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**GEOTEK**  
**Digital Core Imaging**  
**Users Manual Update**

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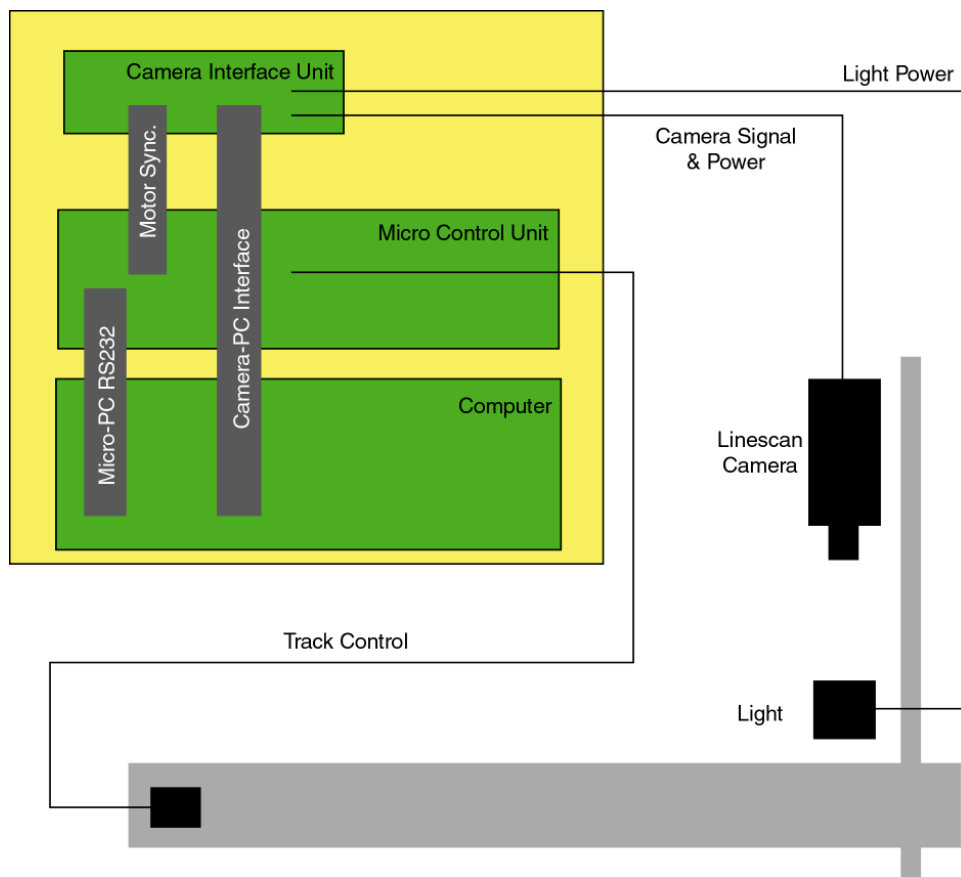
# 1. Electronic and Control Systems

A schematic diagram of the electronic systems is shown below. All the electronics and computer system are mounted in an integrated 19" rack and consists of a power supply unit and microprocessor track control system, a camera interface and a computer.

The computer has a minimum specification of a single processor 1GHz Pentium III, with 512 MB RAM, 20GB hard drives, a CD drive, a network card, a video card with minimum 8MB Video RAM, and is installed with the Windows 2000 operating system. All systems are designed for shipboard use, with vibration-mounted hard drives and cards.

The diagram below shows the connections between the PC, the camera control unit and the track control unit.

Synchronisation between the camera and the track is achieved by using the stepper motor pulses to trigger the line acquisition of the camera. Since each motor pulse corresponds to a fixed amount of track movement it can be seen that the camera images a line across the core at precise spatial intervals down the core. This means that there is no optical distortion from the lens or variation in lighting in the down-core direction, a very important factor for high-resolution studies.



# 1. Software operation

## Power-On Procedure

The camera system can remain powered up continuously. If the system has been switched off, the camera (black controller box) should be switched on first. The camera should be allowed to warm up for at least one hour before calibrating or collecting images. The software, Camera.exe, can be found in the Geotek folder or on the Start menu under Programs/Geotek MSCL/Geotek Digital Imaging System.

## Main Menu

On launching the application a start menu appears. It contains three options:

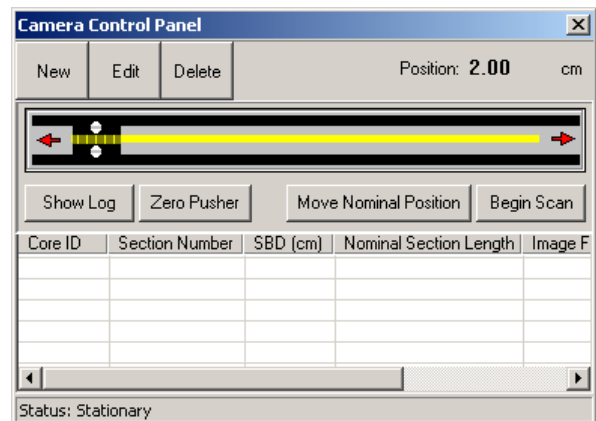
- Acquire Image**.....(see 1.1)
- Set Up**.....(see 1.2 and 1.3)
- and Exit** .....which quits the program.



## 1.1 Acquire Image

This brings up the main track/camera control panel where the user enters the core sections to be logged and removes the core sections that have been logged. The options available are New (see 5.1.1), Edit (see 5.1.2), Delete (see 5.1.3), Show Log (see 5.1.4), Zero Pusher (see 5.1.5), Move Nominal Position (see 5.1.6) and Begin Scan (see 5.1.7). Click Close Box (x) in the top right corner to exit.

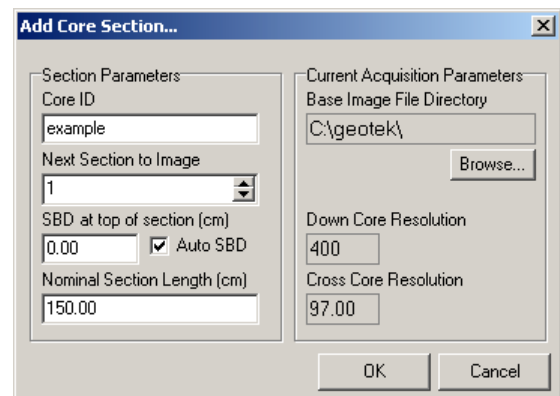
This camera control panel shows an imaging queue at the bottom, where all core sections currently entered are shown.



### 1.1.1 New (Core Section)

This adds a new core section to the imaging queue. Cores can be added at any time during the imaging process.

Most fields default to the last entry. Section Number defaults to the last entry plus one, and SBD (sub-bottom depth) Top of Section defaults to the last entry plus the length of that core section. The base image directory sets the directory structure where the image files will be stored.



### 1.1.2 Edit (Core Section)

Allows the user to edit the section parameters already entered. Click on the section to be edited and then click on the edit button, or alternatively double click on the section in the list.

### 1.1.3 Delete (Core Section)

Allows the user to delete the section. Click on the section to be deleted and click on the delete button.

#### 1.1.4 Show Log

This shows the entire log of imaged core sections and calibrations.

#### 1.1.5 Zero Pusher

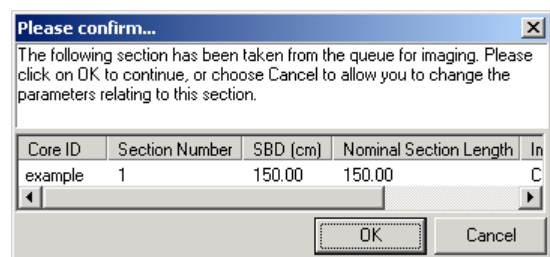
Finds the laser reference point.

#### 1.1.6 Move Nominal Position

Moves the pusher to the nominal section length of the next section in the queue.

#### 1.1.7 Begin Scan

Start track moving and collecting images. The image collection is tied to stepper motor pulses. Imaging of a section must be completed once begun, but imaging can be halted once a section has been completed by removing all other sections in the imaging queue. While scanning, core sections can be added and edited and the Log can be shown.



An image of the core section being scanned is show in a companion window. This image is scaled to the screen and is used for monitoring progress.

## 1.2 Basic Set Up Menu

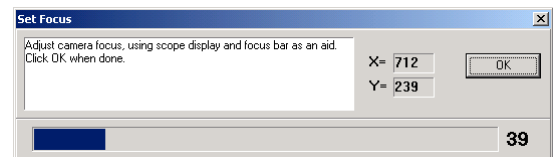
This menu contains five options. The first three are procedures that may be used quite frequently:

- Set Focus** (1.2.1)
- Set Aperture** (1.2.2)
- B & W Calibration** (1.2.3)
- Advanced Set Up** (1.2.4)
- Close** returns to the Main Menu



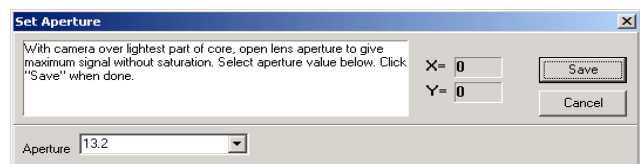
### 1.2.1 Set Focus

This assists the user in focusing the camera in the plane of the split core surface using a focus bar (shown at bottom of window) and the RGB Scope window (see 2.4.1). Focusing should take place on a subject that is in the same plane as core sections to be imaged and has sharp transitions (edges). Aperture (see 2.2) will affect the depth of field and the need for refocusing.



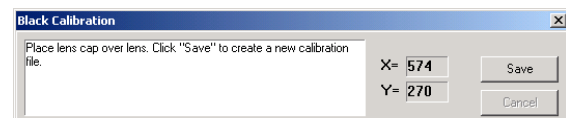
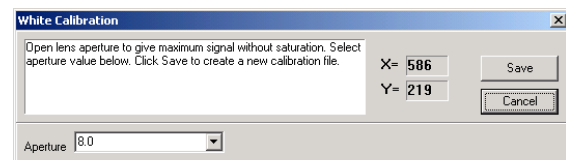
### 1.2.2 Set Aperture

Writes the chosen Aperture value to the settings (.ini) file. Aperture should be selected using the output of the RGB Scope (see 2.4.1) such that the scope output is as large as possible without flattening at the upper values, indicating saturation of the CCD.



### 1.2.3 B & W Calibration

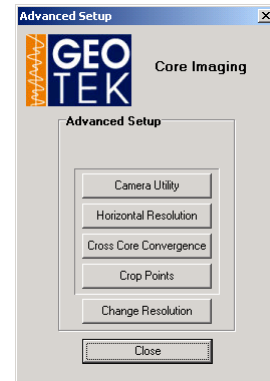
This procedure writes calibration files containing the black and white calibrations for each element in the CCD. This ensures that all CCD pixels are scaled to the same black (minimum) and white (maximum) values. White calibrations are performed on a special white ceramic tile and integrated for an amount of time. The camera travels a short distance across the tile to remove the effects of any dust on the tile. This white calibration will be a function of aperture and scan speed. White calibration aperture does not have to be the same as the scanning aperture, but both of these apertures are very important to the accurate replay of the images and must be accurately noted by the user using the pulldown menus in the White Calibration and Set Aperture (see 2.2) dialogs. Black calibrations are performed with the lens cap on. Data is collected for few seconds and averaged.



## 1.3 Advanced Set Up Menu

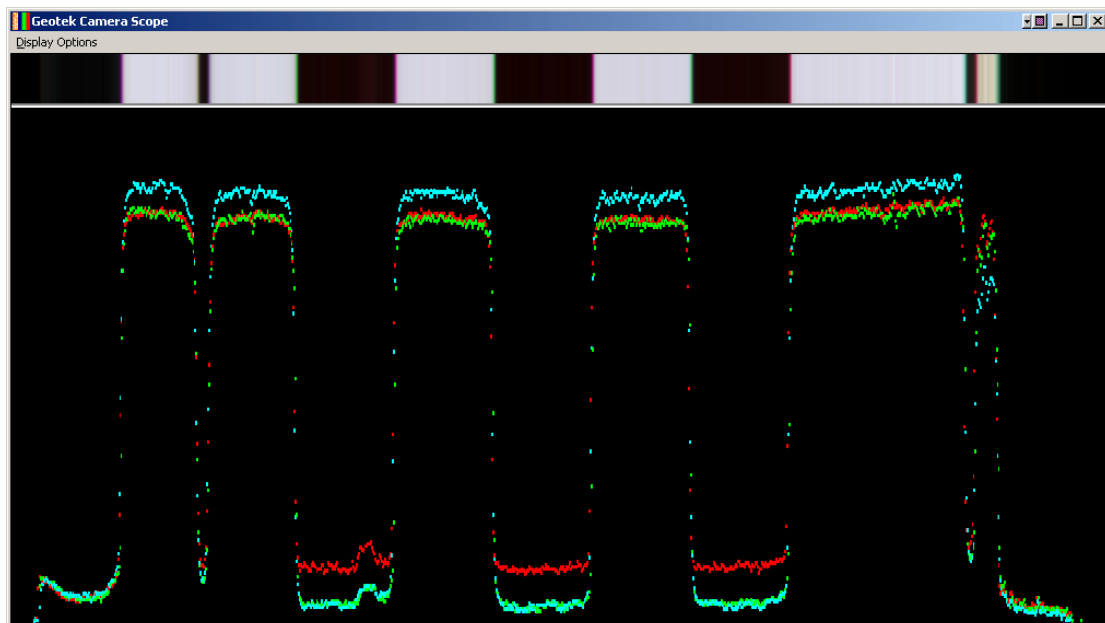
This menu contains options that are likely to be used relatively infrequently and normally by experienced operators:

- Camera Utility** (1.3.1)
- Down-core Resolution** (1.3.2)
- Horizontal Resolution** (1.3.3)
- Cross-core Convergence** (1.3.4)
- Crop Points** (1.3.5)
- Close** returns to the **Basic Set Up Menu**



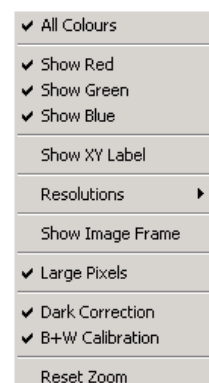
### 1.3.1 Camera Utility

The Camera Utility provides direct access to two useful tools: the RGB Scope (oscilloscope) and the Camera Control Panel. Both of these tools are also displayed in most of the set up and calibration screens where their function is essentially the same.



**The RGB scope** monitors the output of all 1024 elements of each of the 3 CCDs (red, green, and blue). The window shows the output of the red, green, and blue channels on the bottom and the linescan image (repeated for better visibility) at the top. The scope can be resized as requested (bottom righthand corner). Dragging an area on the scope from top left to bottom right can enlarge portions of the scope and corresponding linescan view. Dragging in reverse, from bottom right to top left, will reset the zoom.

The Display Options menu allows customization of the scope. The options are:



- All Colours: This forces the scope to display RG&B channels.
- Show Red (Green, Blue): Toggles individual channels on and off
- Show XY Label: Displays the X (pixel No 1-1024) and Y value (0-255) of any location on the scope.

Resolutions:	Set the number of pixels displayed across the scope.
Show Image Frame:	Shows yellow frame corresponding, in the horizontal, to the edges of the image (removing the permanently dark pixels at the left) and in the vertical to 0 and 255.
Large Pixels:	Doubles the size of the scope pixels on the screen for easy viewing.
Dark Correction:	Toggles the correction applied from the permanently dark CCD pixels to compensate for thermal noise and other environmental effects.
B & W Calibration:	Toggles the corrections applied to each pixel from the Black and White Calibration files.
Reset Zoom:	Returns the scope to full view. Areas can be enlarged by selecting and clicking. Maximum zoom is 20x in either dimension; if this value is exceeded zoom will not proceed.

**The Camera Control Panel** allows the operator to move the pusher within the software by either dragging the pusher to the desired location or using the nudge arrows provided.

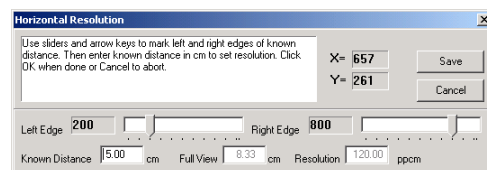
### 1.3.2 Down-core resolution

The down-core resolution is a function of a number of parameters but is controlled by the line acquisition rate as synchronised to the stepper motor. Consequently it is not a continuous variable but is a multiple of the smallest step distance. This is currently 0.01 mm (1000 ppcm, pixels per cm) which means that in theory the down-core resolution could be any multiple of 0.01 mm. In the standard operational mode the down core resolution will be set at 0.1mm (100 ppcm).

### 1.3.3 Horizontal (Cross-core) Resolution

The cross core resolution is controlled by the lens and the height of the camera above the object but of course is limited to 1000 pixels wide. If the full width were used then the cross-core resolution on a 9 cm wide core would be 0.09 mm (111 ppcm).

To reduce the cross core resolution to match that of the down-core resolution the user simply has to raise the height of the camera so that it is imaging a full 10cm providing the 100 ppcm cross core resolution.



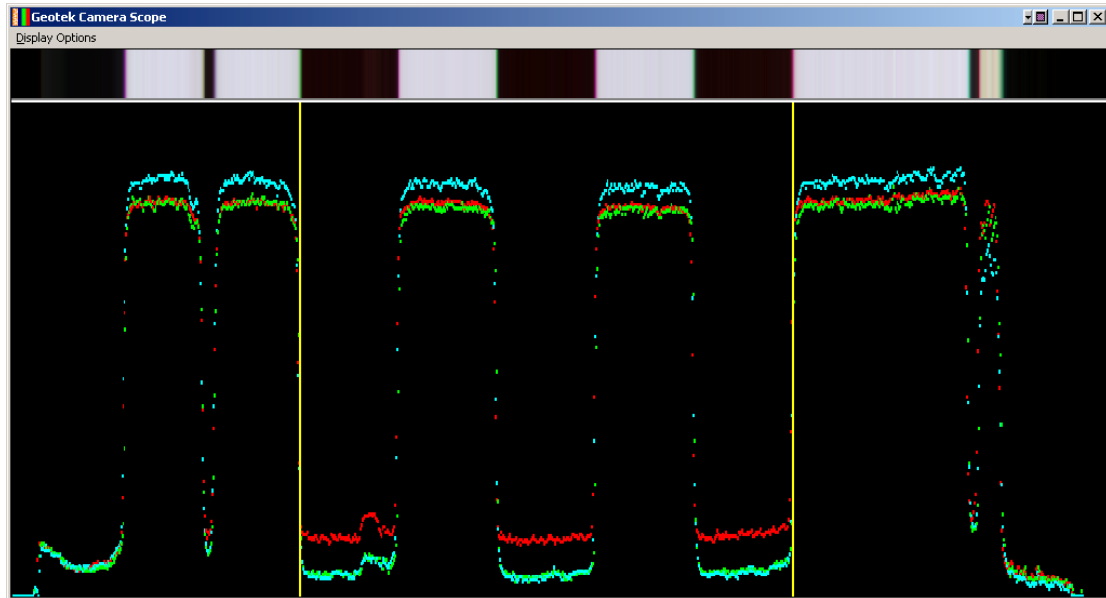
The software contains a feature to crop the additional image on either side of the core.

Since the cross core resolution depends on the distance between the camera and the object imaged, or practically, the camera height. The resolution is determined by placing something of known dimension under the camera at the height of the core surface.

To determine the cross core resolution the user should use the sliders and arrow keys in the control panel to move the left and right yellow lines on the scope to the known edges. Zooming in on the scope window can be helpful. See illustration.

The user should enter the known distance (in cm) and the software will automatically calculate the full view and the cross core resolution.

To set a predetermined cross core resolution (for example if the user wishes to adjust the camera so that the cross core resolution is the same as the down core resolution, ie 100 ppcm) then the user should follow the procedure below.

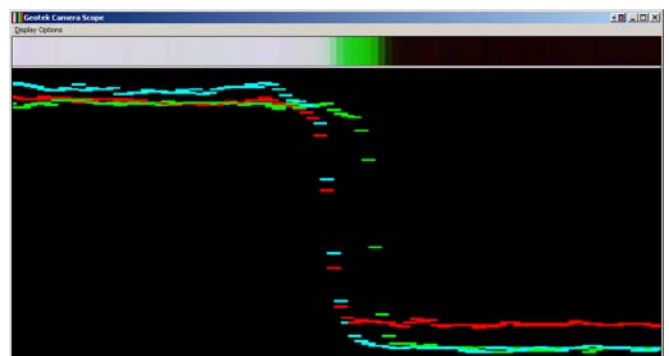


- Place an object of known width at the core surface level (say 5cm wide).
- Enter 5 cm in the known distance and set the left and right yellow markers at a difference of 500 pixels (eg set the left edge at 200 and the right edge at 700). This will produce a resolution of 100 ppcm. Now adjust the camera height and focus so that the image fits exactly between the yellow marker lines. An iterative procedure of moving the camera, focusing and moving the object will be required.

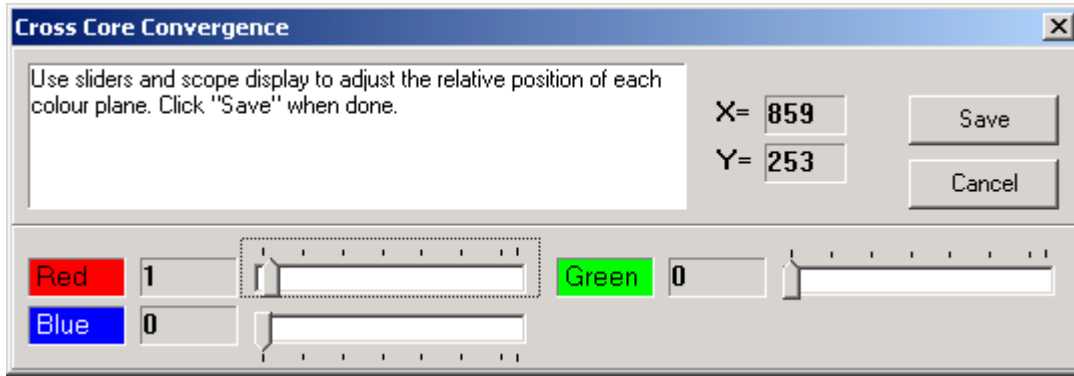
### 1.3.4 Cross-Core Convergence

The cross core convergence facility enables the user to check and adjust any Y axis misalignment in the 3 RGB colour planes. To do this the user should view on the scope a black to white edge and observe the transition in each colour. They should of course occur at the same pixel no.

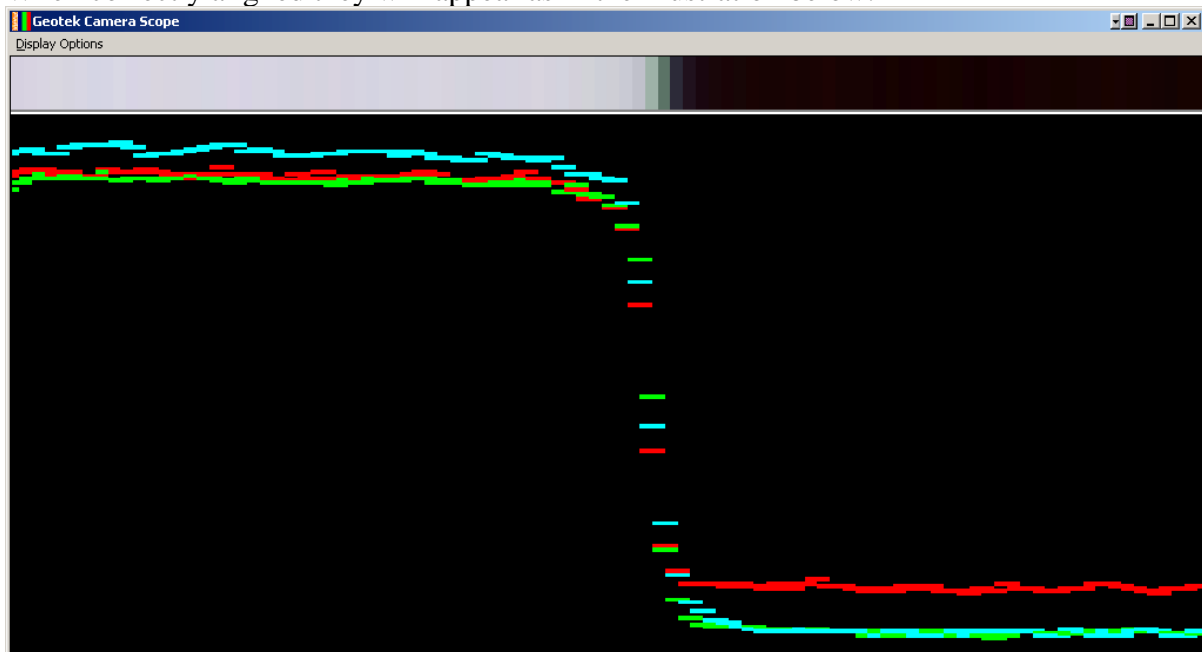
The user can adjust the position of each colour transition by using the colour sliders on the control panel.







When correctly aligned they will appear as in the illustration below.



### 1.3.5 Crop Points.

This option allows the user to discard data at the edge of the CCD array, for example if a particular cross-core resolution is required then this may leave parts of the image without any useful data in. The data that is not recorded to file is simply saved as black pixels.

## 2. Settings File

The settings file is a simple text file that can be edited with caution by the user. It contains a number of parameters that are used both directly by the user and automatically by the software to control the imaging acquisition. The table below provides a comprehensive list of these parameters together with brief explanations of their purpose.

Category	Comments	Parameter	Further Parameter Explanation
[General]	# Camera type	Camera=1	** Manually entered by operator ++ Automatically updated by Software ** Sets camera type enabling newer camera hardware compatibility
		SerialPort=2	** Serial port number

Category	Comments	Parameter	Further Parameter Explanation ** Manually entered by operator ++ Automatically updated by Software
		CameraMode=X	**Type of track system
	# Save Directory	ImagePath=c:\geotek\	** This defines the location where the image files will be automatically stored at the end of each image acquisition (at the end of each section).
	# Last entered section		These parameters are automatically updated
		CoreID=example	++ Self explanatory
		SectionID=1	++ Self explanatory
		NominalSectionLength=150	++ Self explanatory
		ImageAperture=22.0	++ Self explanatory
	# Calibration Parameters	CalibrationAperture=8.0	++ Aperture at which white calibration was last collected
		CalibrationX=3.00	Not used
		CalibrationY=30.00	Not used
		CalibrationDistance=6	** X travel distance (cm) for white tile calibration
		CalibrationTime=8	** Time for white calibration (s)
		IntegrationTime=20	** Time for each line acquisition (ms) normally 20 - DO NOT CHANGE
		IntegrationControl=0	** Enables integration times to be changed – NOT YET IMPLEMENTED
	# Current Camera Position	CameraX=1.00	++ Self explanatory
		DownCoreResolution=100.00	++ Self explanatory
		CrossCoreResolution=100.00	++ Self explanatory
[Red Convergence] [Green Convergence] [Blue Convergence]			Convergence correction parameters which refer to the relative alignment of the 3 individual RGB colour planes. There is one set of parameters for each of the 3 colours.
		X=1	++ Cross core (X) convergence (pixels)
		YLow=0	++ Down core (Y) convergence (pixels) at low resolution (100 pixels per cm)
		YMed=0	++ Down core (Y) convergence (pixels) at medium resolution (200 pixels per cm)
		YHigh=0	++ Down core (Y) convergence (pixels) at high resolution (500 pixels per cm)
		YMax=0	NOT USED
[Xcamera]		LaserOffset=6.8	** Position of the laser sensor on the track
		CameraOffset=5.2	** Position of the camera on the track
[Table]		LeftPixel=50	++ Left Crop Point
		RightPixel=950	++ Right Crop Point
[Tray1]		Length=150	** Length of track