Chapter 2 - Operation

Operation

This chapter contains the information necessary to operate the standard functions of the *Stereoscan 430*. The structure of this chapter is as follows:-

- Overview of the user interface
- Operation of the instrument
- Customisation of the user interface

In many cases additional information on a given topic is available within the on-line help mechanism. It is good practice to refer to it when a difficulty with the user interface is encountered (see Section 1.2 *Windows*$_{TM}$ *and How to Use Help).*

2.1. User Interface Description

2.1.1. The Menus

The following text is a brief outline of the functions provided on the main menu bar. Details of how these options are used is included in the Instrument Operation section of this chapter.

Some of the options listed below only appear if the system is switched into ***Expert*** *mode (selected on the* ***File*** *menu).*

File

The file menu provides options to:-

- Select the user directory
- Restore and load states (including the last state and the standard state)
- Import and export images
- Select **Novice** or **Expert** mode

View

The view menu provides the means to allow the user to control the appearance of the user interface. This includes options to:-

- Display the image as full screen or quarter screen
- Select which planes are to be displayed (Windows, Image and Overlays)
- Toggle the toolbar on and off
- Display a Status window and/or a Datazone

- Assign the current control parameters to a Navigation Box

Beam

The beam menu provides options to:-

- Turn the beam on and off
- Select the gun and column control panels and parameters
- Control the *Optibeam* operating mode
- Identify the current aperture and check whether it is appropriate for the current operating conditions

Detectors

The detectors menu provides options to:-

- Select and configure the detectors assigned to the current zone
- Adjust the collector bias

Image

The image menu provides options to:-

- Assign the signal level and magnification parameters for mouse control
- Select the noise reduction and signal mixing panels
- Freeze or Unfreeze the current zone
- Apply beam shift and centre points of interest on the image.
- Display a histogram or a line profile of the current image

Edit

The edit menu provides options to:-

- Edit save and load the display LUT
- Edit save and load the toolbar
- Select the pressure units for the vacuum level display
- Select annotation and measure mode

Scanning

The scanning menu provides options to:-

- Select the scanning speed
- Select the scanning mode (Normal, Reduced, Split or Line scanning)

Stage/Vac

The stage and vacuum menu provides options to:-

- Inspect the vacuum status
- Control the beam and vacuum system to perform a specimen change
- Initialise and move the motorised stage (if fitted)

Tools

The tools menu provides options to:-

- Select the macro editor
- Define the magnification table
- Specify the links between certain functions
- Go directly to any system control panel

Help

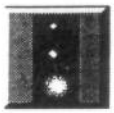
The help menu provides information on topics related to the control of the *Stereoscan 430*. Items on the menu include:-

- An introduction to using help (Help on Help)
- Help with the Leo interface (Leo Help - F1)
- Help with special keys used by the interface (Keys Help - F9)
- The Release Notes for the version of software currently running

2.1.2. The Icons

The icons in the standard toolbar provide a set of operations associated with the left and right mouse buttons. It is possible to modify the arrangement of icons and actions (or even to define completely new toolbars) using the toolbar editor (see Section 3.7.4 *The Toolbar Editor*).

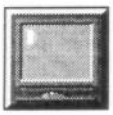
The icons described in this section are those for the novice toolbar. Selecting Expert Mode will cause a more extensive set of icons to appear. Context sensitive help can be used to examine the functions associated with each icon.



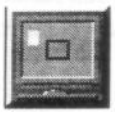
Icon: **Run Up**
Left: Executes the Restore Conditions macro
Right: Previews the Restore state

Icon: **Filament Current**
Left: Assign Fil I(M)
Right: Selects the Gun Align Panel

Icon: **kV/Probe Current**
Left: Assigns EHT and Probe Current to the mouse
Right: Selects the Gun Set Up Panel



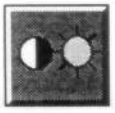
Icon: **Normal Mode**
Left: Selects Normal scanning
Right: Selects the Scanning panel



Icon: **Reduced Mode**
Left: Selects Reduced scanning
Right: Selects the Signal Adjust panel

Icon: **Scan -**
Left: Decrements the scan speed (pixel averaging)
Right: Selects the Scanning panel

Icon: **Scan +**
Left: Increments the scan speed (pixel averaging)
Right: Selects the scanning panel



Icon: **Signal**
Left: Assigns Brightness and Contrast to the mouse
Right: Selects the Signal Adjust panel

Icon: **Mag/Focus**
Left: Assigns Magnification and Focus to the mouse
Right: Selects the stigmation panel

Icon: **Noise Reduction**
Left: Assigns N (number of frames to average) to the mouse
Right: Selects the Noise Reduction panel

Icon: **Photo**
Left: Initiates an image record sequence
Right: Selects the Image Export panel

Icon: **Stigmation Correction**
Left: Assigns Stigmator X and Y to the mouse
Right: Selects the Stigmation panel

2.2. Instrument Operation

2.2.1. Specimen Handling and Vacuum Control

The routines described below are required to get the specimen into the chamber, under vacuum and in the right position to be scanned by the beam. In addition some less frequent operations such as changing the filament and installing the anode spacer are also included here.

2.2.2. Changing the Specimen

The beam must be switched off before opening the chamber for a specimen change. Proceed as follows:-

1. Select the drop-down box for beam state in the toolbar.
2. From the list, choose **Beam Off**.
3. A message will be displayed to show that the filament current is being decreased before the state Beam Off is displayed.

Alternatively:-

1. From the menu **Stage/Vac**, select **Specimen change**
2. A control panel will be displayed from which the beam can be switched on and off and the chamber vented or pumped.

When Beam On is selected, the beam conditions used when Beam Off was selected are restored.

Before loading a specimen into the specimen chamber, the chamber must first be brought to atmospheric pressure by selecting **Vent** in the vacuum status drop-down box in the toolbar. Safety interlocking of high voltage supplies results in the Vent

command being disabled unless the beam is first switched off. To open the chamber and change the specimen:-

1. Ensure that the beam is off (indicated in the toolbar). If it is not, switch it off using the previous routine.

2. Vent the chamber using the drop-down box in the toolbar.

3. When the chamber is at atmospheric pressure, the door can be pulled open.

4. Remove the previous specimen, if there is one, by loosening the small locating screw holding the specimen stub in position. Note, any one of a variety of specimen holders may be in use - however, they are all held in position with a small locating screw. To loosen the screw, use the smaller of the two ball-ended drivers provided.

5. Insert the new specimen and tighten the locating screw.

6. Close the chamber door.

7. Select **Pump** from the drop down box in the toolbar. The pumps should now start.

8. Within 5 minutes, depending on the specimen and the length of time the chamber was left open, the vacuum status should reach Ready. This is indicated both in the toolbar and in the vacuum status panel, obtained using keyboard key V. If vacuum is not achieved within this time, see Section 2.2.6 *Getting a Vacuum.*

9. Resume specimen examination by selecting Beam On.

Some stage movement may be required to locate the specimen area requiring examination

2.2.3. Specimen Handling

Cleanliness of all items to be placed within the vacuum system is essential. Anything that has any oil or grease on it must first be cleaned with solvent, preferably using an ultra-sonic bath. Anything to be handled should be done so using lint free gloves to avoid contaminating it with finger grease. Failure to do so will eventually cause a degradation of the vacuum and resultant contamination of the sample over the area being examined.

Specimens should normally be fixed to a stub prior to loading onto the stage within the chamber. The sample can be fixed down into the stub by the use of conductive glue, either carbon or silver. It is also possible to use conductive double sided sticky tape. If this type of tape is used there is the possibility that the sample may move very slightly during examination, this may become apparent at high magnifications or if the sample is heavier than normal.

The ideal sample is one that is electrically conductive as no other preparation is required. However if the sample is non-conductive such as plastic or a biological sample the operator must decide whether or not to coat the sample with a conductive layer. The subject of specimen preparation and the selection of operating conditions is covered in Chapter 3 *Advanced Operation*.

2.2.4. Changing the Filament

Whenever the filament blows, or is otherwise open-circuit, a message is displayed on the screen to inform the operator that the filament has blown.

When a new filament is installed the New Filament parameter must be updated. This is shown in the **View->Status** or **Gun Set Up** dialog box.

To change the filament:-

1. Admit air to the column and chamber and open the gun. Remove the emitter assembly by loosening the three locating screws holding the emitter assembly in place, close the gun and pump down the system.

2. Take the emitter assembly to a clean area for cleaning and reassembly.

3. Place the assembly on a clean sheet of paper with the grid aperture downward. Using the flat metal key unscrew the height adjusting ring. As this is done the filament will move away from the grid.

4. Grip the filament pins with the tweezers provided and lift the filament assembly out of the grid cap.

5. Release the filament clamp screws (visible in the four large holes) and, using the tweezers, lift out the filament.

6. If the cathode assembly or grid aperture is not excessively contaminated a new filament can be fitted. If any contamination is present, dismantle the unit and clean the components, paying particular attention to the inside of the grid aperture. This must be free of all contamination and particles.

7. Using the tweezers, put the new filament into the filament holder, first ensuring that the pins are clean. Align the filament legs with the marks and ensure the ceramic is centralised when tightening the filament clamp screws. Do not overtighten as this can cause the ceramic to crack when the filament becomes hot.

8. Replace the filament assembly in the grid cap. Replace the height adjusting ring and screw it down until it touches the sleeve.

9. Adjust the filament height and centralising as described below.

To adjust the tip position:-

1. Using a low power magnifier and a good source of illumination, ideally a stereo zoom microscope, look through the grid aperture hole and locate the filament tip. It may be necessary to adjust the height adjusting ring to move the filament forward so that the tip can be seen. Do not move the tip forward so that it touches the grid.

2. As soon as the tip can be seen through the grid aperture hole, adjust the filament centralising screws to centre the tip in the grid hole. Set the height adjusting ring so that the tip of the filament is level with the front face of the grid aperture.

3. When in this position the tip is inside the hole in the grid, so care must be taken to ensure that the tip is correctly centred before adjusting its height.

4. Now turn the height adjusting ring back one and a quarter turns anticlockwise, as viewed from the adjusting ring end of the assembly. The filament height is now correct at 0.6mm.

The gun will require re-aligning after running up again because the tip will not be in exactly the same position that the previous one was.

2.2.5. Installing the Low kV Anode

The acceleration voltage range of the *Stereoscan 430* is 300V to 30kV. Although the instrument may be operated over the entire acceleration voltage range with the normal high kV anode installed, better gun geometry and brightness and hence better instrument performance is usually obtained with the anode lifted towards the grid whenever an acceleration voltage of 3kV or less is selected. This is achieved using the low kV anode, as follows:-

1. Admit air to the gun. Open the gun.
2. Lift out the anode.
3. Fit the low kV anode.
4. Select **Low kV anode** in the Gun Setup panel

This automatically restricts the acceleration voltage to 3kV.

5. Close the gun, pump down, select the desired low voltage and obtain an image.

The *Stereoscan 430* should not be used at an acceleration voltage higher than 3kV with the low kV anode fitted. It is important to ensure that the state of the anode parameter reflects the state of the machine.

2.2.6. Getting a Vacuum

If the vacuum ready state is not achieved after several minutes of pumping, the following guidelines provide an ordered approach to diagnosing the problem.

Investigating a vacuum leak, few simple rules:-

1. Before looking for a vacuum leak give the vacuum system time to pump. If you have just changed a specimen in a very humid atmosphere the pump down may take longer. If the specimen is wet it may take several minutes (up to 1 hour with a very large, very wet specimen has been known.) If the stage has been left open for long periods it will take longer to pump. If the column or chamber have been washed with solvents then it may take several hours to achieve a good vacuum.
2. Vacuum leaks rarely happen by themselves; they are often caused. If you have just done anything to the column or chamber then that is the most likely cause of the leak. If the specimen has just been changed, check the stage door 'O' ring. Similarly if the filament has been changed check the gun 'O' ring.
3. The most frequent cause of leaks is dust or fibres on 'O' rings. 'O' rings may be cleaned with a fluff free tissue. 'O' ring grease should never be used. Grease traps fibres and may cause leaks.
4. Do not use any metal tools to remove 'O' rings from their grooves. A small scratch in the bottom of a groove causes a big leak.

5. If the pump down is slow, check the air admittance drier and renew the desiccant before looking for a leak.

If none of the above point to the cause of the leak, refer to Section 5.5 *Looking for Vacuum Leaks.*

2.3. Electron Gun and Column

2.3.1. Setting Filament Current and Aligning the Beam

Filament Setting

Optimum performance of the SEM is achieved only after saturation and alignment of the electron gun. The gun runup function sets the filament current at the value it was last set, so it is important to keep a check on this as the filament ages and after large changes to accelerating voltage, so that its working life is maximised.

The above conditions can be achieved by selecting the **Filament Current** icon and slowly increasing filament current (having selected **manual** brightness control) while observing the points at which maximum brightness occurs. The two peaks of maximum brightness correspond to the two saturation peaks.

Using the arrows at each end of the Filament current scroll-bar, adjusts the saturation point (or second peak see Figure 2.1) usually occurs at about 2.75A for a new filament. If "first peak" operation is required, reduce the filament current to about 2.25A . Operation at this point gives reduced resolution but much longer lifetime.

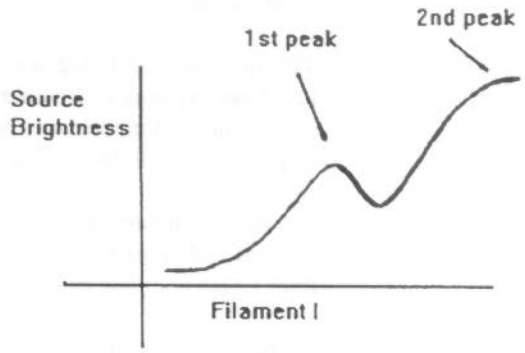


Figure 2.1

*If the filament current is increased beyond 2nd peak saturation, no advantage is gained but the life will be **considerably** shortened (the emission profile also does not change for currents higher than saturation point).*

Check filament saturation about once a day. Saving conditions when you close down ensures that new values of filament current will be used when you restart the system.

Beam Alignment

The beam is correctly aligned down the column when the brightness level of the signal cannot be increased any further (ensuring the system is switched to manual brightness control) by an adjustment of the gun align screws. These are moved as opposite pairs where one is slackened and the other screwed in. Both pairs should be adjusted against each other until the signal brightness is at a maximum. It may be necessary to check the filament current after this adjustment.

2.3.2. Setting EHT and Probe Current

Accelerating Voltage

The accelerating voltage and probe current can be assigned to the mouse buttons from the **Beam** menu. Whenever the accelerating voltage is changed it is important to check that the beam and the final aperture are correctly aligned.

In addition to adjusting these parameters with a mouse it is possible to double click on the parameter display (in the toolbar) which will bring up a dialog box allowing the value for the selected parameter to be entered from the keyboard (this applies to any parameter assigned to the mouse).

The accelerating voltage must be set for the type of specimen under examination:-

- For low atomic number or beam sensitive specimens, choose a voltage between 1kV to 5kV
- For high atomic number specimens, a voltage of 25kV to 30kV is normal
- For atomic numbers in between (say 20 to 50), a voltage of 10kV to 20kV is best
- For X-ray analysis, the voltage is dictated by the elements under analysis

The subject of selecting appropriate operating conditions for the specimens is explored further in Chapter 3 *Advanced Operation*.

Probe Current

The probe current effectively controls the spot size of the beam on the specimen. *Optibeam* Auto Resolution mode (selected on the **Beam** menu) sets the probe current to give the best resolution. If auto resolution is left on then changes in magnification will result in changes of probe current, so it is advisable to enable auto brightness.

Further guidance on selecting the correct probe current is given in the Advanced Operation chapter.

Optibeam

The *Optibeam* program takes the requirements for probe current, working distance, etc and determines the optimum lens settings to achieve the best performance from the column. Usually the best performance is defined as the highest resolution, but *Optibeam* can be told to optimise for the greatest depth of focus instead. This is done by selecting **Depth Mode** on the **Beam** menu.

2.3.3. Adjusting the Aperture

Optimum imaging can sometimes depend on the correct choice of aperture size. The internal software model, *Optibeam*, continually calculates the best setup for the selected aperture, however it will sometimes recommend using a different aperture. This message is displayed in the **Beam->Apertures** menu, as **Recommended Aperture =.** If preferred, this information can be displayed automatically on screen by switching off **Suppress Aperture Warning**.

The three apertures installed (sizes as displayed in the Apertures menu) are all located on the Y axis of the aperture changer mechanism. To reach another aperture, simply rotate the Y control either clockwise or counter-clockwise according to the direction of the required aperture.

As the control is rotated, the signal will disappear as the current aperture moves out of position. The signal returns as the next aperture moves into position, however there will either be much less or much more signal according to the change in aperture size. For this reason, it is sometimes easier if auto brightness is enabled during the change.

Having located the aperture in position, click on the "radio button" next to the new current aperture selection and **OK** the menu. This ensures that *Optibeam* will continue to achieve the best column performance.

Finally, it is necessary to make a fine adjustment to the aperture position to ensure that it lies exactly on the electron optical axis. Select a focused field of view at

about 1000x and switch on focus **Wobble** under the **Beam** menu. The speed and amplitude of the wobble can be adjusted from the operating panel that appears, and should be adjusted so that the change of focus of the image can be easily followed. This requires a fast scan speed, and preferably reduced raster.

*Reduced mode can be automatically enabled with focus wobble in the **Links** menu under **Tools**.*

Carefully adjust both X and Y controls until no **lateral** movement of the image can be seen during the focus wobble. Switch off focus wobble.

If adjusted carefully, preferably just after gun alignment, further aperture alignment adjustments can be avoided except when large changes in either probe current, working distance or accelerating voltage are made.

2.3.4. Setting Focus and Magnification

Focus

When the focus is adjusted the parameter controlled is Working Distance, which can also be set directly by double clicking on the Working Distance display in the toolbar. *Optibeam* uses the working distance value to set the lens currents to achieve the required focusing. If *Optibeam* is not active the focus is adjusted by controlling the C3 lens current directly.

Auto Focus

Auto Focus is initiated by the **F** key on the keyboard. The algorithm uses a portion of the image to select the best focus. By default this is the centre of the image, but the user can adjust this by selecting **Focus Area** on the **Image** pop-up menu. The right mouse button cancels adjustment of focus area.

If a large change in working distance is made, then it is recommended that the **Remove Hysteresis** function (F2) to ensure the accuracy of the magnification and probe current values.

Magnification

Before describing how to adjust the magnification, it is important to understand the precise definition used on the *Stereoscan 430*. Each output device (HRRU, video printer, etc) is calibrated and the magnification relates to the selected output device. So the magnification for a video printer is larger than that for an HRRU (because the print is larger). The process of calibrating an output device is described in Section 2.6.

Like many other parameters magnification can be adjusted by assigning control to the mouse. In addition the magnification control window can be selected from the **Mag/Focus** option of the **Image** menu. Due to the wide range of available magnification, the window is divided into two parts. At the top is the coarse scale bar which presents a logarithmic scale, with a green marker indicating the mid range value of the lower fine scale bar. The required scale is selected with the mouse, the nearest graduation to the cursor will become the fine scale centre.

Because the green marker only indicates the range centre it only changes position when there is a range change.

The fine scale bar presents a linear portion of the magnification range. The red marker indicates the current magnification, which is also display in the caption area in the magnification control window. The required magnification is simply selected on the lower control bar.

A further facility for setting the magnification is provided by the mag table which can be accessed using the **F4** and **Shift F4** keys. The table is defined by selecting **Mag Table** on the **Tools** menu. Each non zero entry is active and pressing F4 will step the magnification through the values defined in the table. Pressing Shift F4 returns the magnification to the value it had before the first selection of F4.

If the word 'LOW' is entered in the mag tab, the magnification will be set to the lowest value achievable when that entry is selected.

Low Mag

If the word "LOW" is placed in a mag table entry, selection of that entry will cause the magnification to be set to the lowest achievable value. Subsequent changes to other electron optic parameters may cause this low value to change.

Stigmation

High resolution images can only be obtained after correct adjustment of the stigmators. Astigmatism (non-roundness of the beam) is caused by microscopic contamination within the column charging up and applying an asymmetric field that affects the focus of the beam usually in one direction. It can be corrected, if not too serious, as follows:-

1. Select the Stigmation panel by pressing the Stig icon with the right mouse button.

2. Choose a suitable field of view at about 5kX to 10kX containing a round feature.

3. Focus normally to optimum focus so that the feature does not "smear" in any direction.

4. Select the reduced raster icon and, using the **Beam Shift** function in the Stigmation panel, bring the feature to the centre of the reduced raster.

5. Press **Stigmation** in the navigation box and adjust for best focus.

6. Repeat 3 and 5 as necessary.

Alternative methods are provided:-

A Press **Auto Stig** in the Stigmation panel.

B Press **Dynamic Stig** and, using the mouse pointer click on the region of best image focus using the left mouse button.

C Press the Stig icon with the left mouse button and adjust the Stig X and Stig Y parameters as normal parameter adjustments with the mouse.

It is a good idea to align the aperture correctly before adjusting stigmation.

It is generally considered easier to adjust just one stigmation area axis at a time. The best way to do this is to use the scroll bars for X and Y adjustment picking up the scroll box with the mouse and dragging it to find the best stigmator setting.

2.3.5. Adjusting Beam Shift

Beam shift appears as an option on the Stigmation panel. Selecting it allows the beam shift to be controlled from the navigation box on the panel. The beam shift function allows a small amount of movement across the specimen and can be used at high magnifications where it is impossible to position the specimen with the stage.

The beam shifts are also used in the **Centre Point** Function on the **Image** menu. Centre point can be used to bring any point of interest to the centre of the screen (if it is within the range of the beam shifts). Select **Image->Centre Point** and the click on the image feature required.

The beam shifts can be zeroed by selecting the **Home** key on the keyboard.

2.4. Imaging and Image Processing

2.4.1. Adjusting Signal Level

Signal level can be adjusted manually or automatically. Automatic signal adjustment is controlled from the Signal Adjust panel (right mouse button on the Signal Level icon).

Manual

The signal level can be adjusted using the brightness and contrast controls assigned to the mouse with the signal level icon. If more than one zone is displayed, then the detector controlled is the detector assigned to the current zone (which is indicated by the anchor symbol). The concept of zones will be described in the Section 2.4.2 *Scanning Modes*.

Auto Signal Level

The Signal Adjust panel provides the controls for the auto signal level functions. Brightness and contrast can also be controlled directly from this panel using the slider bars labelled accordingly.

There are two types of auto signal level function which each operate in two ways. The auto signal level function will either control the **Mean** signal level or the **Peak** signal level. The mean signal level is defined as being the average brightness of all the pixels in the image, while the peak level is defined as the brightness of the brightest part of the image.

Peak and mean signal level controls each operate in two ways. The **Find** function is a single shot activation which sets the peak or mean to the level defined in the associated Auto Video slider bar. The **Keep** function activates the auto video function to maintain the video level (peak or mean) of the image at the time of selection.

Typically the Find function will be used to set the required video level if the image is a long way from the required brightness. The Keep function is useful when the content of the image is likely to change, for example if the stage is being moved across a specimen with distinct light and dark phases, or if the probe current is being adjusted.

Auto video control can be disabled at any time by selecting the **Auto Video Off** button.

2.4.2. *Using Scan Modes*

Before considering the different scan modes available, it is necessary to define some terms which will simplify the whole issue of scan modes, signals and Windows.

The Zone

The basic concept underlying all the display and scanning modes it that of a **ZONE**. A zone is an area of image store which can be mapped onto part of the image window. In normal imaging only one zone is used, but for split or quad modes two or more zones are required.

Inputs

Associated with each zone are two input signals **A** and **B** which can be selected from the list of detectors configured on the system. The full chain of processing is shown in Figure 2.2.

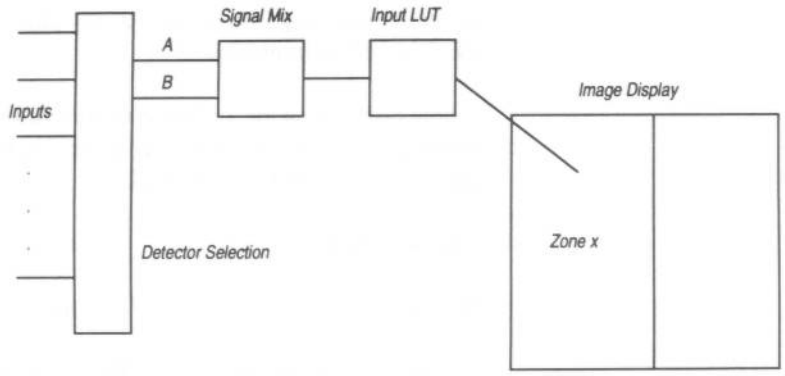


Figure 2.2

The signal mixing and Input LUT can be adjusted by the user if the appropriate software option has been purchased, otherwise the default settings will apply (no mixing, output = input LUT).

The Anchor Symbol

When working in a display mode with multiple visible zones the anchor symbol will appear.

It signifies which zone on the display is the current zone. This is important because many operations act on the current zone, these include:-

- Detector selection
- Frame averaging
- Freeze and unfreeze

In addition to these, the signal level controls adjust the settings of the detector assigned to the current zone.

It is easy to select a new zone to be the current zone. Select the anchor symbol with the mouse and drag it to the new zone. Thus whichever zone the anchor is in is by definition the current zone.

Double clicking on the anchor symbol will select '**All Zones**' (denoted by a blue border to the symbol). When 'All Zones' is selected any zone specific function will apply to all the zones on the display.

Scan Rotation

This allows electronic rotation of the image by rotating the scanning of the beam.

Scan Rotation is selected from either the **Scanning** menu or from the Scan Rotate icon in the Expert Toolbar. It is switched on and off using the **Scan Rot** check box on the Rotate/Tilt panel.

The angle of rotation can be adjusted using the slider bar on the Rotate/Tilt panel, or by assigning control to the mouse (using the Rotate icon). It is also possible to enter the exact value by double clicking on the rotate value on the Rotate/Tilt panel.

Scan rotation can be used to set the orientation of an image to the desired angle without having to rotate the specimen. Care should be taken when using stage controls while scan rotation is active as the actual direction of stage movement will not correspond to the screen axes.

Split Screen

In split screen mode (selected from the **Scanning** menu), the image area is divided into half with a different zone being displayed in each part. Different detectors can be assigned to each zone and each zone can be frozen independently of the others.

Quad Mode

When quad mode is active (also selected from the **Scanning** menu), four image zones are visible, each occupying a quarter of the image window. The anchor symbol is used to select the current zone. Normal scanning can be returned to by selecting the Normal icon, or by selecting the **Normal** option from the **Scanning** menu.

Reduced

When adjusting focus or stigmation, it is often convenient to use the Reduced function to increase the frame rate without having to increase the pixel rate. **Reduced** is selected from the icon or the **Scanning** Menu.

2.4.3. *Detector Control*

The detector controlled by the brightness and contrast functions is determined by the detector assignment to the current zone. A detector is assigned to a zone using the **Select Signal A** field in the **Detector** menu. Selecting this field displays a list of the available detectors from which the required detector can be selected.

Each zone has its individual detector assignment, so in quad mode as many as four different detectors could be displayed. The detector controlled by the signal level functions is determined by the current zone, although if that detector is assigned to more than one zone then more than one part of the quad image may be affected.

It is possible to set up different auto signal level controls for different zones. If there is a conflict between two zones which have the same detector assigned to them, then the first zone with that detector will take precedence.

Collector Bias

The Collector Bias can be assigned to mouse control from the option in the **Detectors** menu. It can be varied in the range -250V to +400V. For normal operation of the secondary electron detector this value should be set to maximum.

Four Quadrant BSD

The four quadrant back scattered detector has a configuration panel dedicated to it, which can be selected from the **Detectors** menu. Each quadrant of the detector can be in one of three states (**Off, Normal or Invert**). When normal the signal from that quadrant is added to the total signal, when inverted the signal is subtracted. Clicking on the quadrant fields allows each one to be configured as desired.

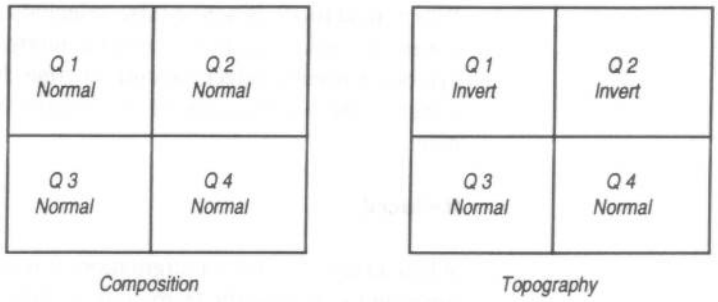


Figure 2.3

Two predefined configurations of quadrants are available to set the detector to give best performance for composition (Compo), that is atomic number contrast, or surface topography (Topo). Selecting these predefined configurations will set up the detector quadrants according to the diagram above.

There are two other fields on this panel. The Four Quadrant BSD: Gain field indicates which range the amplifier is currently on, it is set automatically from the signal level controls and need not be changed by the user. The Four Quadrant BSD: Fast field selects the bandwidth from the detector, it should be set to FAST for normal visual scan rates and to SLOW for slower scan rates and photo recording.

2.4.4. Scan Rate and Noise Reduction

Scan Rate

There are 4 scan rates available as standard on the *Stereoscan 430*. They are represented by the Pixel Average parameter which can have values 1, 4, 16 or 128. The scan rate is usually changed using the scan rate icons, but there are also options on the **Scanning** menu and on the Noise Reduction panel to do the same.

Noise Reduction

The Noise Reduction panel is selected with the right mouse button on the Filter icon. It allows the type of noise reduction to be selected (Line average or Frame

average) as well as the number of lines or frames the averaging is to be performed over. In addition the freeze options allow the current zone to be frozen or unfrozen. The **Freeze At End** option freezes the zone when the image acquisition has completed (determined by the number of frames in frame average, or just 1 frame if line average is selected).

There is one important difference between line and frame average. In line average mode the same noise reduction is applied to all the active zones. But for frame average it is possible to set different frame counts for each zone.

The use of noise reduction is explained further in Chapter 3 *Advanced Operation*.

2.4.5. Live Line Scanning

The **Line** option on the **Scanning** menu selects live line scanning. In this mode a single line of the image is scanned repeatedly and a profile of that line is displayed. The rest of the image is frozen during line scanning and a line cursor is used to select the line to be scanned.

The profile's appearance is controlled through the pop-up menu associated with it. The following fields are used:-

- **X Scale** - determines the width of the profile (displays every nth pixel)
- **Y Scale** - determines the height scaling of the profile
- **Static/Active** - Determines whether the profile is redrawn at the end of each line scan

Selecting normal scanning will deselect line scanning.

One special case of live line profiling exists when the system is also in split screen scanning. In this mode two traces are displayed on the profile, the usual white trace represents zone 0 and a red trace represents zone 1 (the left and right hand sides of the image respectively).

2.4.6. Spot Mode

Spot mode is selected from the **Scanning** menu. On selection the image is frozen and a crosshair cursor appears to indicate the beam position. The cursor may be moved by dragging with the mouse. Selecting normal scanning deselects spot mode.

2.4.7. Histograms

Selecting the **Histogram** option on the **Image** menu displays a grey level histogram of the image, that is a bar chart showing the number of pixels at each grey level. A pop-up menu controls the appearance of the histogram with the following fields:-

- **Bin Width** - Sets the width of each bin on the display
- **Height** - Sets the height of the histogram display
- **Source** - Selects the source of the histogram data
- **Sample, Start and Stop** - Control the updating of the histogram data

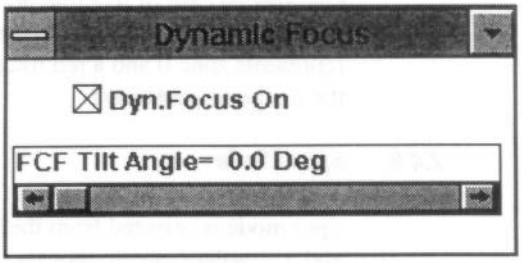
The source can be defined as either the stored image, the current zone or a specified zone. If the stored image is selected then the histogram data will only be updated when the **Sample** option is selected. If the data source is a zone, then the **Start** and **Stop** options control the updating of the data. The source of the image is important because stored data has been processed by the input LUT and the noise reduction, whereas the zone data is entirely unprocessed.

On the histogram display there is a red cursor which may be positioned by the mouse, the selected bin number and its contents are displayed below it (B and N respectively).

2.4.8. Dynamic Focus

The dynamic focus licence enables the dynamic correction of focus within the frame for tilted specimens.

The dynamic focus control panel is displayed by selecting Top Menu - scanning - dynamic focus.



The Dynamic focus function is switched on/off using the checkbox on the panel.

The FCF (Frame Corrected Focus) Tilt angle is the angle of tilt about the middle of the image frame (i.e. about a horizontal line mid way down the image). The procedure is as follows:-

- Switch on Dynamic Focus

- When Dynamic focus is switched on the scan rotation is automatically switched on, this should be set to 0 degrees so that the angle of tilt goes down the frame
- If the specimen is itself tilted adjust the scan rotation so that the angle of tilt is down the frame
- Adjust the focus so that the middle (horizontal) is in focus
- Adjust the FCF Tilt Angle so that the top and bottom of the frame is in focus

2.5. Annotation and Measurement

The annotation and measurement functions are accessed via the image pop-up menu (press right mouse button while over the image area). To get the annotation menu select the **Annotation** option, then press the right mouse button again to bring up the annotation pop-up menu. This menu can now be used to do any of the following:-

- Display a user defined datazone
- Place annotation text on the image
- Display a system parameter on the image
- Place a magnification marker on the image
- Perform point to point or linewidth measurement
- Save or load a file of annotation objects

When in annotation mode the image window title bar displays additional information concerning the annotation state. Annotation mode is deselected when the Adjust option is selected from the pop-up menu and also when a parameter is assigned to the mouse for adjustment.

Before considering how the annotation menu is used to achieve the above effects, it is important to clearly define some concepts upon which the annotation system is built.

Annotation Modes

There are three annotation modes **Move**, **Edit** and **Delete.** The current mode is indicated in the title bar at the top of the image window. In move mode an item can be selected and dragged to any position on the screen. Edit mode allows the contents of text strings to be edited, but the precise edit operation depends on the kind of object selected. Delete mode is used to remove any annotation object selected.

The annotation mode is set using the **Mode** option on the pop-up menu.

Annotation Objects

An annotation object is any item which is displayed on the image which is contained in the overlay plane. Turning the overlay plane on and off from the **Planes** field of the **View** menu will cause any annotation objects to appear and disappear. There are several different kinds of annotation object, including:-

- Text
- Parameters
- Panels
- Measurements

The use of each of these objects is described below.

Panels

A panel is a special kind of annotation object in that it is essentially a collection of other objects. Panels provide a convenient way to manipulate a collection of other annotation items, in fact a datazone is a panel although it does have a special status within the annotation system. Panels are created from the **Annotation->Panel** field on the menu, then other annotation objects can be moved into them. A panel can be locked (using the **Panels->Lock** option) which prevents the selection of objects within the panel and means that any operation will be on the whole panel. Panels can be moved by dragging with the mouse and resized by selecting and dragging the edge of a panel in edit mode.

A special type of panel can be selected from the annotation menu ***Annotation->ZPanel****, these are Zone Panels. A zone panel will display parameters which relate to a particular zone display. Please refer to the on-line help text for further information concerning zone panels*

2.5.1. Datazone

The datazone can only be displayed on a full screen image. It is selected using the **Datazone** field on the **View** menu.

The datazone is normally not part of the annotation system and is therefore not affected by annotation operations. In particular it is not removed when the **Reset** option is selected from the pop-up menu (which removes all other annotation objects from the display). However for the purposes of customising the datazone it can be brought into the annotation system. This is done by selecting **Panels->DZone->Edit** from the menu and results in the datazone becoming a panel in the annotation system. It can then be unlocked (**Panels->Unlock** and select on the panel) to allow its contents to be edited.

A new customised datazone can be created from any panel by selecting **Panels->DZone->Install** and selecting on the panel in question. This operation takes the panel out of the annotation system and saves it in the user directory as the file DZ.ANN. The default datazone file is not overwritten, but any previous user defined datazone will be.

When the datazone is displayed the system looks for the file DZ.ANN in the user directory and if it does not find one there, it looks in the LEO directory for the system default.

2.5.2. Annotation Files

A file of annotation objects can be saved as either a panel, or a complete set of annotation. To save a panel, select **File->Save** and click on the panel to save. A file dialog will then appear to allow the file name to be entered. To save a set of annotation, make the same menu selection, then click on any part of the image. Again a file dialog will prompt for the file name.

There is a small difference between loading panels and sets of annotation. If a set is loaded (by selecting **File->Load**), it replaces any existing annotation (except for the datazone), whereas if a panel is loaded, it is merged in with the existing annotation.

2.5.3. Text Annotation

To add text annotation to an image, select **Annotation->Text** from the pop-up menu. A dialog box then appears which allows annotation text to be defined. The actual text is entered in the scrollable text window, foreground and background colours can be selected, as well as text fonts and styles. It is also possible to add a μ symbol or any other special character available in the selected font.

When the text has been typed select OK on the dialog and the text will appear on the image. To move the text to the desired position, select and drag it with the mouse (move mode must be selected to do this).

If it is necessary to change some existing text, it can be edited by selecting it in edit mode. The text dialog then reappears with the selected text already in the text window.

Special Characters

The μ symbol is probably the most common non standard character required for annotation, so a panel button has been dedicated to it. Selecting this button will insert the μ character into the text string at the cursor position. Other special characters are available from the special character scroll box. The characters are

scrolled until the desired character is displayed, then the Insert key is selected to place it into the text string.

Text Attributes

The foreground and background colours for the text can be set by selecting the appropriate colour panel (this does not change the system defaults, only the current text string). In addition the font and style of the text can be modified. The fonts available are:-

- Leica 29
- Leica 24
- Leica 16
- Arrows 31
- Arrows 25
- Maths 24
- Maths 16

The μ character is only available in the Leica fonts.

Each text string is a single font. Mixed strings can only be achieved by placing two or more strings of different fonts next to each other on the image. It is recommended that all annotation and measurement is performed in full screen mode (using the large fonts). If quarter screen mode is selected, then the small fonts will be substituted for the large ones, but the proportionate sizing is not exact and may cause the text to change size or position slightly.

The style of the text reflects the way in which the foreground and background colours are used to display text. The different selections available are:-

- Unbacked Normal - Text on a transparent background
- Backed Normal - Text on a solid background colour
- Halo - Text with a transparent background but with a single pixel halo of background colour
- Unbacked Bold - Bold text on a transparent background
- Backed Bold - Bold text on a solid background colour

Pins and Links

It is possible to indicate the area of the image referred to by some text by using pins and links. Both these objects are selected from the Annotation menu. A pin is a round dot which can be placed anywhere on the image. A link is a line which can be attached between any two annotation objects (usually one is a pin). If either object attached to a link is moved, then the link will be redrawn to follow the shortest line between the two objects.

Attributes

Each object displayed by the annotation system has a set of attributes which describe the way in which the object is displayed. For each attribute a default can be set up using the **Attributes->Defaults** menu. When an attribute has been changed, existing annotations can be made to reflect that change by selecting edit mode and selecting **Attributes->Modify Item** and clicking on the appropriate object. All existing objects can be made to reflect a change by selecting the **Attributes->Modify All** option.

The set of attributes available are:-

- Text Font
- Text Foreground
- Text Background
- Text Style
- Panel Colour
- Line Style
- Line Width
- Line Colour

Clearly some of these attributes only apply to a subset of the objects displayed by the annotation system.

2.5.4. Parameters

A display of any system parameter can be placed as annotation on the image. These options are selected from the **Annotation->Analogue** and **Annotation->Digital** options which each display a list of available parameters. When displayed the parameter's value text is updated as the parameter changes.

Time and Date

In addition to the system parameters, it is also possible to display the time and the date as annotation objects. They are selected directly from the Annotation menu and inherit the same default attributes as annotation text strings.

2.5.5. Zone Magnification

The zone magnification object is similar to the analogue parameter Mag. But unlike Mag it changes its value according to the magnification of the zone it is placed in. Apart from this difference in behaviour, there is no way of distinguishing between the Mag parameter and a Zone Mag object. It is therefore recommended that zone mag objects be used to display the magnification to avoid confusion.

2.5.6. Micron Markers

Two types of micron marker can be placed on the image, fixed and variable. Both types of marker show a line and a length, the line size will change according to the magnification of the image. However the variable marker will change scale according to the magnification, while the fixed one will not.

If multiple zones are displayed, the micron marker will display the magnification of the zone in which its top left corner appears.

Editing a variable micron marker changes the maximum size limit for the line. Editing a fixed micron marker allows its fixed size to be changed. If a fixed micron marker is inserted into a datazone it will be converted to a normal micron marker using base magnification.

2.5.7. Point to Point

The point to point measurement facility consists of a pair of related pointers and a measurement panel and is selected from the Measurement menu. The points are labelled **Pn** and **PnR** where **n** is the number of the instance of the point to point object (it is possible to have multiple point to point objects concurrently).

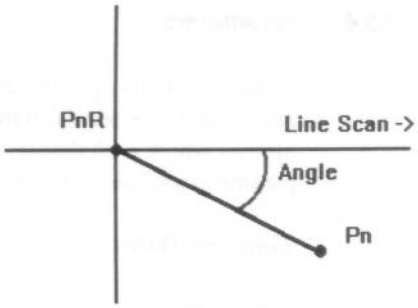


Figure 2.4

In the measurement panel the distance between the markers is displayed along with the angle of the line joining the markers. The angle is defined as the angle between the line PnR and Pn and the line scan direction, measured in a clockwise direction (see Figure 2.4).

Either point may be moved by selecting and dragging with the mouse, but this method of control has two disadvantages:-

1. The mouse cursor may cover the area of interest.

2. Very fine control may be required which cannot be achieved with the mouse.

For these circumstances precision adjustment mode is available.

Precision Adjustment

Any measurement marker may be controlled in precision adjustment mode (point to point, linewidth, etc.). It is used in the following way:-

1. Select annotation edit mode.
2. Select the object to be moved.
3. Select a *handle* on the selected object and while holding the mouse button down press a keyboard arrow key.
4. Keeping the mouse button depressed, move the mouse cursor away and continue to adjust the position of the marker with the arrow keys.
5. Release the mouse key to end the precision adjustment.

A *handle* is a point associated with an object which allows some property of that object (either its position, shape, size or orientation) to be adjusted in some way. Selecting the object (point 2 above) causes a small square to be displayed on points which may be selected. There is only one handle for each point to point marker which controls its position, other measurement objects may have multiple handles.

The selected object remains selected after adjustment so that further adjustments may be made. To deselect the object press the right mouse button or select "escape" on the pop up menu.

2.5.8. Linewidth

When the linewidth selection is made, a rectangle appears with an associated measurement panel which contains the height, width and orientation of the rectangle. The rectangle can be positioned in move mode and sized in edit mode. The handles on the corners of the rectangle are used to rotate it, while the handles on the sides are used to adjust its size. The precision adjustment mode described above is available for linewidth objects.

2.5.9. Graticule and Crosshairs

Graticule and crosshairs are toggled on/off from the **View** menu. A grid of evenly spaced horizontal and vertical lines or intersecting 45° lines in the overlay plane is

displayed. The spacing of the lines is user defined from the **View** menu, an appropriate pixel distance is entered between the values of 50 to 512.

2.6. Recording an Image

There are three ways of recording an image on the *Stereoscan 430*:-

1. Micrograph on HRRU (if fitted).
2. Image print on a Video Printer (if fitted).
3. Image Save to disk (as a TIFF file).

The last of these is available on all systems, the others require the necessary options to be fitted.

The photo icon provides an interface to all the record methods. In the **File** menu the **Export/Photo set up** option allows the output device to be selected from those fitted. The selection is made by clicking on the **Output to:** field, which displays a dialog box of the available selections. Once a destination has been set up, selecting the photo icon with the left mouse button initiates a record sequence. Selecting it with the right mouse button brings up the appropriate record set up panel.

In addition to the icon, record sequences can be initiated from the **File** menu **Export/Photo** option, while the set up panels can be accessed from the **Set up** option on the Export/Photo set-up panel.

Magnification Calibration

The magnification is defined as the scaling between the size of a pixel scanned on the specimen and the size of that pixel on the final image. Clearly the latter is dependent on the way in which the image is recorded. An image recorded on an HRRU will not be the same size as one recorded on a video printer. The Export/Photo set up panel provides a means of calibrating the magnification according to the user's own requirements.

An output device can be calibrated in the following way:-

1. Freeze a full size image.
2. Select **Calibrate** on the Export/Photo set up panel.
3. Move the markers so that they are well apart.

4. Take a photo (or print).

5. Measure the physical separation of the line on the print.

6. Enter the separation in the calibration panel.

The displayed magnification value will then be adjusted for the final image size.

2.6.1. The High Resolution Record Unit

If the HRRU is correctly set up, a micrograph can be taken by selecting the photo icon with the left mouse button. The right mouse button on the same icon will display the HRRU set up panel. When a photo record is completed, the camera status returns to idle and a dialog box appears to confirm that the record sequence has finished.

The set up page allows several parameters of the camera, HRRU and film to be set up (some of these parameters are located on the **HRRU settings** submenu).

Image Source

This can be selected from Left, Right or Live. Of these only Left or Live should be used. A live image is used to take a micrograph which has more pixels (thus higher resolution) than can be held in the image store.

Overlay Source

The overlays can be None, Left or Right. Again only the None or Left options should be used. It is possible to apply the Left overlays to a live image, to obtain the annotation or the datazone.

Film Speed

The film speed in use, 800, 400, 200, 100 or 50 ASA.

Camera Type

The type of camera being used, this will affect the magnification value of the final image.

HRRU Brightness and Contrast

These parameters are best set using the grey wedge (from the output LUT set up menu). The brightness should be adjusted until the darkest level is just black and the contrast should then be adjusted until the brightest level is white.

Development Timer

The Development Timer is a simple count down timer which 'Beeps' on completion. The duration (in seconds) can be entered by clicking on the time. The timer is initiated with the start Development Timer button.

Photo Number

The photo number increments each time an image export is performed (regardless of output device). Besides appearing in the HRRU panel, it can also be displayed in the status window or used as annotation. It can be set to a new value by clicking on it whenever it appears.

In addition to the fields mentioned above, the **Photo** and **Abort** photo buttons operate in the obvious way.

2.6.2. Video Printers

The sequence of operation to take a video print is as follows:-

1. Ensure the video printer is selected as the current output device.
2. Optimise the brightness and contrast of the image.
3. Apply any noise reduction and freeze the full size image to be printed.
4. Select photo icon with the right mouse button.
5. Set up the required size and orientation.
6. Select OK to initiate the print sequence.

When the record is complete the **Video print to do** field will return to zero. If the settings are known to be correct for the next print, then operations 4 to 6 above can be replaced with a single selection of the photo icon with the left mouse button.

Image Content

The Image, Overlay and PC Plane check boxes on the set up page determine what appears on the final print. The grey data is part of the image, annotation and the datazone are in the overlay plane and the menus are all in the PC plane. A plane will appear in the image if its check box is selected.

One other field is relevant to the image content, but only applies to Monochrome printers. The **As seen** check box will cause the image data to be passed through the display LUT to make the recorded image the same as the displayed image (only the red part of the LUT is used to produce the monochrome output). If the box is not checked, then the stored image will be sent directly to the printer.

Image Orientation

Two orientations of the image are possible, portrait or landscape. Printing an image in landscape format will take slightly longer than portrait. The format used will depend on the printer resolution and the size of the image to be printed.

Image Size

Three options are available for image size. A full size image could be printed (whole image), or a portion of the image (adjustable) using the mouse to position and size the red box which selects the part of the image to be printed. The third selection (best) uses the known resolution capabilities of the installed printer to select the largest possible image which can be displayed at full resolution. Selecting this option will also override the image orientation setting.

Paper Size

The Large Paper checkbox is used to set Large rather than Standard paper size for the CP100, CP210 and CP200BH printers. The setting of this checkbox affects the best resolution image dimensions.

Form Feed

Selecting this checkbox causes a form feed code to be transmitted to the printer following the video print.

2.6.3. *Saving TIFF Files*

Tag Image File Format[1] (TIFF) provides a standard format for various kinds of image files. Images can be binary, grey, grey with a colour palette, or true colour. They can also be of various sizes with additional data stored with the image. It is to enable easy use of *Stereoscan 430* images that TIFF import and export facilities are provided.

TIFF export can be set up as the action taken by the photo icon by setting the **Export/Photo setup** to **File/Display.** In addition the TIFF File Export panel is always available from the TIFF Export option of the **File** menu.

The TIFF Export Panel allows various image parameters to be set up before the image is written to disk. When all the parameters are correctly set, pressing the **OK** button will save the image to disk.

Image Content

The type of file saved is determined by the radio buttons of **Save Binary**, **Save Grey** or **Save Colour**. It should be noted that of these only Binary and Grey files may be reloaded into the *Stereoscan 430*. If grey is selected then the **Palette** option can be selected to save the colour LUT with the image. The **As seen** box may also be selected to save the image after it has been processed by the display LUT, rather than as it is in the image store. The **Reduced** option saves a reduced resolution image which can later be used with the grey directory function on the TIFF import panel.

The **Image, Overlay and PC Plane** fields have the same function as those on the Video Printer set up panel.

If the file type is selected as binary, then the image content is determined by the RGB colour setting. Any pixel in the image which is the colour defined in the threshold will be saved as a binary 1. The RGB levels can be set by typing absolute numbers in to the RGB fields, or by selecting **Threshold** and then clicking on the part of the image which represents the colour to be saved.

The binary condition is determined by the colour on the display. It is possible to set up the display LUT so that several grey levels are mapped onto the same display colour.

[1]Tag Image File Format Specification Version 5.0 - The Aldus Corporation

When saving a binary file Huffman run length encoding can be applied to reduce the size of the file by selecting the Compression check box. It is stressed that **No** data loss occurs when such encoding is used.

Image Size

The whole image or an adjustable portion of it may be saved. The portion of the image is selected in the same way as for video prints.

Info

When an image is saved the operator may, if desired, save a list of various parameter values to be associated with the image. Select the **Info** option will call up a panel which will allow the operator to create the desired list. This list of parameters will then be associated with all subsequent saved images.

Subsequently, this date can be read by select the **Info** option from the **Import Tiff** panel after highlighting the filename of the appropriate image. Alternatively, after importing the image into the frame store, the list can be recalled as annotation by using the **Annotation->TIFF data** option from the **Annot/Meas** panel.

Save State

Clicking on this box will cause a macro of the current operating conditions to be saved at the same time as the image is saved, and with the same name. This macro can then be used to reset the microscope to the conditions that were current when the image was saved. These macros can be found from the **Tools->Macro** option of the drop down menus and then by selecting **Macro->From Tiff**.

File Name and Directory

The directory in which the image file will be saved is shown on the panel and can be changed with the file dialog selected from the **Change Dir** option. The filename generated for the file is also shown. It consists of a 5 character name with up to 3 digits. The digits are automatically incremented each time a file is saved. A list box of the TIFF files in the selected directory is also displayed on the setup panel.

2.7. Recalling an Image

Unlike the options for recording an image, there is only one way to import an image to the *Stereoscan 430*. The TIFF Import panel is selected from the **File** menu and allows a file to be selected for import as well as controlling the way it is displayed.

*Before an image can be recalled **Freeze** must first have been selected.*

File Selection

The current directory and the list of TIFF files in it are displayed on the Import panel. The required file is selected from this list. The directory can easily be changed using the **Change Dir** dialog.

Image Information

When a file is selected information contained in the TIFF file is displayed, including:-

- The type of image
- The size of the image
- The size of any reduced image saved with it
- The description text saved with it
- Whether a colour palette is present

The only type of TIFF file that cannot be imported is true colour files. Binary (compressed or uncompressed) and Grey (with or without colour palette) can all be imported. If a grey file has a colour palette, it is optional whether the palette is imported into the display LUT when the file is loaded (click on the **palette** box to import a palette).

Loading Grey Images

For a grey image the only other consideration when loading it is where on the screen it should be positioned. Clearly if it is a full size image then there is no option, but if it is smaller it can either be loaded at (0,0) screen coordinates, or at a position defined by moving the red outline with the mouse. The red outline appears when the **Load at 0,0** option is deselected.

*Care must be taken when loading grey images which have been saved with the **As Seen** option. Because the saved image has already been processed by the display LUT, it is necessary to reset the display LUT (to linear) so that the image will appear as it did when it was saved.*

The **Grey Dir** button can be used to display the reduced images of all the grey files in the current directory, then selecting with the mouse on any of the reduced images will load the full image associated with it. Individual reduced images can be loaded with the **Reduced** button.

Once a grey image has been selected and the red outline box has been position (if not at 0,0) then the load is initiated with the **OK** button.

Loading Binary Images

If the image being loaded is binary, then two other fields come into play. Firstly it is necessary to define the binary plane into which the image is to be loaded and secondly the other bits option must be set to the required state. If a binary image is to be loaded with no reference to anything in the image store at present, then the other bits option must be set to **Clear other bits**. If the binary image is to overlay another binary image, then the bit plane must be changed and the other bits option must be set to **Keep other bits**. To overlay a binary image on a grey image select **Grey backed** as the option for other pixels.

In all cases it will be necessary to define a suitable display LUT to allow the binary information to be seen. This process is described in Customising the User Interface.

2.8. The Clipboard

The clipboard is a Windows$_{TM}$ feature which allows information to be copied or cut to it and pasted from it. Many Windows$_{TM}$ applications make use of it to exchange data. The *Stereoscan 430* makes use of the clipboard for the following purposes:-

- To import certain types of image data from other applications.
- To temporarily store part of an image.

The **Clipboard** option is selected from the **File** menu. Its appearance is similar to the TIFF import and export panels with many of the fields being common. The actual operation is defined by the Copy Grey, Copy Binary and Paste buttons.

2.8.1. Copying to the Clipboard

The following procedure copies a portion of the image to the clipboard:-

- Freeze the image
- Select image type (Copy Grey or Copy Binary)
- Select portion of the image with red outline (or select Whole Screen)
- Select OK

The selected area of the image is then copied into the clipboard. If Overlays or PC Plane options are selected, then the relevant data is merged with the image as it is copied. The format of the data put into the clipboard by the LEO user interface is application specific and therefore cannot be read by other applications.

2.8.2. Pasting from the Clipboard

Grey image data can be copied from the clipboard by selecting Paste on the Clipboard panel. The position for the paste can then be adjusted with the mouse before selecting OK to copy and therefore cannot be read by other applications.

The clipboard contents will be determined by the last copy (or cut) made to the clipboard by any application. If the format of the data is not supported by the *Stereoscan 430*, the OK button will be disabled when Paste is selected.

The following types of data may be exported to the clipboard:-

- Binary images are exported as monochrome
- Grey images are exported as 8 bit grey

The following types of data may be imported from the clipboard:-

- Monochrome as a binary image
- 4 bit grey as a grey image (as bits 4 through 7, other bits cleared)
- 8 bit grey as a grey image
- 24 bit colour as a pseudo colour image

If the format of the data in the clipboard is supported the Paste function will be available.