Section Half Imaging Logger: User Guide

Manual Information

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Contents

Introduction

The section half image logger (SHIL) takes digital images of the flat face of split cores using a line scan camera. 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>> 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 Installation).
- Setting black and white saturation gain levels (see Maximum Dynamic Sensor Range).
- Setting color balance **[Author: Where is this covered?].**[djh1]
- 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 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)
- Barcode imager: Microscan model MS-4 with USB hub
- Robot modules: NSK 2-meter model XY-HRS200-F06246[djh2]
- PC Workstation
  - NI frame grabber card model PCIe-1429
  - NI camera link I/O extension board

Software

Data are collected using the LabVIEW 8.2 application DigitalImaging v0.0[djh3].

Sample Preparation & Analysis

Core imaging takes place in the Core Description Laboratory on board the ship. The workflow is as follows:

1. Preparing samples (***Sample Preparation***).
2. Preparing track system (***Instrument Preparation***).
3. Calibrating the system (***Calibration***).
4. Running samples (***Running Samples***).
5. Analyzing data and uploading to LIMS (***LIMS Integration***).

Sample Preparation

Sediment Cores

After whole-round core sections are split into archive and working halves in the splitting room, use a flat spatula to scrape the flat face of the archive half section to provide a “clean” surface for imaging.

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 Cores

All 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.

If the user wishes to image the outside surface of….[djh4]

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[djh5]

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. See **<LINK>** **[Author: Where is this procedure documented?]** for details on this procedure.

Running Samples

1. Ensure that the track gantry is clear of obstacles for the entire length of its linear actuators and that camera height is adjusted so that 20 pixels = 1 mm.
2. After the section has been split and prepared either by scraping or scrubbing, place the section on the rails with the section top against the stop by the color standard tiles.
3. Rotate the section/hard rock pieces along their lengths so that the split surface is approximately perpendicular to the axis of the camera lens.
4. Click **Scan** on the computer screen and verify that the barcode information has decoded correctly.
5. The 2D barcode includes the original length of the section. If the section is now longer due to expansion then enter the new length manually.
6. If you are satisfied that all information is correct then hit **GO**.
7. The section will be imaged. If the image is satisfactory, select the **Ends of Material Points** > **Save**, [djh6]and a virtual label with section identification will attach to the saved image while the concatenation endpoints are recorded to the LIMS.
8. Otherwise, press **Discard**, correct any problems, and scan the image again.

LIMS Integration

Sample and Analysis Components[djh7]

Analysis Code	Component	Description
IMAGES	adapter_mag	
	adapter_tube	
	comment	
	compound_field_of_view	
	contrasting_method	
	dimension_horizontal	

	dimension_vertical	
	file_create_date	
	filename	
	filesize	
	filters	
	illumination_type	
	light_source	
	objective	
	objective_field_of_view	
	objective_mag	
	ppi	
	total_magnification	
	tube_field_of_view	

Uploading Data

After section is imaged, select the **Ends of Material Points** > **Save**, and [djh8]a virtual label with section identification will attach to the saved image while the concatenation endpoints are recorded to the LIMS.

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.

Maintenance & 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

Issue	Possible Causes	Solution
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!>*[djh9]	
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[djh10]. 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.[djh11]

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.

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[djh12]

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