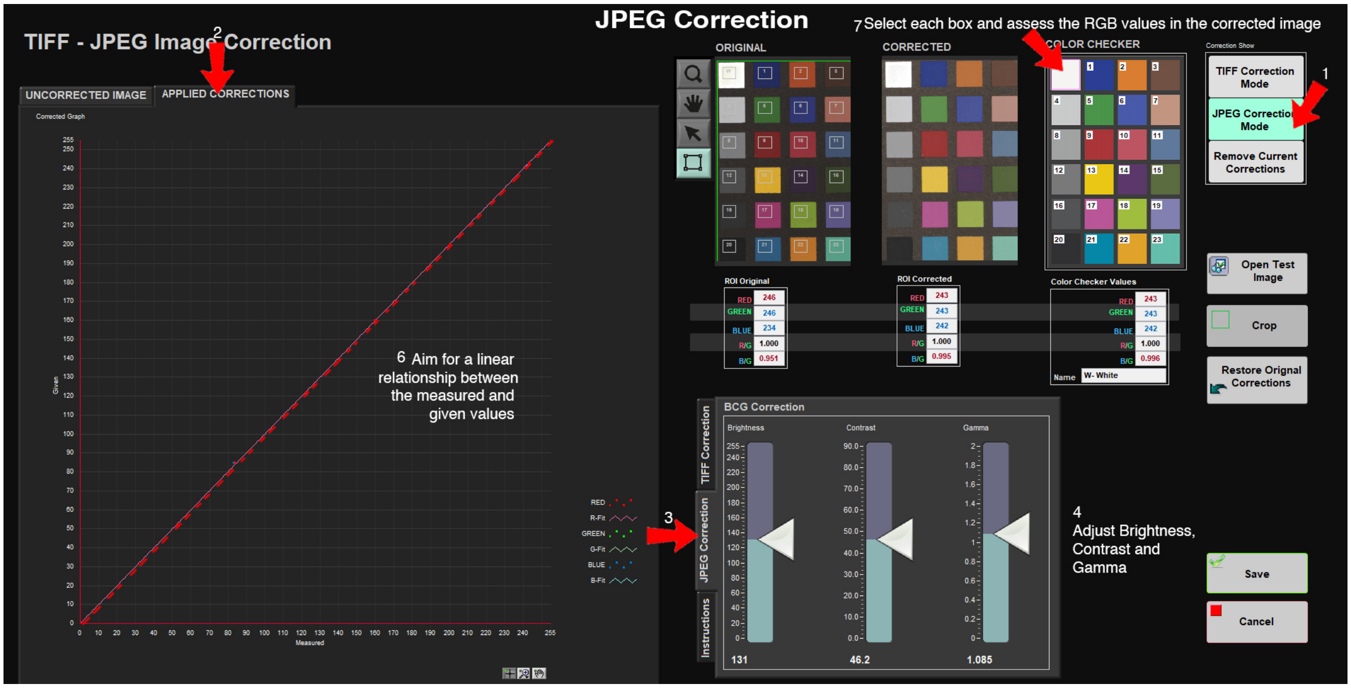


Figure 30: Steps for JPEG Correction illustrated on image. 1. Select JPEG Correction Mode. 2. Select Applied Corrections tab on graph. 3. Select JPEG Correction to see Brightness, Contrast, and Gamma Corrections. 4. Adjust Brightness, Contrast, and Gamma corrections. 6. Check graph for Linear Relationship. 7. Check the boxes in the Color Checker and compare to RGB values in corrected image.

4. If the values are good and there are no streaking issues in the images or other unwanted artifacts, you can click **Save** and no further adjustments are needed. However if you have determined the doesn't look good, click **Cancel** and you can proceed to the following section and complete the calibration instructions listed in the **Calibration** section below.

Calibration (JAI Camera Setup and Image Corrections)

Camera and Track Setup

1. Confirm the camera F-stop is set to F/16 or F/22 (Figure 31). F/22 is preferred by the camera manufacturer for scanning with the current light set up however the imaging specialists onboard have been using F/16 and are confident F/16 works for our set up. For hard rock cruises, where 360° whole round scanning is required, a larger F-stop number is required (ie. F/22).

Figure 31: Setting the F Stop on the Camera.

2. In the **IMS control panel** select **Motion** and then **Drive Disable** from the dropdown menu (Figure 32). You will have to move the camera by hand for the calibration, disabling the motor allows manual movement of the camera on the track.

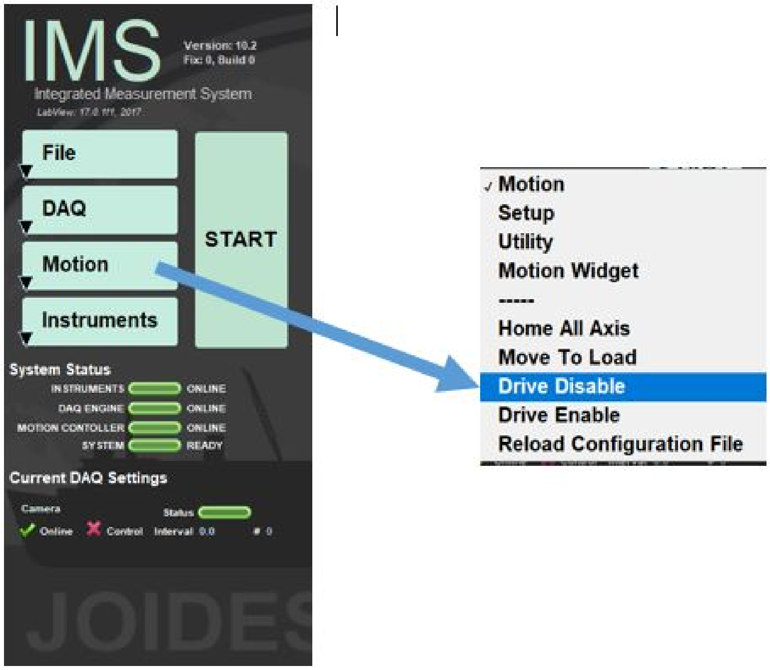


Figure 32. IMS commands to disable the drive.

3. In the **IMS control panel** click **Instruments > JAI Camera Settings** (Figure 33). The lights turn on automatically when the JAI Camera Setup window opens.

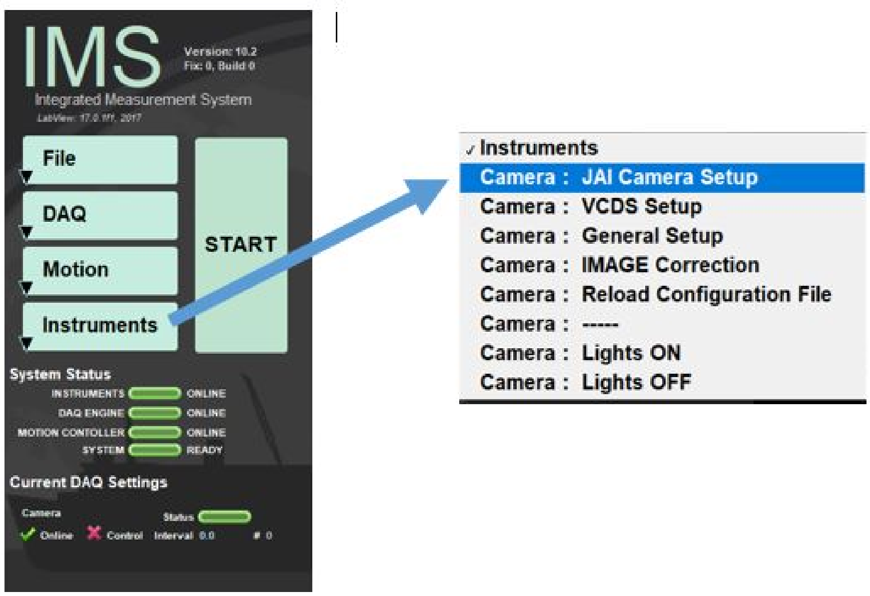


Figure 33. Selecting JAI Camera Setup

4. Click **Lights OFF** (Figure 34) **IMMEDIATELY**. ~~You can also turn the lights off with the physical power switch located behind the monitor (Figure 35)~~. ~~Note if the lights are turned off by the hardware switch, the lights cannot then be turned on the software command.~~

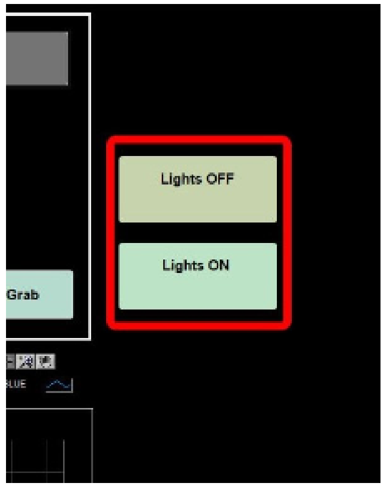
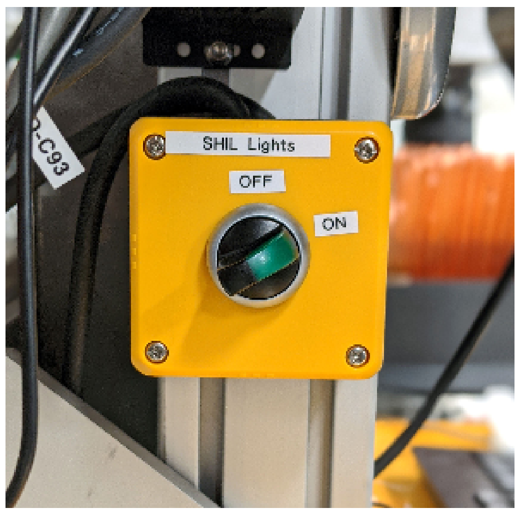


Figure 34: Software commands to turn the Lights on or off.



~~*Figure 35: Hardware Switch to turn power on or off to the lights located behind monitor.*~~

Resetting Gains and Corrections

1. Click the **Gains-Black-Shade-Flat** tab (Figure 36).

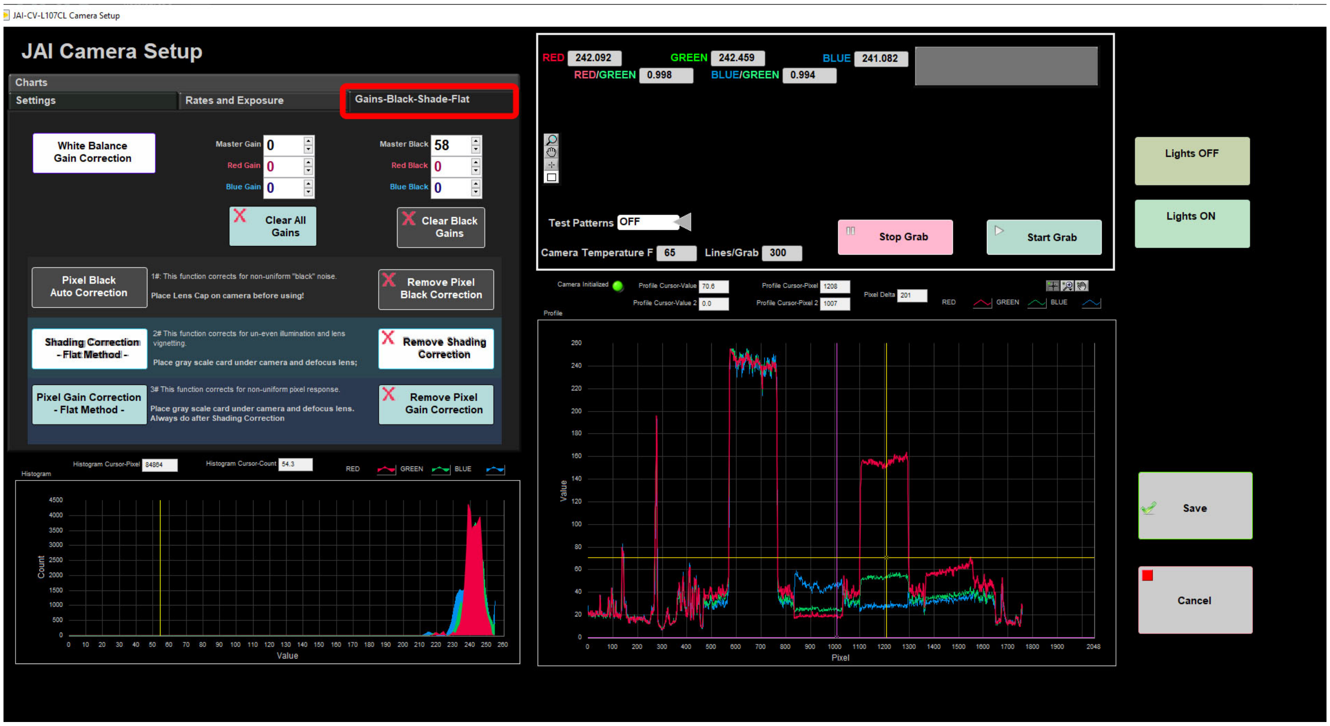


Figure 36: JAI Camera Setup Window showing the Gains-Black-Shade-Flat tab. The Gains-Black-Shade-Flat tab is outlined in red.

2. Click the **Clear All Gains**, **Clear Black Gains**, **Remove Pixel Black Correction**, **Remove Shading Correction**, and **Remove Pixel Gain Correction** *(* Figure 37*).* You will notice all values in the Master and Black gains go to zero.

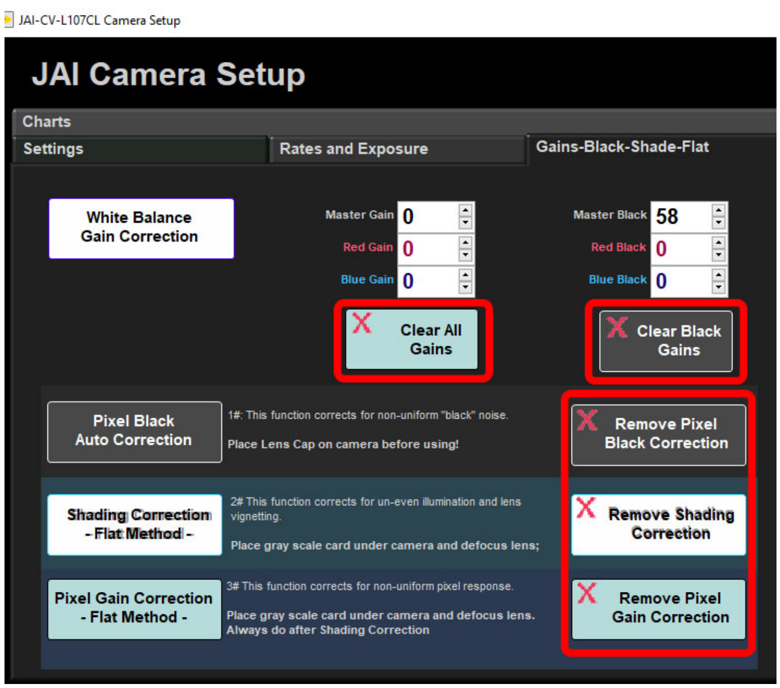


Figure 37: Remove the corrections and clear gains.

4. In **Master Black** field, enter 40. That is a good starting point. The last value used on the Master Black was 60, so you may want to try 60 now (Why?).

Color Balancing the Camera

Color Balancing should be done with the Xrite color checker MacBeth standard. The grey standard on the top of the track should be the QP card 101 v4 gray scale card. Be sure to use new color standards as some where damaged (faded) by the high temperature of the previous light set up. The calibration using the MacBeth white standard card is described below (note: the QP card v.4 101 method that was implemented in 2020 due to high temperature of lights is described at end of this User Guide if you need to reference that method).

Color Balancing Camera - MacBeth Color Checker Card

Make sure the lens is focused. Use the cm marks on the QP 101 V4 card to focus the lens.

1. Put the 3D Calibration Standard in the track. The color square must be oriented as pictured Figure 38.

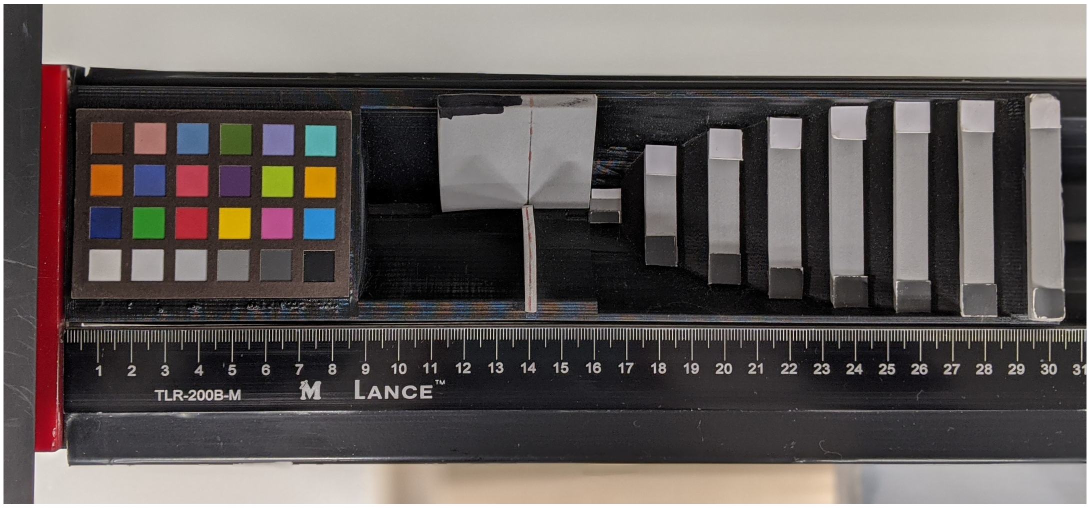


Figure 38: Color standard in track in correct orientation.

2. Select the tab **RATES and EXPOSURE** (*Figure 39).*

Figure 39: Rates and Exposure window, the tab is highlighted in red.

3. On the **Green Lock** control select OFF (*Figure 40*). The other exposures are now adjustable.

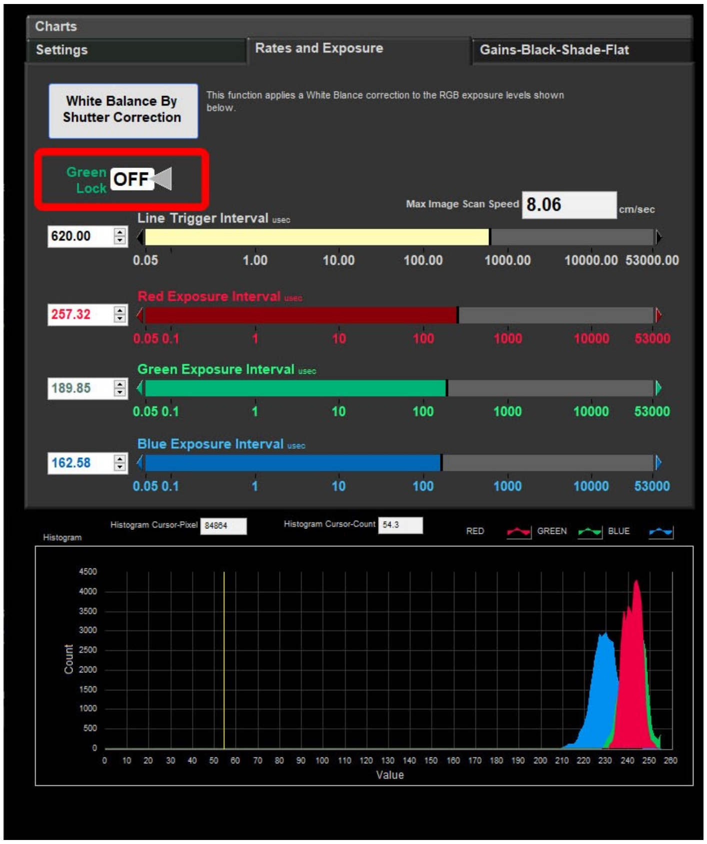


Figure 40: Green Lock control highlighted in red and set to off.

4. Set the Line Trigger Interval until the Max Image Scan Speed is between 8 and 10. Adjust values by clicking in the light trigger Interval field and typing values.

5. Turn on lights. Remember if the Temperature goes above 35 °C you must turn the lights off and wait until the temperature drops before proceeding.

6. Click the **Start Grab** (*Figure 41*).

Figure 41: Start Grab button highlighted in red.

7. Move the camera over the Macbeth color standard until you see the white, dark blue, orange and brown color bars in the image. Place the cursor in the white square, right-click and draw a rectangle by dragging diagonally. Release the mouse when you have selected most of the white bar. The rectangle (marked in green) should only have the white color and nothing else inside (*Figure 42*).

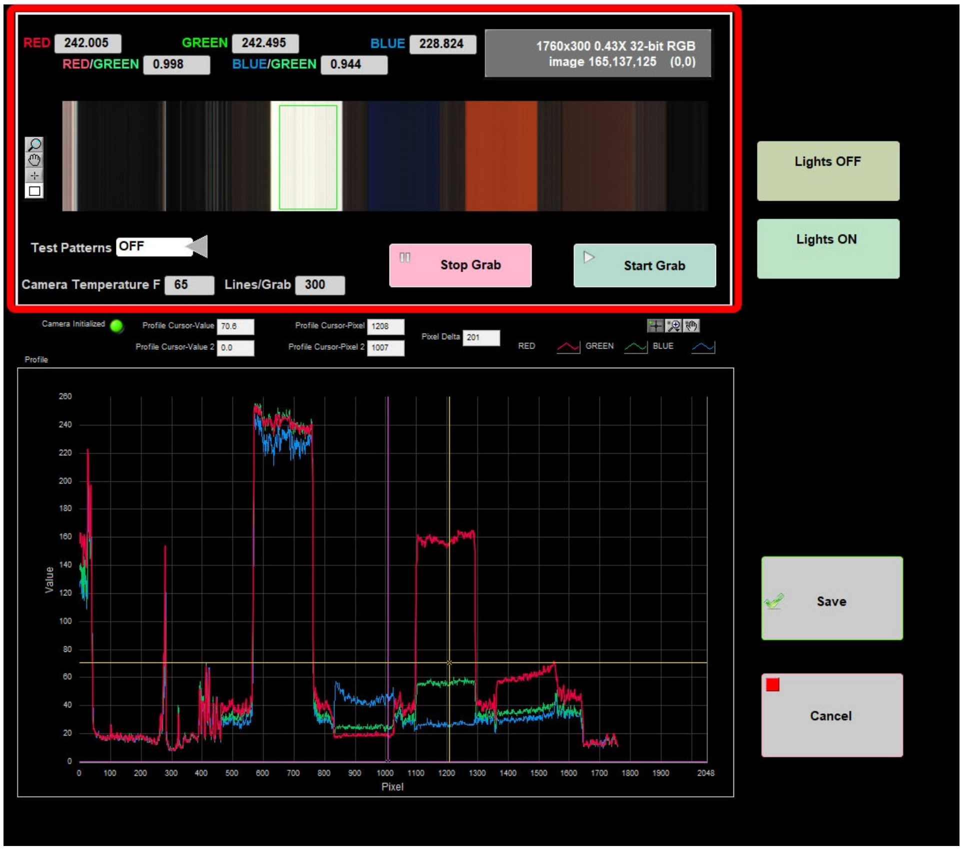


Figure 42: The grab window is highlighted in red. A green square is drawn in the white color square of the appropriate row.

8. Above the image you will see values for the average RED, GREEN and BLUE (RGB) for all of the pixels within the green selected rectangle (White square). You will also see the ratio values for RED/GREEN and BLUE/GREEN.

9. Adjust the **Red Exposure Interval** value until the RED value is 242.

10. Adjust the **Green Exposure Interval** value until the RED/GREEN value is as close to 1 as you can achieve.

11. Adjust the **Blue Exposure Interval** value until the BLUE/GREEN value is near 1 (actual ratio 0.98, Blue is 236, Green is 242). You just completed the White Balance of the upper limit of the camera.

12. Turn lights off by clicking Lights Off.

Adjust Gains

Master gain changes the whites/high RGB values. You can use positive or negative values. Master black changes black/low RGB values. You can only input positive values for Master Black. Without changing the gain values, the SHIL gives you a raw image with too high of a contrast. That is, whites are too bright, and blacks are too dark. You need to adjust the mid-tone and black level to achieve a good calibration. To do this, it is recommended to at least raise the master black. Lowering the master gain will help achieve a more ideal mid-tone, but be careful, because color can start to lose saturation when you do.

1. Select the tab **GAINS-BLACK-SHADE-FLAT** tab.

2. Turn Lights On by clicking Lights On. Remember if the Temperature goes above 35 °C you must turn the lights off and wait until the temperature drops before proceeding.

2. Move the camera over the Macbeth color standard until you see the black, blue, gold and cyan color bars in the image.

3. Place the cursor in the black square, right-click and draw a rectangle by dragging diagonally. Release the mouse when you have select most of the black bar.

3. Adjust the **Master Black** gain until the GREEN value is around 15 (Figure 43). Qualitatively, this is what's been found to produce a nice image. Please note that the RGB value of the black square is about 50, but this will be corrected for in the TIFF/JPEG correction. Remember to turn off the lights regularly!

4. Adjust the **Red Black** gain until the RED/GREEN value is 1.

5. Adjust the **Blue Black** gain until the BLUE/GREEN value is near 1 (actual ratio 1.02, Blue is 50, Green is 49).

6. Keep an eye on the histogram graph on the bottom left corner (Figure 39). We want all the colors to overlay each other pretty closely. Adjusting the RedGain and BlueGain will move the colors (histographs) in the graph in the lower left, move until they are over lapping.

7. Adjusting the gain likely changed the RGB values in the White square of the MacBeth Color checker. Draw an ROI box in the White square. If the values aren't near 242 go back to the **Rates and Exposure** tab and adjust the the values until you hit 242 (RGB 242, 242, 236). Check back in the Black square and see its still about 15. Adjust the gains and/or exposure intervals until the Black reads near 15 and White reads near 242 (RGB 242, 242, 236). This is a balancing act and can be tedious. Remember do not let the temperature to go about 35 °C.

8 Click Lights Off.

Apply Corrections

We apply three corrections **Pixel Black**, **Shading** and **Pixel Gain**. Only do the corrections after you have finished adjusting the RGB exposure and Gain. Obtain the heat resistant silicone gray mat from the drawer PP-2B. The heat resistant silicon mat is homogenous in color which is helpful for the corrections (no mottling as seen in the old grey cardboard card).

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. (Vendor 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 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 (Note: the order of pixel gain and shading correction is debated, it is suggested to do it in the order above). If color streaking is evident in the image, this correction is needed to remove the unwanted streaking.

Pixel Black Auto Correction

2. Take the lens cap (Figure 44) and place on lens (Figure 45). The lens cap is located in drawer PP-2B. The new light set up makes adding a lens difficult and it has been noted that added the lens may nat be needed if the lights are off but I have yet to test that.

Figure 44: Lens cap for the camera

Figure 45: Lens Cap being put on camera

3. Click **Pixel Black Auto Correction**. The RGB lines in the **Profile** graph should be uniform (Figure 46).

4. Remove lens cap when finished.

Figure 46: Grab and Profile after the Pixel Black Correction applied.

Shading Correction

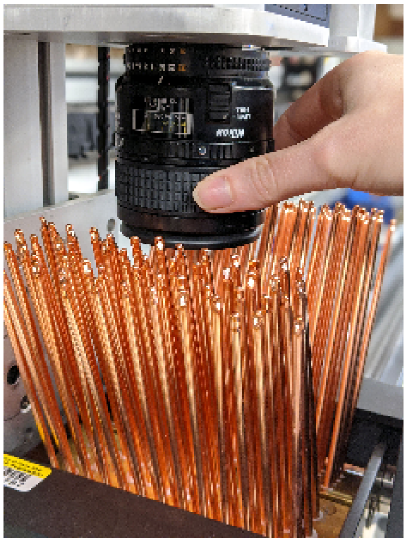
1. Take the heat resistant gray silicone mat and wooden board from the SHIL calibration drawer. Clean off any dust with a piece of tape (Figure 47). Dust will cause unwanted artifacts in the image. The mat must be clean and flat on the track.

2. Place the heat resistant gray silicone mat on the track. Make sure that it is level and perpendicular to the camera's axis.

3. Click **Lights On**, and move the camera over the gray mat.

4. This step is no longer needed (info with ~~strikethrough~~) because the silicone matting is homogenous. The previous material used had a mottle effect and thus defocusing was required to provide an even surface. If you find that defocusing is still valid please make a note here. ~~Defocus the lens on the camera just a little bit (Figure 44). Look at the Profile graph and slightly rotate the lens' focus until the RGB lines are smoother, but still have some variation.~~

Figure 47: The Gray silicone mat being cleaned with tape.



~~*Figure 44: The lens being unfocused.*~~

5. The RGB lines should appear “bowed” evenly across profile and centered in the image (Figure 48). If not check the orientation of the gray mat, it needs to be flat and perpendicular to the camera. This very important!

Figure 48: Grayscale card corresponding RGB Profile visible.

6. Click the **Shading Correction - Flat Method** button. This can take a few seconds, don't click anything else until it is done. The RGB lines should now be flat (Figure 49).

Figure 49: Image grab and profile after the Shading Correction has been applied.

7. Click **Lights OFF** and wait for temperature to decrease below 35 °C.

Pixel Gain Correction

1. Make sure gray silicone mat is flat.

2. Click **Lights ON**

2. Click the **Pixel Gain Correction - Flat Method** button and move the camera very slowly back and forth. This averages the pixels and helps eliminate streaking in the image. This will take several seconds, don't click anything else until it is done. When its done the RGB lines should still be flat and the individual RGB the same, but may not be equal to each other (Figure 50).

Figure 50: Grab and Profile after the Pixel Gain Correction has been applied.

3. Remove the gray mat. Confirm the Camera is in focus by moving it over the cm increments on the grey QP 101 V4 standard and focus the lens by turning it manually if needed.

4. Click **Lights Off.** At this point wait for lights to cool, turn lights back on and check the White square RGB values (243) again and adjust the exposure intervals if needed.

4. Click **Save**. The lights will turn off and the window closes.

5. In the IMS Control panel click **Motion** and then **Drive Enable** (Figure 51). This allows the software to control the camera movement.

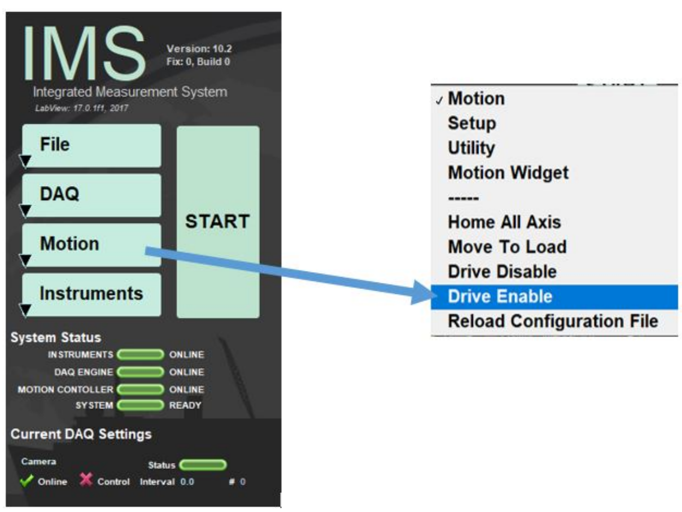


Figure 51: Drive enable control highlighted.

Image Corrections

Note: this section follows the same steps as listed in the **Calibration Check** section above.

Take New Picture

1. Place the 3D calibration standard on track as shown (Figure 52). The color squares must be oriented as pictured below, butted against the red reflection bar.

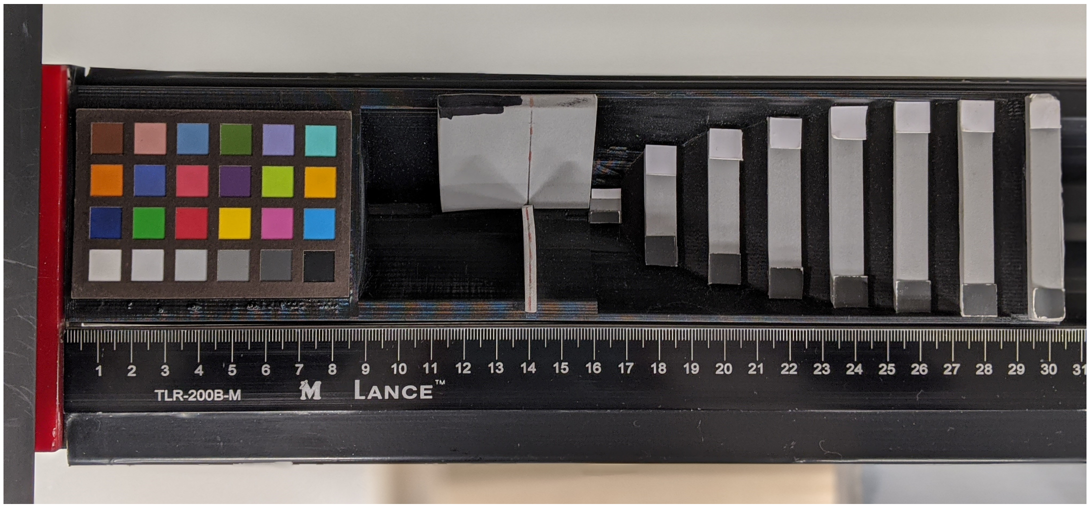


Figure 52: Color standard in track in correct orientation.

2. Open IMS and Click **Start**.

3. Scan the STND Color barcod label (Figure 53b). Check the **ColorChecker Standard** box (Figure 53a). With this box selected no corrections are applied to the image so we are able to assess the raw image quality.

4. Click **Take A Picture**.

5. When the image has finished click **Crop** and then **Save**. We use the uncropped image so the crop here is not important.

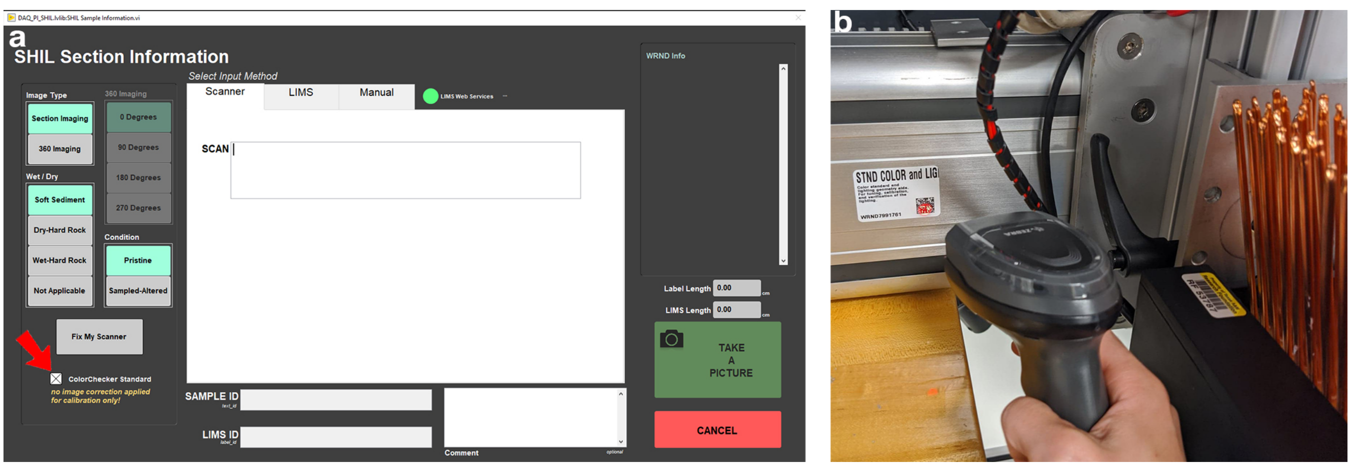


Figure 53: a) sample information screen with ColorChecker box checked, b) standard barcode being scanned.

6. On the main IMS panel select **Instruments** and **Camera: Image Correction** (Figure 54).

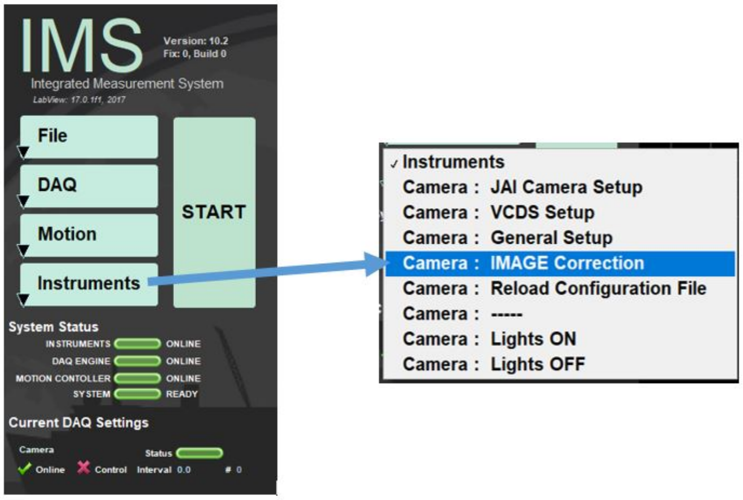


Figure 54: Image Correction command selection.

The main Image Correction window displays three main areas:

A. **Graph panel**: Main graphical viewing area on the left side of the screen.

Uncorrected Tab: Shows the measured Red, green, and blue values of the gray scale color squares.

Applied Corrections Tab: Applies polynomial fit corrections to the RGB lines.

B. **Image Viewing Panels**: Area in upper right portion of the screen that displays the original and corrected test image and color checker with RGB values.

Original: Displays the uploaded tiff.

Corrected: Displays the uploaded tiff with corrections applied.

Color Checker: Displays the known values of the MacBeth Color Checker values

C. **Correction Panel:** Panel in the lower right portion of the screen that allows user to apply corrections to the image

TIFF Correction: Shows tiff red, green, and blue polynomial fit.

JPEG Correction: Shows brightness, contrast, and gamma settings.

Instructions: Shows instructions to follow in this window.

7. Select **Open Test Image** and select the image you just took (Figure 55-1), located in C:/DATA/IN/IMAGE. It does not matter if the JPEG or TIFF file is loaded. The image loads into both the Original and Corrected windows.

8. Draw a ROI box loosely around the color checker in the **Original box** (Figure 55-2)

9. Click **Crop** (Figure 55-3).

10. Draw another ROI box around the Color Checker squares and this time making sure to only have MacBeth colorchecker in the box. White squares will appear inside each square. Adjust the box to get those white squares close to the center of the color squares. Do not click **Crop** again.

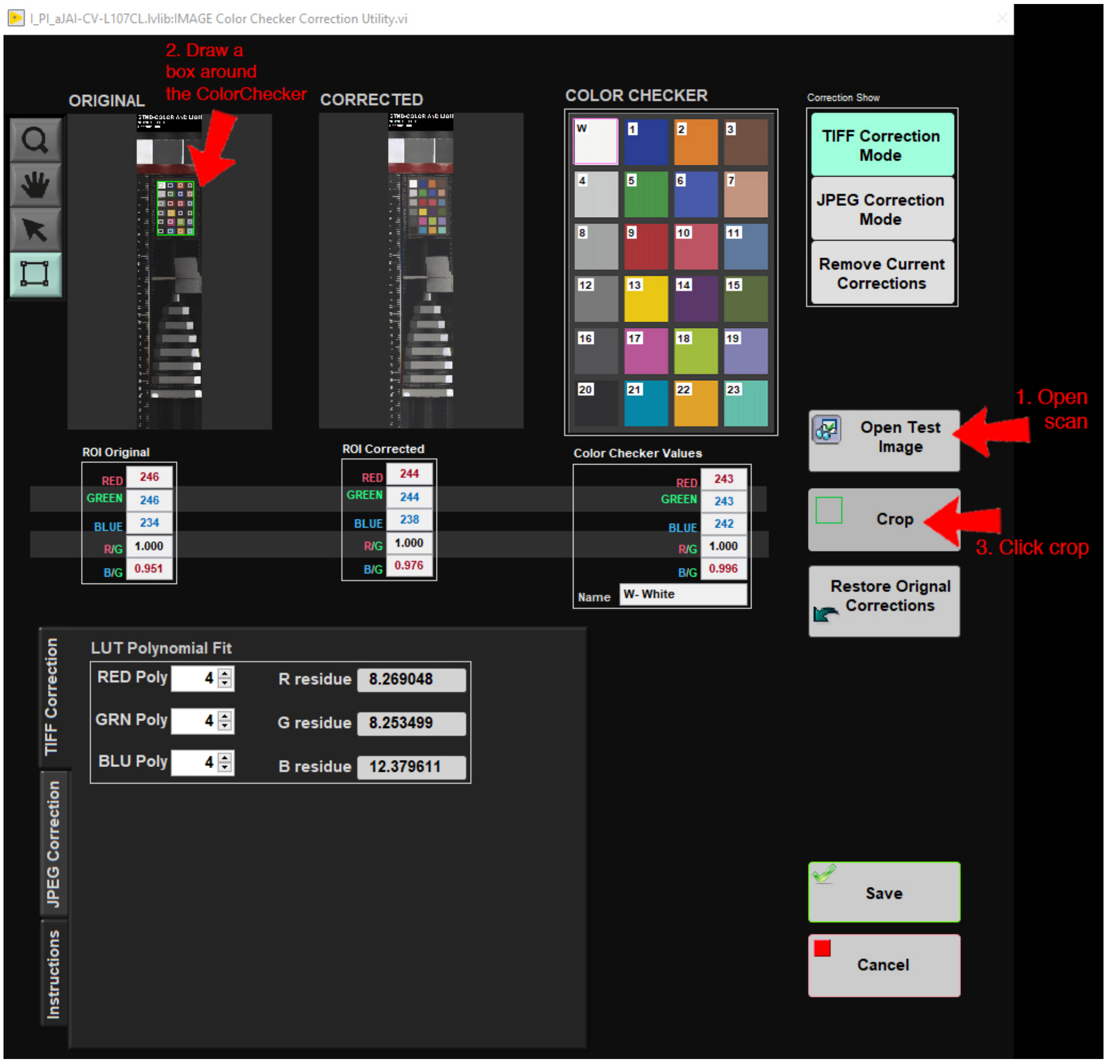


Figure 55: Image Correction Window. Steps are indicated in the figure. New values for Color checker Values, RGB = 242, 242, 236)

Tiff Correction

1. Click **TIFF Correction Mode** (Figure 56-2)

2. Click **Uncorrected Image** tab. This graph shows the measured red, green, and blue values of the gray scale color squares (Figure 56-3).

3. Click **TIFF Correction** tab to adjust the shape of the graph. The goal is to have line as straight as possible (Figure 56-4).

4. In the **Tiff Correction** tab adjust the **LUT polynomial order values** for the **Red, Green, and Blue** channels (Figure 56-5). Adjust these values to create the lowest residual error with the smoothest curve in the **Uncorrected Image** tab. Values should be around 4. Make sure that the curve does not wave about. If it does the order values need to be lowered. Also check that the corrected ROI and MacBeth values should be very close. Make sure that the white does not exceed the MacBeth value (RGB 242, 242, 236). If you are unable to produce a reasonable correction curve, it is necessary to redo your White Balance by Shutter Correction in the **Calibration** section above.

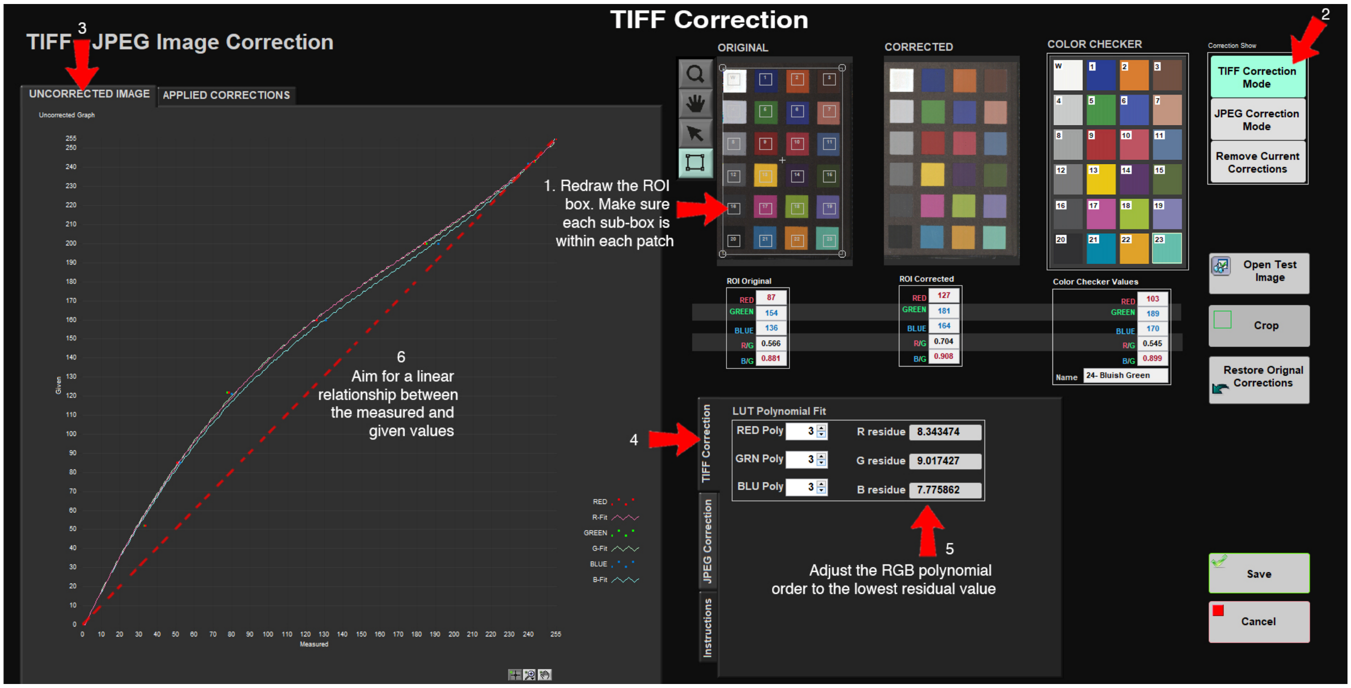


Figure 56: Steps for Tiff Correction illustrated on image. 1. Redraw box on color squares. 2. Select Tiff Correction Mode. 3. Put graph on Uncorrected Image. 4. Select Tiff Correction to view polynomial order. 5. Adjust polynomial order. 6. Check graph for linear relationship.

Note: the **TIFF correction** is applied to both the TIFF and JPEG image but for the JPEG image you can also apply a Brightness, Contrast and Gamma (BCG) correction (See JPEG Correction section below). This is done at the photographer's discretion. With better balanced LEDs on the new light system you may not have to use the BCG corrections (leave the values at their mid-points).

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. Click **JPEG Correction Mode** (Figure 57-1)

2. Click **Applied Corrections** tab (Figure 57-2)

3. Click **JPEG Corrections** tab (Figure 57-3). Adjust the Brightness, Contrast, and Gamma levels (Figure 57-4) to achieve a straight line in the **Applied Corrections** tab and the **ROI Corrected** box should have values near 242 for the white square. We want a linear relationship between the measured and given values. Each BCG setting adjusts the line in different ways and there are many different ways to adjust the values to achieve a linear relationship. You want to achieve a good image with good brightness, where the image has good saturation and not too washed out. The Applied Corrections Graph should be a straight line and the ROI Corrected Box should have values near 242. The BCG may change depending on the instance of extreme colors, extremely white or extremely dark cores, in which the settings may have be tweaked more to get a user friendly consumer image.

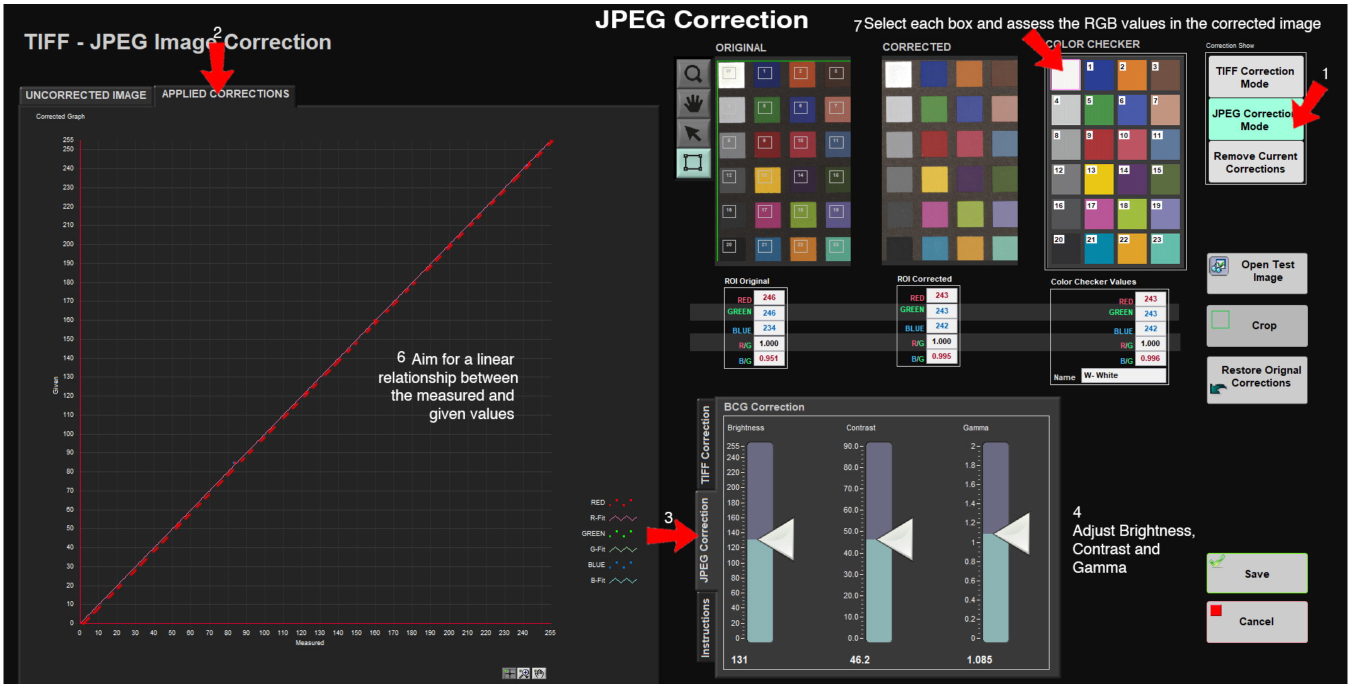


Figure 54: Steps for JPEG Correction illustrated on image. 1. Select JPEG Correction Mode. 2. Select Applied Corrections tab on graph. 3. Select JPEG Correction to see Brightness, Contrast, and Gamma Corrections. 4. Adjust Brightness, Contrast, and Gamma corrections. 6. Check graph for Linear Relationship. 7. Check the boxes in the Color Checker and compare to RGB values in corrected image.

4. If the values all look good and there are no streaking issues in the images or other unwanted artifacts, you can click **Save** and no further adjustments are needed. Calibration is complete.

Check on Calibrated Computer

Check the final scan:

1. To double check your calibration under the same scanning conditions as the scientists see, scan an image of the 3D standard without the **color checker** box selected.

2. Click **Crop** and Click **Save**

3. Copy the image to a shared network folder to view on a calibrated computer screen in the Imaging Office. Images located in the C:/DATA/IN/IMAGE folder.

4. Open the TIFF and JPEG in Photoshop in the Imaging Office (calibrated computer).

5. Visually examine each file you just preformed to ensure the colors, neutrals, mid-tone and contrast are true to the real values, and that the scan is free from artifacts. Use the eyedropper tool in photoshop to see the values of pixels (Fig. ## Figure needs to be added).

Camera Height Adjustment

1. Move the camera so it is just on the edge of the grayscale card at the end on the tray. On this card are mm and cm marks on the edge.

2. Click the **GRAB** button and watch the image as you make slow camera position adjustments until the centimeter lines show up on the image graph as sharp spikes.

3. The graph has two cursors, use the mouse and drag one cursor aligning it with the spike. Take the second cursor and do the same with an adjacent spike. Just above the **Profile** graph there is a control labelled **Pixel Delta** this value should be between 198 and 202 pixels. If not, adjust the camera up and down refocusing after every move until you get within the range. *Warning this can be very tedious!*

METHOD USED FOR HIGH TEMP LIGHTS Color Calibration with the QP 101 V.4 Card. Adjust Exposure (Achieving White Balance by Shutter Correction)

The aim of white balance is to correct the LED's lighting with the Red, Green and Blue sensor's sensitivity to produce neutral values for the QP101 V.4 standard. The exposure intervals we set relate to how long the camera can pick up values for each color band. Try not to keep the lights on for longer than ~ 20 sec and then keep them off for ~60 sec. As the lights warm up the RGB values change, particularly the blue value, and change most rapidly in the first minute of the lights warming up. Since the SHIL is often used after being off for a bit, we are trying to calibrate to represent the measuring conditions, as best we can. Right now we do not have a defined procedure for keeping the lights on/off during calibration and thus suggest 20 sec intervals.

1. Click the **RATES and EXPOSURE** tab (Figure 38-2).

2. On the **Green Lock** control select **OFF** (Figure 38-3). The RGB exposures are now adjustable.

3. Set the Line Trigger Interval until the **Max Image Scan Speed** is 8 to 10 (Figure 38-4). Imaging specialist suggests starting with 8.

4. Adjust values by clicking in the field and typing values or using the up and down arrow on the keyboard. The **Line Trigger Value** must be greater than the **Exposure Intervals** for red, green, and blue.

4. Move the camera carriage over the QP card 101 on the track.

5. Click **Start Grab** (Figure 38-5).

6. Click **Lights ON** (Figure 38-6). You should see the QP card 101 in the live grab window. Remember to only keep the lights on for ~20 sec and then turn off for ~60 sec while preforming the calibration.

7. Draw a green ROI box in the light gray (white) area. Now the Red, Green, and Blue values above the image grab window show the values inside your square. The RGB value of the QP card 101 v4 in the light gray (white) area is 235.

8. Adjust the **Red, Green, and Blue Exposure** times until each value in the live grab window is 235. Remember to turn off the lights regularly!

Figure 38: Rates and Exposure tab with chronological steps on the screen.

Setting the Line Rate (From Older version of User Guide)

The rules:

- Exposure intervals for the Red, Green and Blue channels is a function of the light intensity of the LEDs.
- Led intensity for the three channels is a function of the LED spectrum. Cold lights 65K are very blue while warm lights 55k are reddish. Neutral light is preferred where RGB are nearly equal but all leds are variable. Generally red is the lowest intensity and will require the longest exposure time. That is why in the above procedure we start with red, but you should always start with lowest intensity channel.
- Intensity is also a function of the F-stop. The smallest F-Top is preferred because it gives the greatest depth of focus but also lowers the intensity.
- Intensity is also a function of how closely coupled the lights are to the core surface but for practical reasons we need to keep a minimum clearance for safe operations.
- *Don't forget to check that all of the lights are evenly illuminated or even on. One led can fail without affecting these other. Don't ever look at the leds directly!*
- Line rate must be greater (20us) than the red, green and blue exposure rates set in the above procedure.
- The shorter the line rates the faster the image can be scanned.
- If you move the track faster than the scan rate you will see dropped lines in your 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. *<we need to check how Labview handles this!>*[djh1]	
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. **Call the imaging specialist if the lens needs cleaning. Do not attempt to clean it yourself!**
Monthly	Check socket head cap screws in the camera and lights mounting plates for looseness.
Every Expedition	• 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	• 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: AIcontroller.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 it's 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).

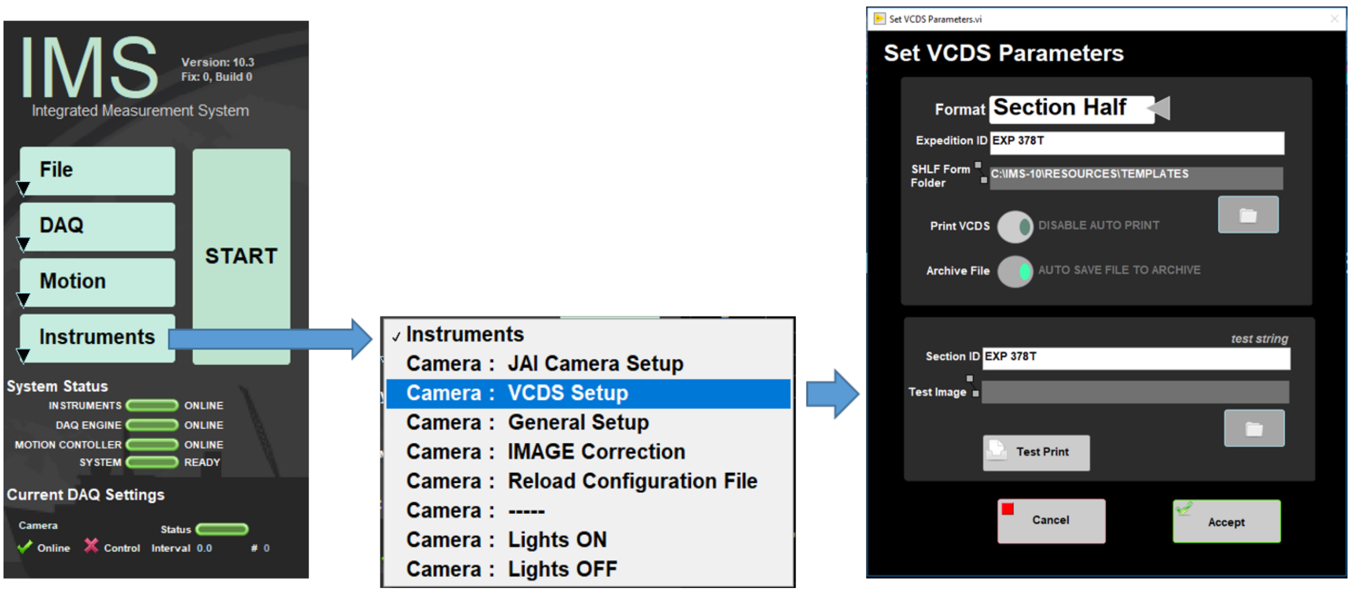


Figure 19. Select VCDS Setup

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).

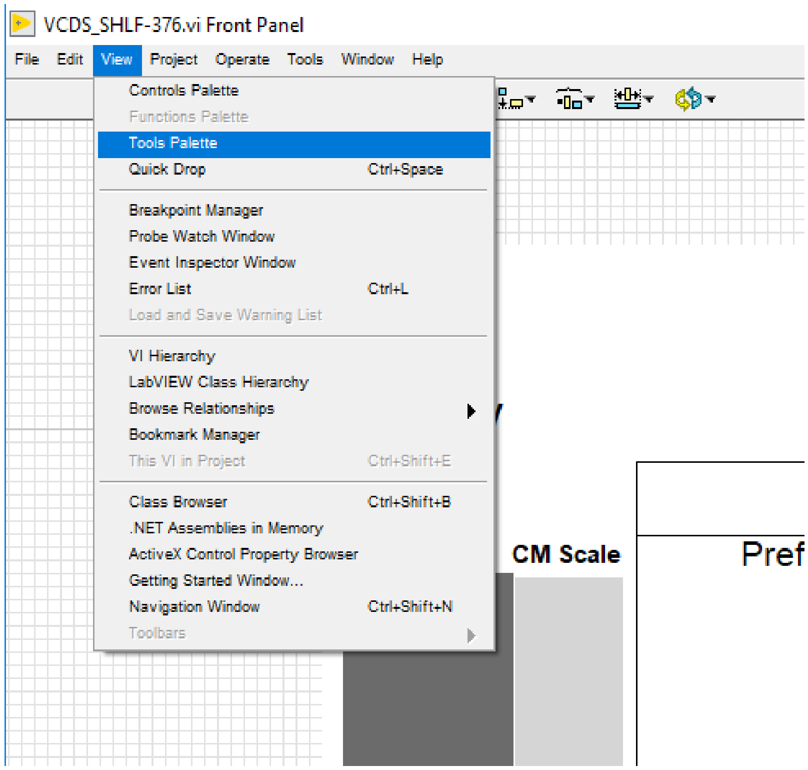


Figure 20. Select Tools Palette on LabVIEW

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

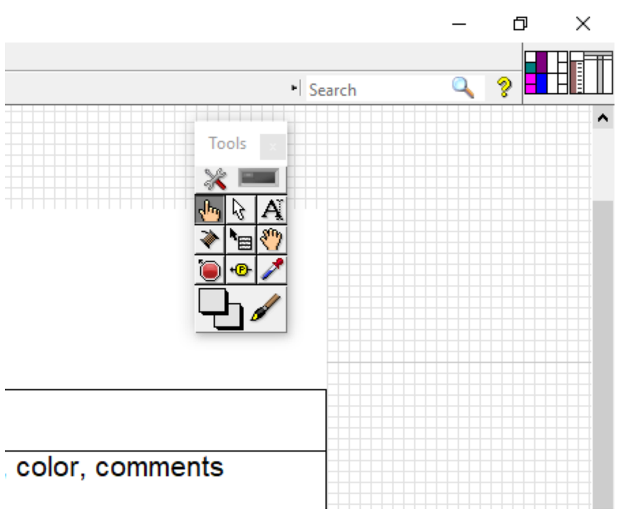


Figure 21. Tools Palette window

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-SHILUserGu...20-1516-374.pdf