Artemis Capture

User's Manual

V. 2.1 – August 2014

1 Artemis Capture

Artemis Capture is a standalone program which allows you to control your Atik camera, take images, preview them, and save them to standard FITS files.It does not perform any image processing other than simple histogram manipulation for mapping the 16-bit images to the display. The data saved in the FITS file is exactly what is read from the camera (raw), so any adjustment is purely for display purposes. Focus should be very easily achieved with focus assist as described further.

1.1 Features

The capabilities of Artemis Capture include:

· Control over pixel binning.
· Selection of an image sub-frame for rapid focusing.
· Automatic capture of a series of images, saved with sequential file names.
· Adjustment of black and white levels, and log stretch for displaying images, with histogram function.
· Focus Assist option using data gathered from star images
· Zoom feature.
· Display adjusted for aspect ratio for sensor whose pixels aren't square.
· Night-vision mode.
· Cooler switching and temperature regulation.
· Motorized Filter Wheel control.
· Autoguider function with dithering.
· Image capture sequencer.
· Can open FITS files for inspection.

1.2 Using Artemis Capture
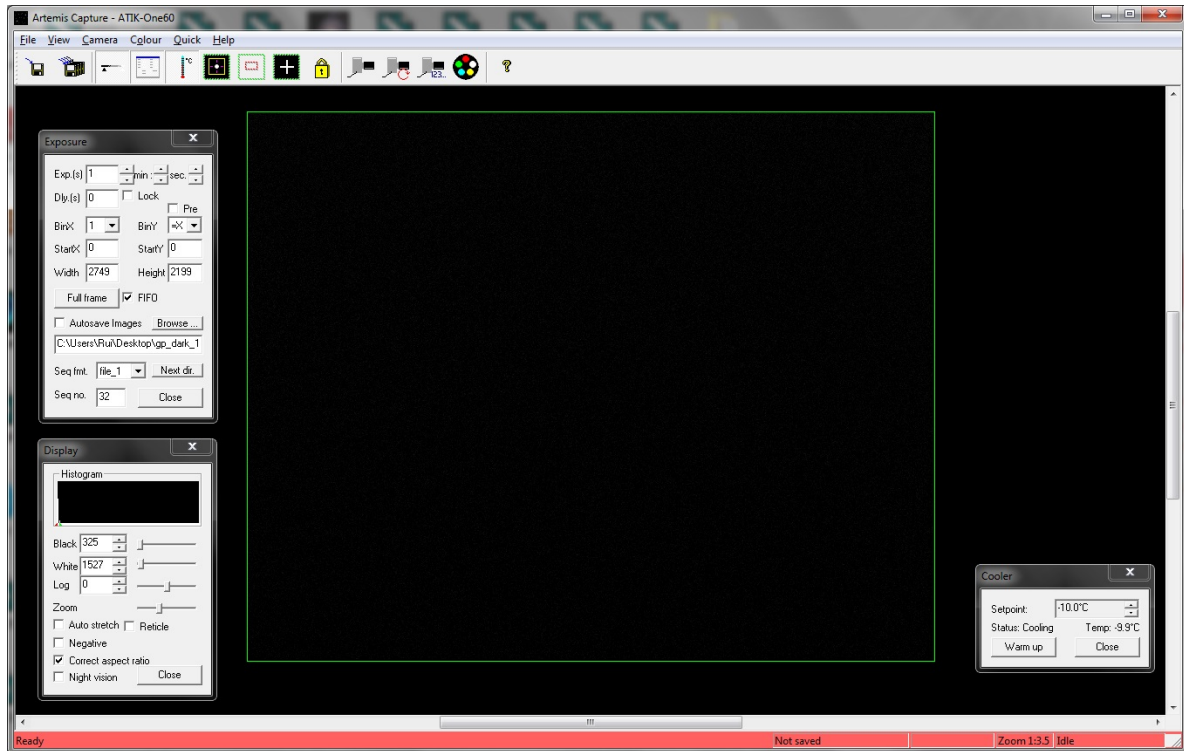
The main Screen

When you first start the program, you will be warned if your camera is not connected or powered up. It is possible to run the program without the camera by clicking on "ignore", although most of the functions will be unavailable.

The main settings in Artemis Capture are controlled using two dialogs, the 'display' dialog and the 'exposure' dialog. Both of these are a modeless dialog, which means that they can be left open while you run the program and capture images, etc. However you should be aware that if one of these dialogs is selected then certain keyboard shortcuts or mouse operations in the main window may not behave as expected. If this happens, simply click on the main window to select it.

1.3 Quick Start

The cooler is off by default on the cameras that support regulation. You can turn it on using the cooler control icon. When the cooler window appears, just press "Cooler on".
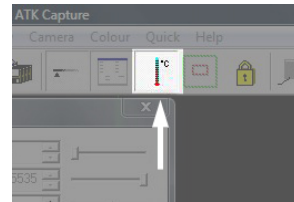
Your camera includes an advanced cooling system which provides cooling down to a specified delta below ambient temperature (model dependant). Also, and because for some applications it's more important to accurately control the temperature of the sensor than it is to achieve the lowest possible temperature, there is a regulation system, which ensures that the temperature is stable at all times (on some models).

The cooler control window has a few options you should be familiar with.

As soon as the Artemis Capture software is opened, the cooler control window is shown. Immediately, the current CCD temperature will be displayed, as well as the current cooler status. On unregulated cooling models (e.g. 320E), the temperature will be displayed as "unknown". In this case the cooler can only be turned on or off, and it will always cool to the maximum possible level.
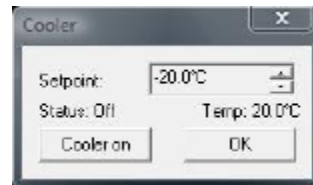
Before activating the cooling system, you should select the desired temperature. While doing this, you should take into account the maximum cooling system capacity of the camera, so you should never go below this threshold to ensure that the temperature is stable. You can use the current CCD temperature as a starting point when selecting the temperature you wish.

There are two buttons available on the control window. The "Cooler on" button initiates the cooler. After pressing this button, it will then change to "Warm up". When pressing the "warm up" button, the camera will initiate the power down sequence, which will raise the temperature slowly. This procedure is necessary to avoid thermal shocks on the CCD itself, and should always be executed before turning power off.

After turning on cooling, it may take about 5 minutes for the temperature to stabilize at the desired set point.

If you want to simply take a quick shot to verify that the program and camera are working correctly, you can use the F1-F8 buttons to take a single test image. F1-F4 take an exposure of 0.1, 1, 5 or 10 seconds respectively, and F5-F8 use the same exposure times but binned at 2x2 for greater sensitivity. Here's a list of shortcuts:

F1: 0,1s
F2: 1s
F3: 5s
F4: 10s
F5: 0,1s (binned)
F6: 1s (binned)
F7: 5s (binned)
F8: 10s (binned)
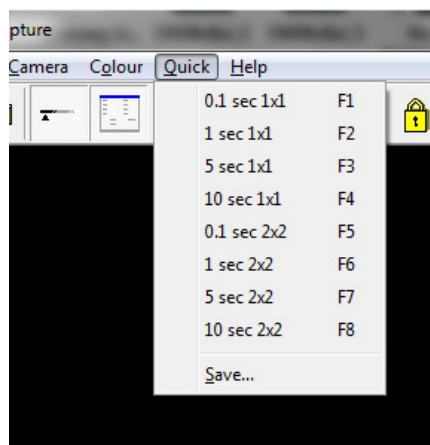
The "Quick" menu

The last menu option, "Save", allows the preset F-key options to be edited.

1.4 Main Screen

The main window in Artemis Capture is used for displaying the most recently captured image. A green outline rectangle is displayed in the window, indicating the full size of the CCD sensor. If a sub frame, or Region Of Interest (ROI) is being used for imaging then it is indicated by a red outline rectangle within the green one.

You can scroll the display using the scrollbars, or by dragging it with the left mouse button. Dragging the right mouse button within the CCD area allows you to set the sub-frame interactively. If you have a mouse with a wheel, you can use the wheel to zoom in and out - the point beneath the mouse pointer is the 'focus' of the zoom, and remains in the same place on the display.

Additionally, you can select a ROI area by clicking the sub frame button and selecting an area within the green outline.
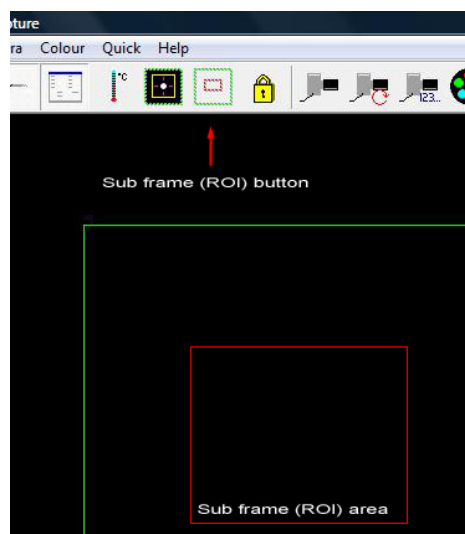

Sub-Frame selection

1.5 Exposure Settings Dialog

This dialog is displayed by selecting the 'View | Exposure Settings' menu option, or by clicking the toolbar button. Here you are able to set the exposure time for the image, the individual X and Y binning factors, and you can numerically specify a sub-frame if you wish.

The "Pre" check box activates the preview mode, where the image download will be about twice as fast. However, quality will suffer. This mode is especially useful for focusing the camera.

The "Dark" check box causes the shutter to remain closed during exposures, allowing dark frames to be taken (only on cameras with mechanical shutters). Please note that whilst the shutter can be relied upon to keep light out of the camera during night-time observing conditions, additional measures must be taken to ensure that the camera is light-tight when taking dark frames during the day.
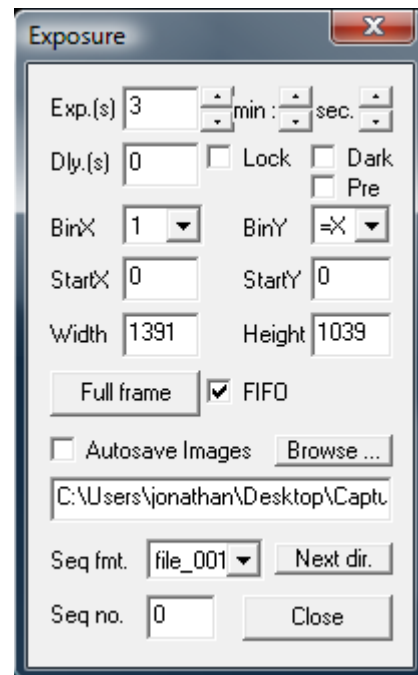
The exposure dialog box

Also, a delay between exposures setting is available, since it is desirable to have the autoguider stabilize before starting the next exposure. This can be set in the "Delay(s)" box, and it's measured in seconds.If the Autosave box is checked then every time an image is captured, it will automatically be saved as a FITS file with a sequence number appended to its name, in the form you select on the "Seq fmt" option. "Seq no." allows you to select the next number in the sequence.

Once you have selected the exposure settings, you can take a snapshot using the Camera |Snapshot menu option, or by clicking the camera toolbar button. The indicator at the bottom right of the window shows the current camera status - exposure time remaining, download state, etc. Once the image is downloaded it will be displayed on the main screen you can adjust the display using the 'Display Options' dialog.

1.6 Display Options Dialog

This dialog is displayed using the 'View |Display Options' menu item, or by clicking the toolbar button. It allows you to adjust the way in which the 16-bit image is mapped to the PC's display. In general, two values are chosen within the range of 16 bit numbers present in the image. Pixel values equal to or less than the lower value are displayed as black, and pixel values equal to or greater then the higher value are displayed as white. Values in between are displayed as shades of grey. The 'Log' value controls how the grey shades are distributed – a value of zero produces a linear map, negative values provide higher contrast at the higher end, and positive values boost the contrast at the lower end.
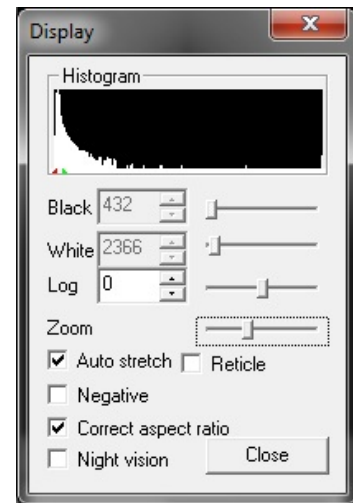
The Display box

The 'Auto stretch' box allows the program to automatically adjust the black and white levels each time an image is captured. The levels are chosen such that only a few pixels fall outside the range. If the box is unchecked then you can manually adjust the black and white levels using the sliders.

A histogram is displayed as well, to give an idea of what is the pixel intensity distribution on the image. The little red and green indicators are where the black and white points are set, respectively.

The 'Reticle' checkbox will add a reticule to the displayed image. It may be of use for determining the center of the frame, so that you can align your goto telescope, for example. The 'Negative' checkbox will display the image as a negative, which can be useful when trying to spot faint objects on a dark background.

The 'Correct aspect ratio' box adjusts the displayed image according to the physical dimensions of the pixels on the CCD sensor. If the box is checked then the height of the displayed image is scaled so that a square area on the screen corresponds with a square area in the sky.

'Night Vision' changes the Windows colors to shades of red, in order to help preserve visual dark adaptation when using the program at night. When the program shuts down, or the box is unchecked, the original colors are restored. [Hint: You can save the night vision color scheme for use with other programs, if you click the checkbox and then right-click the Windows desktop, select 'Properties |Appearance' and then 'Save as'.
Give the scheme a name such as Night Vision and you can then return to it any time you like using this dialog. You may also want to save your standard color scheme, so that you can re-select it after using the Night Vision scheme.]

1.7 Focus Assist and Autoguider function

When taking an astronomical image it is critical that focusing is as accurate as possible. To help achieve this, Artemis Capture provides the Focus Assist dialog.

When you have the camera roughly focused so that you can see stars in the captured image, you can activate the focus assist dialog by double-clicking on a star. For best results you need to choose one which is bright but not overexposed, and which has a relatively clear area around it. The program will select the brightest star in the vicinity of the selection, and draw a small box around it. It will also pop up a dialog showing some information about the Star's image, in a large bold font so that you can read it when at the telescope which may be some distance from the PC monitor.

The information provided is the star's maximum brightness (the difference between the brightest pixel and the background level), and the width of the star image. This is calculated as the size of a square, centered on the star's centroid, containing half the total flux from the star. The objective is to adjust the telescope's focus until the brightness reaches a maximum and the width reaches a minimum - this will give the sharpest and brightest star images.

Whilst focusing it is also a good idea to select a sub frame around the star in order to reduce the image download time, and use the zoom feature so that the Star is displayed highly magnified so you can verify that the image quality is improving as you adjust the focus. Then use the camera 'loop' button to repeatedly

Focus assist box

take images until you reach perfect focus as indicated visually and with the Focus Assist dialog.
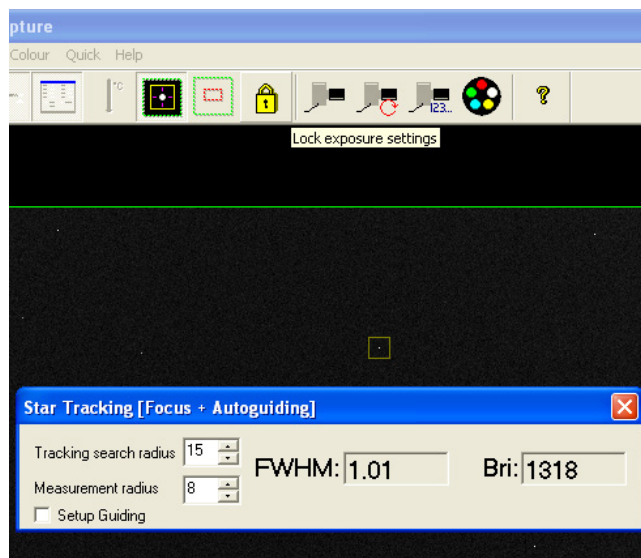
Artemis Capture tracks the star from one exposure to the next by searching for the brightest pixel in the area around the star's previous location. Depending on the magnification and stability of the telescope, the star may drift by a number of pixels from its previous location. Clicking the 'Set' button in the Focus Assist dialog allows you to specify how many pixels the program will search around the previous location when trying to locate the star. You can also specify the radius that will be used to measure the star's properties once it is located - this should be a little larger than the radius of the star, but smaller than the distance to the next star.

1.7.1 Autoguider function

The Autoguider function of Artemis Capture allows using a second camera to guide on a reference star, so that much longer exposures can be obtained. Tracking errors can then be compensated by monitoring the reference star position from exposure to exposure of the guide camera.

To use this very useful feature, you should do the following:

Setup your guide telescope or off axis guider. Open Artemis Capture (if you're already using Artemis Capture with your main camera, open a second instance of Capture. The software will then ask to which camera you want to connect), roughly focus the camera, and then double click a star. Fine focus using the procedure described above.
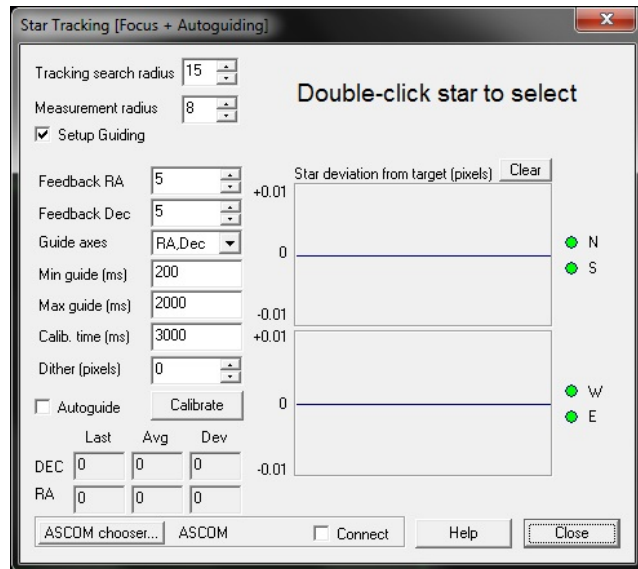

Autoguider setup

As you have already noticed, there is a check box on the focus assist window, called "Setup Guiding. Click it, and the window will expand to show all the controls available.

If you press the "Help" button, a new window with instructions on how to operate all the Guider options will be shown.

The ASCOM chooser is used to select the mount where the guider commands will be sent. You'll need to setup your mount on ASCOM before using the autoguide function.

## *1.8 Filter Wheel control and Image sequencer*

Artemis Capture can Control the Atik USB Filter Wheel automatically, so that it's now possible to take a sequence of images. To control the wheel manually, press the filter wheel icon. A new window will be shown, with a dropdown box, where you can select which filter number you wish to use. Changing this number will turn the wheel to the selected position.
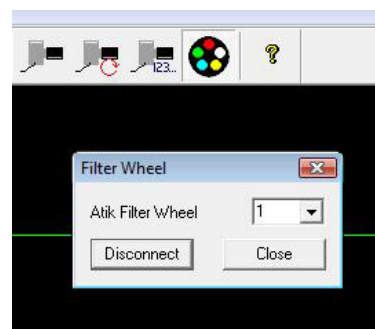
Filter wheel control

Additionally, there is a sequencing function available, which allows taking multiple images in the desired sequence.

By selecting the sequencer button, a new window will be shown. This window has several lines, which represent the sequences. On each line you can select if it's enabled or disabled, the exposure length, binning level, the filter position, file suffix and system command (this last option is still under development).
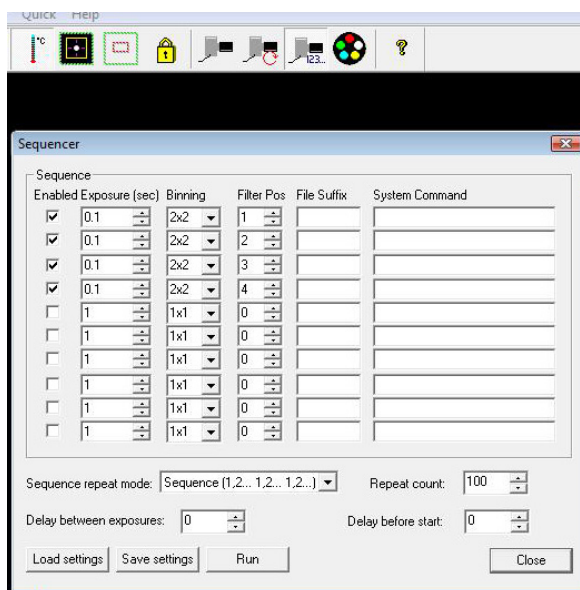
Sequencer window

Below the sequence list, you have additional options:

- o **Sequence repeat mode:** Selects how the sequence is treated – 1;2, 1;2 or 1;1, 2;2, etc.
- o **Repeat count:** The number of times the sequence is repeated.
- o **Delay between exposures:** Inserts a delay between exposures. Useful for guider stabilization, if needed.
- o **Delay before start:** Adds a delay before the sequence is started. Also useful for initial guider stabilization.
- o **Load settings:** Loads a previously saved sequence
- o **Save settings:** Saves a sequence for later use
- o **Run:** Runs the sequence

Please note that, to save the images that the sequence will generate, you need to setup the file name and destination on the Exposure Settings dialog (see 9.5 above), and activate the "Autosave" option, otherwise none of the images will be saved!

1.9 The Marker mode

The marker mode is very useful to help aligning your images from session to session, especially if you need to setup and tear down every time.

It allows you to create markers on reference stars, which will then help you realign your camera on the next session. This helps minimizing any rotation issues, as well as keeping the image as aligned to the original as possible, preventing the loss of image area in post processing.

To activate this mode, just press the 'Marker mode' button. Then simply double click on the reference stars of your choice. A small crosshair will be visible on
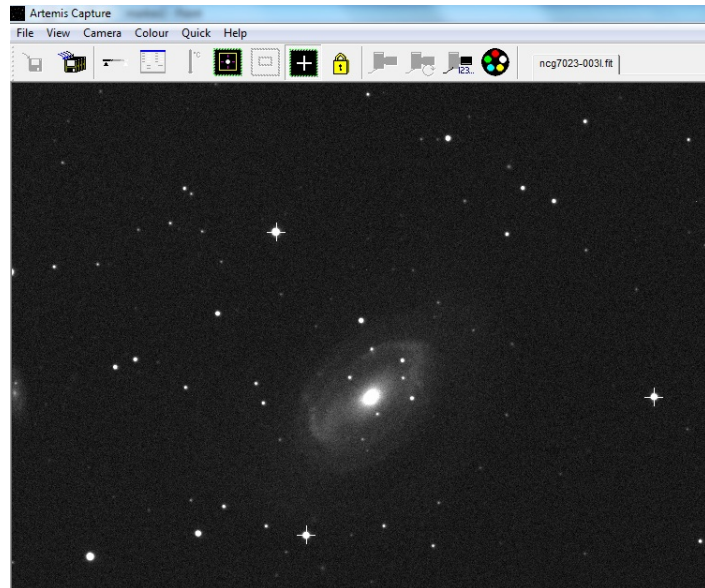

Marker Mode

top of the star. It is recommended to use brighter stars for this, as it will be easier to realign later on, as sorter exposures will be needed to record the stars.

When the markers are put in place (2 or 3 are enough), you can right click anywhere on the image and the menu on the left will be visible. It will allow you to insert a new marker (same as double clicking), delete a marker (if you right click on top of an existing marker), delete all markers and load or save the markers.


Once the markers are put in place, you'll want to save them for later use.

On your next session, just point the telescope to the target object, activate the Marker mode by clicking the button, right click on the image and select 'Open markers'. After loading your previously saved markers, the crosshairs will be visible on screen.

You can now adjust your camera rotation and use your mount controls to put the reference stars exactly where they were on your previous session.
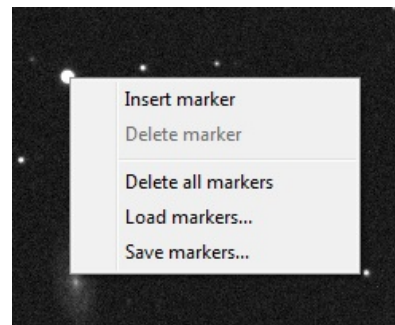
1.10 Colour cameras and the ArtemisRGB utility

Basically, the Colour version of any Atik camera is the same as the monochrome counterpart, both in aspect and functionality. However, it features a CCD which has colour filters built in, enabling the capture of colour images in a single exposure.

Artemis/ATIK Capture handles these cameras just like the monochrome versions, but features a menu dedicated to colour imaging.

The "Colour" menu has 3 options:

RAW - Displays the image as it comes from the camera
Colour - Displays a synthesized colour image from the RAW data
Luminance - Displays the Luminance channel of the image (grayscale)

Keep in mind that all these options only affect the way the image is displayed. Images are always saved as RAW data. Since images are saved in RAW data, there is a need to decode colour data for further processing. That's where the ArtemisRGB utility enters.

ArtemisRGB is a standalone application designed to work with FITS files produced from Artemis cameras fitted with colour CCD sensors. The CCD sensors in these cameras have a matrix of colour filters over the sensor elements, so each pixel samples a certain colour of the image. The function of ArtemisRGB is to take this raw image and convert it into a full-color image.

Features:
· Conversion of images from Primary (RGB) and Secondary (CYMG) mosaics
· Allowance for offsetting image on matrix
· Adjustable low-pass filtering of colour
· Adjustable high-pass filtering of luminance
· Adjustable image brightness
· Apply same conversion settings to a batch of images
· View raw image, colour version, or luminance (grayscale) only
· Output in various formats for post-processing, including FIT, TIF, BMP

When you start ArtemisRGB, you will see the main image preview area occupying most of the window. On the left is a list which will contain the names of all the images to be processed.

Above this are some controls for specifying how the processing is performed, and at the bottom are buttons for dealing with files.
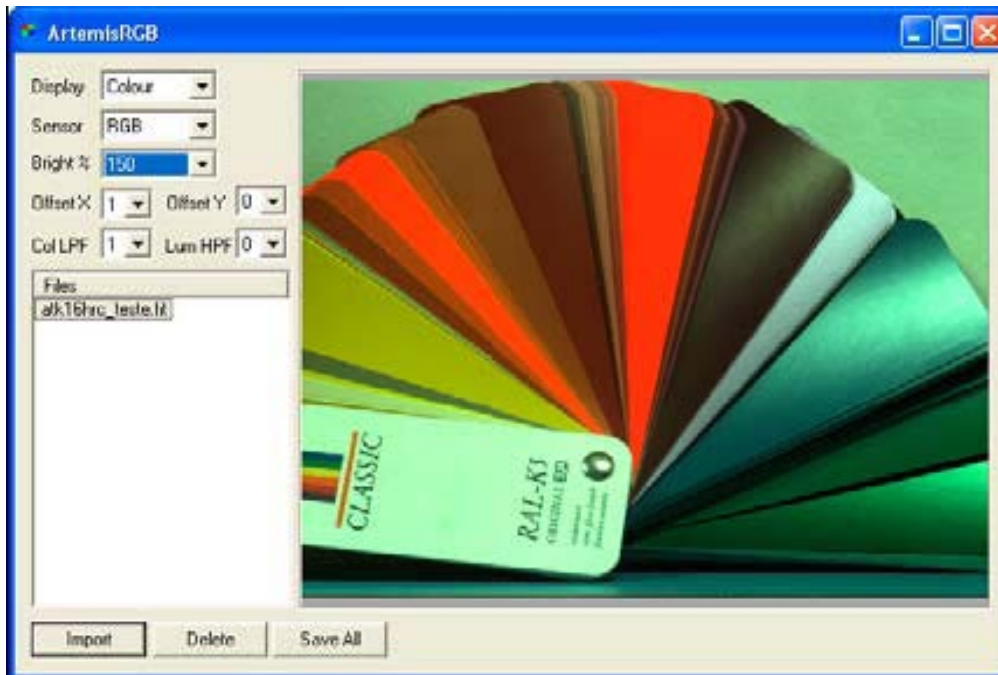
Artemis RGB screen

To import a file, click the 'Import' button and locate a FITs file produced by a color camera. The name of the file will appear in the list box on the left, and the image will appear in the preview window. It may not look quite right at this stage! The 'Delete' button can be used to remove an image from the list - it does not delete it from the hard disk. At the top left is a combo box where you can select whether to view the raw, colour, or luminance image. The raw image will show you the checkerboard matrix pattern, but for now we want to see the color image. Below this combo box is another one in which you can select whether the CCD uses a primary (RGB) or secondary (CYMG) matrix. The Atik Series 3 Color uses an RGB matrix; If you saved the file from a recent version of Artemis Capture, the colors should already be correct.

Otherwise you can try adjusting the X and Y offset values, which tell ArtemisRGB where on the matrix the top left corner of the image lies. For a full-screen image in the standard orientation these values ought to be 0, 0 - but if the image has been rotated or flipped then the values will need adjusting. With a bit of trial and error you should find values that give the correct colors.

Most deep sky targets are very faint, and because ArtemisRBG doesn't have any histogram stretching tools, a "Brightness" selection is available, which will allow you to increase the image brightness. This will help to better see the object in the image, but won't change the image in any way, since it's for display purposes only.

Because some information is lost when the CCD samples the signal into different colors, reconstructing the full color image can sometimes introduce colors which weren't present in the original scene. These are typically seen in regions of high contrast. To help reduce these false color artifacts, you can run a low-pass filter (blur) on the color channel. Then, to restore sharpness to the image, you can run a high-pass filter (sharpen) on the luminance channel.

If you have multiple images loaded into ArtemisRGB, you can give each one its own set of processing options if you need to. In particular if some images were saved from a sub frame, then you may need to give them different X or Y offsets. If you make a multiple selection in the image list, the controls at the top of the program will indicate any values which are common to all selected images. If values differ between images then they will be displayed as '---' in the controls. Changing any value will update that value in all selected images - this can be a quick way to set the processing parameters for a batch of images.

Finally, when you have set all your images as you like them, you can use the 'Save All' button to convert all the images to a file format suitable for post-processing. You can choose to save as separate Red, Green and Blue FITs files, or a single 3-layer FITs file, or a 48-bit uncompressed TIFF file, or a 24-bit BMP file. The last option will lose information, but is more compact and more widely used than the other formats. When using the first option each image is saved under its original filename, with _R, _G or _B appended to indicate the color channel.

1.11 Other controls

There are a few other controls apart from the dialogs described above. The most important are probably the 'Camera |Snapshot' and 'Camera |Loop' menu options, also available as the two toolbar buttons (the 'loop' button is the one with the red circular arrow on it). The Snapshot command takes a single image, and the Loop command starts the program taking repeated images. You can abort the current exposure by clicking the Snapshot button while the exposure is in progress. If you want to terminate the exposure early but keep the result, hold the shift key down while you click the Snapshot button. When looping, you can stop the whole looping process by clicking the Loop button again. The current exposure will be aborted. You can change exposure settings while looping, but they will not be acted upon until the start of the next exposure.

'Camera |Subframe' or the red square toolbar button allows you to drag an imaging sub-frame using the left mouse button, which is normally used to scroll the display. You can always use the right mouse button to create a sub-frame. The green square toolbar button, or the 'Camera |Fullframe' option, will revert to using the full CCD area for imaging.

'Camera |Rotate 180' will rotate captured images 180 degrees. This also rotates the saved image.

'Camera |Info' gives some details of the Atik camera.

'Camera |Connect' and 'Camera |Disconnect' will connect or disconnect the Atik camera.

'File |Image header' allows you to specify the target object, telescope, and observer name for recording in the header of saved FITs files.

'File |Open image' allows you to open a previously saved image in FITS format. This can be useful to check if the previous image(s) in a sequence is of good quality, for example. It also allows to create markers for alignment in future sessions (see 1.9).

The 'Quick' menu options allow you to take an instant snapshot at a variety of exposures and binning levels, with a single click or key press.

2 Maxim DL™ plug-in

Introduction
Maxim DL is an astronomical program, from Diffraction Limited. It is able to control most of the equipment used in astronomical imaging, as well as processing the captured images. In order to allow Maxim DL to communicate with a new piece of hardware, a driver is required to be installed in a location known to Maxim DL.

Installation
The driver files for the Atik cameras is installed during the initial camera setup (if you selected to install it). If you don't have the plug in installed yet, just re-run the setup application and select it when prompted. Be aware that you will need to have Maxim DL installed first.

Using the Plug-in
Once the driver is installed, you can start up Maxim DL and open the CCD Control Window - either by pressing Ctrl+W or by selecting menu option View|CCD Control Window. There may be a short pause while Maxim DL build up a list of available camera drivers, and then you will see the camera setup dialog.
In the box headed 'Main CCD Camera', click the 'Setup' button, and in the dialog which appears scroll down the 'Camera Model' list until you find the "ArtemisHSC" camera.

Once selected, press connect and you should have a box similar to the one on the right. Keep in mind that, as on the Artemis Captures application, the cooler is off by default. You need to turn it on by pressing the "Cooler On" button. To turn it off, press the "Cooler Off" button.
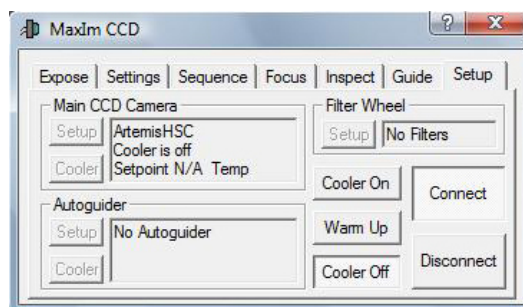
Working with Color Cameras

Maxim DL has some useful tools for working with Colour cameras. Under the menu "Color", select "Convert RGB".

On this window, you will need to check X an Y offsets, to match the Bayer patterns on the sensors, as well as the High quality Debayer mode.

You can also adjust colour scaling and background levels, or you can leave those parameters to be adjusted later.
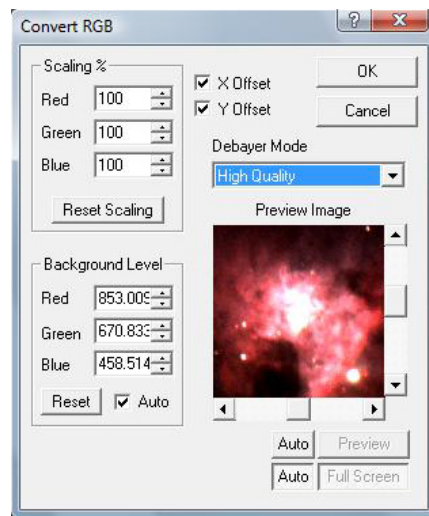
3   AstroArt Plug-in

Introduction

AstroArt is an astronomical program, from MSB. It is able to control most of the equipment used in astronomical imaging, as well as processing the captured images. In order to allow AstroArt to communicate with a new piece of hardware, a driver is required to be installed in a location known to AstroArt.

Installation

The driver file for the Atik camera is installed during the initial camera setup (if you selected to install it). If you don't have the plug in installed yet, just re-run the setup application and select it when prompted. Be aware that you will need to have AstroArt installed first.

Using the Plugin

Once the driver and user interface files have been copied to the correct directory, you can start up AstroArt and open the CCD Control panel by selecting menu option

Tools|Plugin Commands|CCD Camera

All being well you will see the camera setup dialog, at the left of which is a drop-down list of supported camera types. Select "ArtemisHSC" in this box, and then click "Check CCD" to connect to the camera.

If you need to find out more about how to use AstroArt for imaging there is plenty of information, and some tutorials, available from the AstroArt 'Help' menu.