

Fokuspokus

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1 Overview

1.1 Remark

Originally I planned to make a program to control my focuser. However, the summer 2007 was very rainy and so it became a complete telescope control for mount, DSLR, Webcam and last not least for the focuser.

This document was written with Open Office, the free office software. Partially I used Google Translator beta.

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1.2 Function list

- Focussing
 - Focus control by pulses from 64ms to 8 seconds
 - Control by mouse and keyboard (arrow-keys)
 - Save focus positions for multiple eyepieces
 - Graphical display of the focuser
 - Calibrate focuser and define backlash
 - Software-stop for focuser
 - Focus assistant
- Mount control
 - Lx200
 - Mount control by mouse or keyboard (arrow-keys)
 - Turn by a defined angle
 - Move mount according to a mouse click on the Preview Window
 - Backlash in RA and DEC
 - Undo last move
- Preview Window
 - Two windows, e.g. for Webcam, DSLR, other file
 - Reticle
 - Zoom 25% to 400%
 - Live dark subtraction for Webcam images
- Capture from Webcam
 - Sequence of images

- Long exposure
- Video
- RAW
- Capture from DSLR
 - Integrated interval timer with long exposure
- Guiding
 - Subpixel guiding
 - Use a tolerance
 - Guide between images of a series of long exposures
- Integration of external programs
 - Planetarium (e.g. Cartes du Ciel) can be used for goto
 - External capture program (with immediate display of the captured images)
 - External DSLR-Program, (e.g.. Pentax Remote Assistant) (with immediate display of the captured images, also in RAW format)
- Automatic logging of all captures
 - Time, coordinates (Ra, Dec), focuswidth, exposure details and corresponding filenames
 - Show the captured area from the logfile in Cartes du Ciel or Sky-Map
- Update Exif information of RAW images with target coordinates and focuswidth

1.3 Preconditions

- Windows XP with .NET Framework (at least .Net 2.0)

To use the full offered functionality, you need:

- A mount with LX200, e.g. Rajiva's MCU-Update or Littlefoot
- I tested Fokusfokus with MCU Update, Version 3.59. Other versions should work as well. Please inform me if problems occur
- A focuser that can be controlled by the parallel port. The pins can be assigned in any order
- Better have a focuser that can be controlled via LX200 with the mount control
- A parallel port to control the long exposure of Webcam or DSLR. You can control the long exposure also via serial port, but you need a special adapter.
- Some functions are available only for Anand Rajiva's MCU-Update and LittleFoot, e.g. PEC-Training and Intelly.

2 First Steps

Before usage the program needs to be configured according to the existing devices. In particular, the ports must be set correctly. The settings made in the Settings dialog (Tools – Settings).

- Which serial port is connected to the mount? Does the mount „speak“ LX200 or the LX200-"dialect" by Anand Rajivas MCU / LittleFoot?
- Is a focuser available and how should it be connected? Via parallel port or via the mount control?
- Is there DSLR available and how should it be triggered? Via the parallel port, serial port or the mount control? A adequate adapter must be present. In addition, the manufacturer's software to load the images from the camera should be installed and assigned in the options (e.g. EOSViewerUtility).
- Is there a webcam with long exposure mode available? It will normally be connected via parallel port. Please check the PINs used for the control.
- Is a planetarium program (Cartes du Ciel) installed and assigned?
- For a exact positioning of the telescope, it is also important to enter the correct focal length and pixel size.

If this is entered and everything is wired, you're ready to go:

- Switch on the devices and start Fokuspokus. Fokuspokus will notify if it is connected to the mount.
- Direct the telescope to a star and synchronize the mount using the planetarium program. If you do not have Goto, you can enter the declination on the preview screen manually. Just enter a rough value.
- On the tab "control box" check the orientation of the telescope or camera: Looking towards the East or West? Camera upright, rotated or upside down? The settings can be checked with the direction buttons: The star on the preview image must follow the direction of keystrokes, e.g. Button "right" key: star moves to the right.

Now you're done. The rest is fine-tuning and will be described below.

3 The Windows

3.1 Main Window

The Main Window is kept small due to tabs for the various tasks. You can control the focuser from there, position the telescope and capture images with Webcam and DSLR. Besides, you can start the planetarium program and open the Preview Window.

3.2 The Preview Window

In the Preview Window you can display the preview image of the webcam or DSLR. You can also open an image from disc to compare it with the current live image. You can open two Preview Windows, but the webcam preview is only possible in the first one. In the first Preview Window you can set the parameters for the webcam and move the telescope by click on the preview screen. The second Preview Window can be used additionally for DSLR images or images from disc.

3.3 Options

The Options Window can be opened from Extras Menu in the Main Window

3.4 The Logbook

The Logbook shows which part of the sky was captured at which time and with in file the images are stored.

3.5 Technical Information

Here you can see technical information about the usage of the ports and pins as well as the communication between mount and telescope.

4 Functions of the Main Window

4.1 Focussing

4.1.1 Options

In the option window you can define if you want to use the parallel port or lx200 (serial port) to control your focuser. When you use the parallel port, you can also define which pins will be used for which direction. Also when you use lx200 you can switch the direction of the focuser motion. When you use the parallel port for focuser control, you cannot control your mount with lx200. So it's recommended to use lx200.

4.1.2 Setup the focuser for first usage

- The focussing functionality is based on the time which is needed to move from one eyepiece position to another one, using the focus motor. So when you want to focus again, you first synchronize with one focused eyepiece, then you mark another eyepiece position and press focus. The program then calculates the needed time and moves the focuser accordingly.
- After the start of the program, check if the focuser moves when you press the buttons „<“ or „>“ and if it moves to the expected direction. If not, you can switch the direction in the options dialog.
- Then you must measure the speed of the focuser on tab „Setup focuser“, if you want to use this functionality. To measure it, move the focuser a well defined distance, using the buttons of tab „control box“. The best method is to move it until the focus wheel has turned

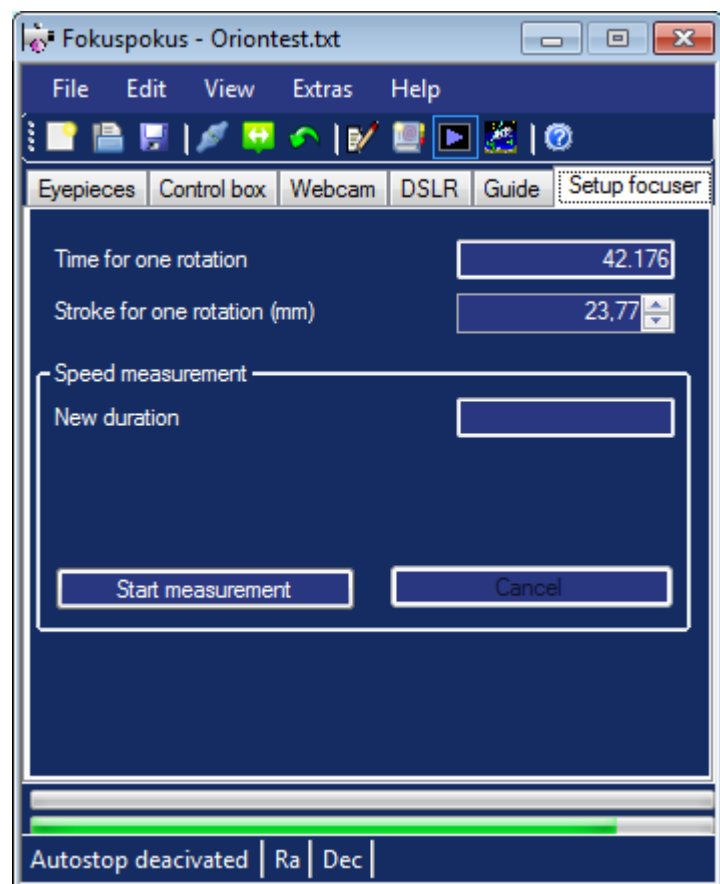


Image 1: Calibrate the focuser

- 360 degrees. The movement may consist of multiple parts in different directions. The program cumulates all movements. Of course, you can use also another distance as reference. It is only important to use always the same distance, whenever you measure it.
- Now take the first eyepiece, focus it and save the position. I recommend to take an eyepiece with short focus length first because you can focus it very precise. The focus position of further eyepieces will be measured in relation to the first one as reference. To use it as reference, select the eyepiece and press button „Synchronize“.
- Then you can focus the next eyepiece and save the focus position (relative to the reference

- Don't forget to save the data at the end. Choose your telescope's name to save it in case you have more than one.

4.1.3 Focusing

When you start Fokuspokus the next time, the last used eyepiece is marked as synchronized. Please check, if it's really the correct one. If not and you don't know where the focuser is positioned, just enter an eyepiece, focus it on tab „Control box“ and then synchronize on it.

To focus on another eyepiece then just mark it and press „Focus“. The program will calculate the distance and move the focuser correspondingly.

If it does not focus correctly maybe the focus speed has changed since the last measurement. A reason for that may be that the battery power has decreased. In this case just measure the focuser speed again. The saved distances will then be converted accordingly. You do not need to measure all focus positions again!

It depends on your focuser motor and power supply how exact this works. At least you come quite close to the focus and it's easy to do some fine tuning from the control box.

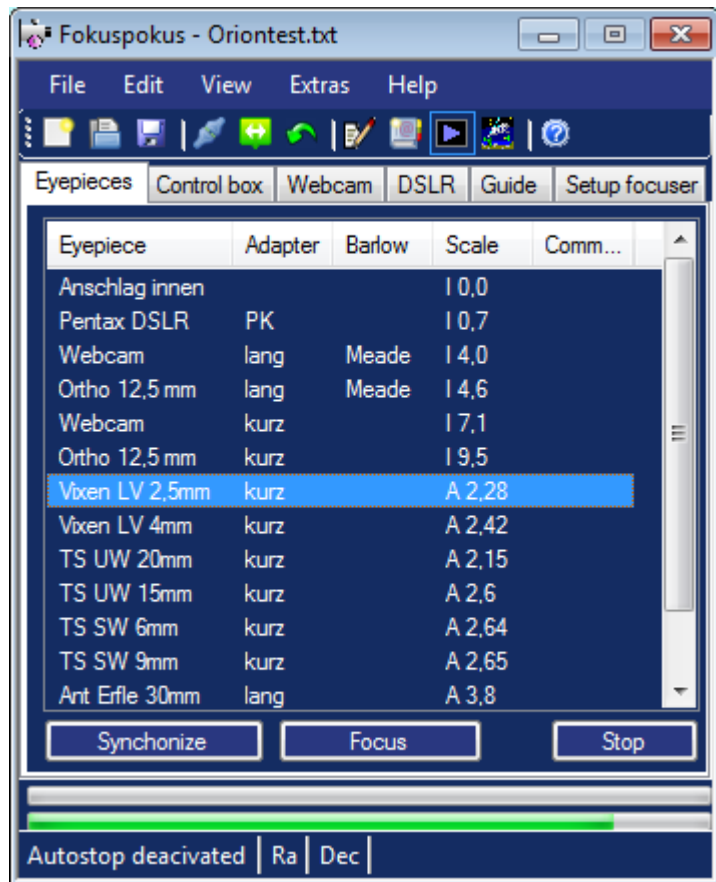


Image 2: Synchronize and focus

4.1.4 Focussing with Mouse and Keyboard

On tab „Control box“ you can use the right group box to focus. The focuser can be moved out or in with the buttons „<“ and „>“. You can control the pulse time of the movement with the buttons „I+“ and „I-“. To interrupt it, press the button again or press Stop. The progress bar at the bottom of the window displays the position of the focuser.

It is also possible to use the keyboard to control the focuser. Just use the arrow keys, notice that they are similar positioned on the keyboard like the buttons on the UI. Press the Stop button to activate the keyboard control on the control box. This is necessary as you can control also the direction of the telescope with the keyboard from this tab. You can switch between both modes with the shift key. On other tabs and on the Preview Windows you can control the focuser with Ctrl + Arrow Keys.

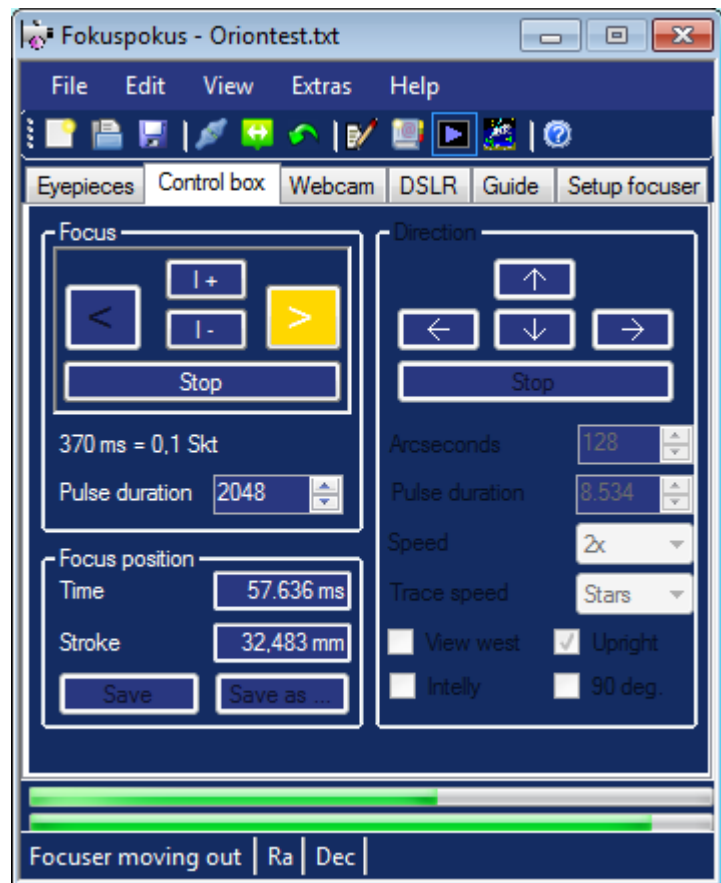


Image 3: Focussing on the control box

Key board functions:

- Left Arrow – move focuser in
- Right arrow – move arrow out
- Arrow up – Increase pulse duration by factor 2
- Arrow down – Decrease pulse duration by factor 2
- Space or Enter – Stop movement
- Shift key: Switch between focusing and turn the telescope

During the movement only the space key may be used to stop it.

4.1.5 Synchronize

Fokuspokus does not get informations from the focuser about it's position. So all movements are calculated relative to a reference point. You can define any eyepiece position as reference point using the button „Synchronize“. The only condition is, that this eyepiece must be focused before.

4.1.6 Autostop

Autostop is a safety feature for the focuser. When activated the focuser is stopped automatically at the first and last saved focus position. So it is a good idea to save the inner and outer focuser position like an eyepiece, with some reserve to the physical stop.

The physical stop of the focuser cannot be recognized by the program. So the autostop is not really save and it can work only when the movement started with a synchronized position. Otherwise the movement can damage your focuser despite of an activated autostop. So please have a look at your focuser when it moves.

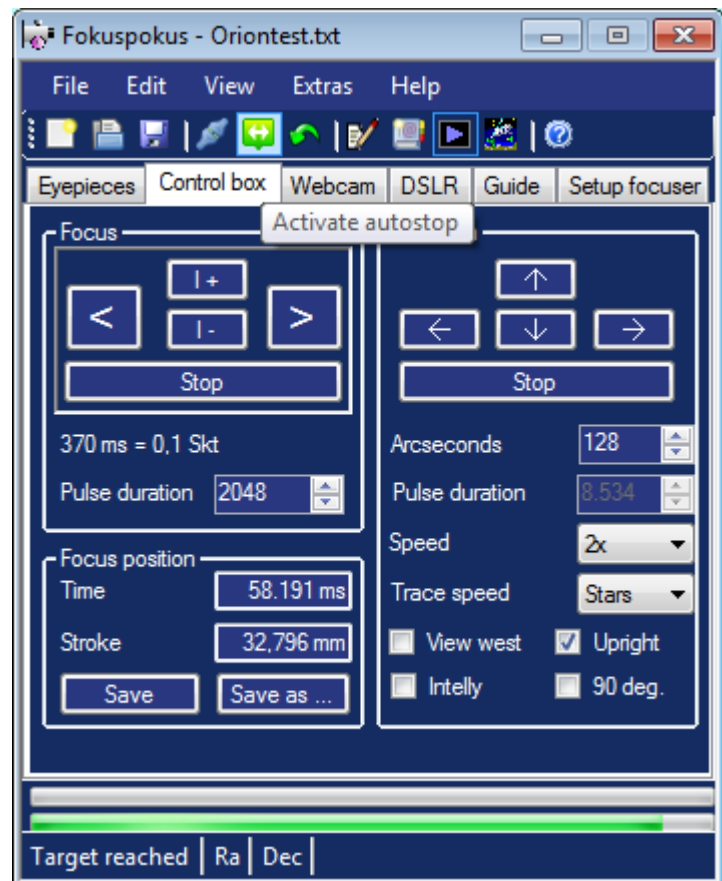


Image 4: Autostop

4.1.7 Display the Focuser Position

The position of the focuser is displayed in millimeters and milliseconds of movement, relative to the inner stop position. Of course, you need to measure the speed of the focuser for this and enter the stroke for the related turn of the focuser. The progress bar at the lower end of the window shows the position of the focuser.

4.1.8 Change Saved Eyepiece Data

When you double click on an eyepiece in the list, you get a popup to edit the item. Here you can change the name and other informations oder just delete it. The position cannot be changed directly. You can change it with the following steps:

- Synchronize on a reference eyepiece

- Focus on the eyepiece to be change using the focus button
- Move the focuser on tab control box or use the keyboard.
- When focused, save it on the control box

To save the position of a new eyepiece, use „save as“ on the control box

4.1.9 Focus Aide

You can activate the focus aide on the Preview Window. When activated, use the right mouse button to click on a star. This star will be tracked then and will be shown eight times enlarged in a stable position in the left upper corner of the image area.

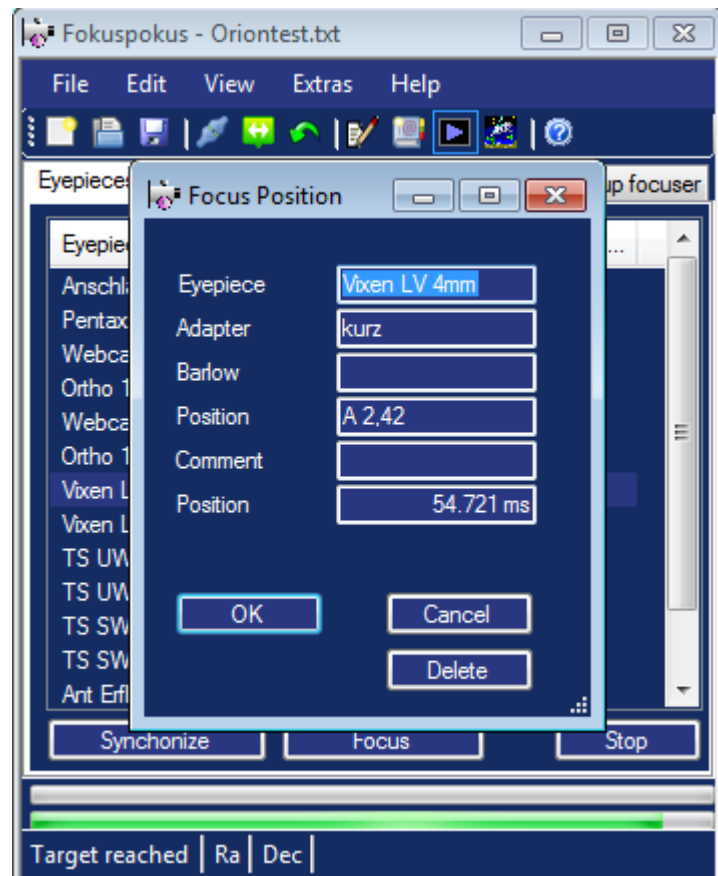


Image 5: Change data of an eyepiece

4.2 Move the Telescope

4.2.1 Move the Telescope using Buttons

On tab „Control box“ you can move the telescope with the buttons on the right. When you press a button the stars visible in the Preview Window will move to the indicated direction. So it's more like moving the image as moving the telescope. Width in arc seconds and speed can be defined below the buttons. You can see the needed with when you look at the reticle of the Preview Window.

You can also define the general trace speed of the mount: Siderial, Terrestrial, Lunar or Solar. When you choose lunar, Fokuspokus will track the moon movement periodically also in declination. This is an advantage for longer observations like an eclipse, as the moon can move up to 15 arc minutes per hour in declination. Besides, deviations from the mean speed in right ascension will also be considered. As you know, the moon is faster when he is near the apogee then when he is close to the perigee. For most exact results you should synchronize your mount position with a planetarium program.

Before you do any movements of the mount, you should check if the indicators „View West“ and „Upright“ are marked correctly. „View West“ means, that the telescope is directed west while the counterweight is in a lower position than the telescope (that means: no exotic position)

„Upright“ should be marked when you look normal through the telescope or your camera is placed directly on the mount. It should not be marked, when the camera is placed near the counterweights.

You can also flag that your camera is turned by 90 degree. Use this when your camera is directly on the mount, that means the bottom of the camera is at right angle to the declination axis.

It's easy to check if everything is flagged correctly: Just move the mount a little bit with the buttons. The stars on the Preview Window should always follow the direction of the arrows on the buttons.

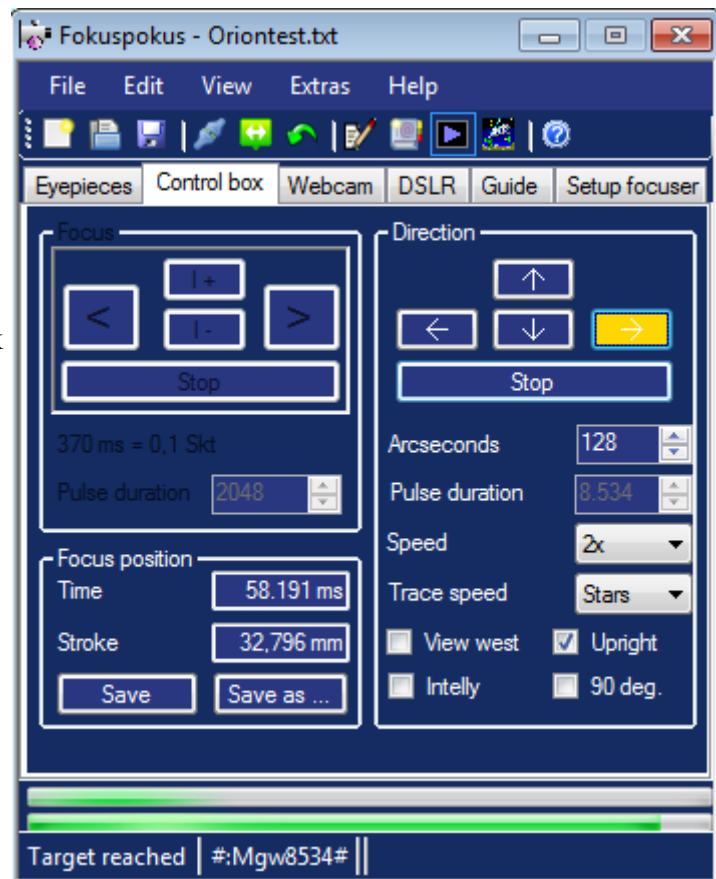


Image 6: Controlling the telescope direction

4.2.2 Using the Keyboard to Move the Mount

You can use also the keyboard to control the mount on tab „Control box“.

- The arrow keys correspond to the buttons.
- Space key stops all movements.
- The width can be controlled by „Browser back“ and „Browser forward“.
- Shift key switches between mount control and focuser control.

So here the same keys are used as for focussing. To activate the keyboard control for the mount, press the stop button.

4.3 Capturing Images and Videos with the Webcam

On tab „Webcam“ you can control the capturing of images or videos. The Preview Window will open automatically when you open this tab and your webcam will be activated.

4.3.1 Capturing Images

In the upper part of the webcam tab you can start capturing a series of images. Choose number of images and format and press start. For each series a new folder will be created according to the given name and a sequence number. The images will be save with the given name and a sequence number, too. Bmp format is best, as it is the fastest format to save the images. To check if everything is saved as expected just press the open button in the save box. The progress of the image capturing will be displayed in the status line.

Note: Exposure time, gain and frame rate can be set in the exposure dialog. You can open it on the Preview Window.

You can capture also long exposure images and enter the exposure time here. In the status line you will see then a count down for each exposure. The camera is controlled via the parallel port for long exposures. In the options dialog you can define which port or which port address will be used. Additionally, you can define there which Pin of the D-Sub-plug will be used to control the exposure.

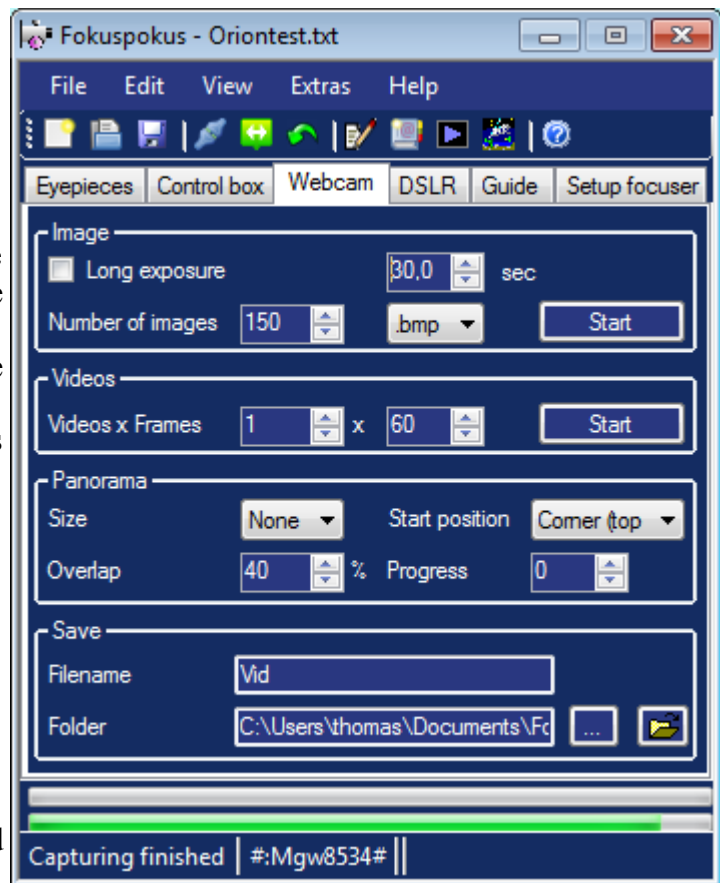


Image 7: Capturing images or videos

4.3.2 Recording Videos

To record videos enter the number of frames required and press start. You can also record a series of videos. Each video will be saved under the given name and a sequence number. Pressing the start button (labeled Stop when recording) again or pressing the escape key will stop the recording before all frames are recorded. I have set the limit to 4500 frames, as otherwise the video may get bigger than 2 GB and it cannot be processed by Giotto.

Note: Exposure time, gain and frame rate can be set in the exposure dialog. You can open it on the Preview Window.

4.3.3 Panorama Images (Mosaic Images)

When you capture images of the moon using a webcam you might wish to combine multiple images to one bigger image. To achieve that, enter the panorama size and the percentage of overlap of the images – a typical value is 40%. You can capture a series of images or videos for each part of the mosaic, as described in the previous chapters. Then press one of the start buttons for an image series or video and the rest will be done automatically. Fokuspokus positions the telescope to each part of the mosaic and then records the images. As the telescope is positioned automatically in between the mosaic parts, autoguiding is not possible during mosaic capture. To achieve most exact positions for the mosaic, synchronize the mount position with a planetarium program. Exact positions help to put them together later on without problems, especially if you use a barlow lens for high resolution images.

Note: If you have a telescope with 1200mm focus length and a Toucam you need a 7x7 mosaic for full moon size. Some of the images will be beside the moon in this case.

You can choose the start position of the mosaic: this means, if the currently visible image will be in the upper left corner, in the middle of the top line or in the center of the result image, as seen in the Preview Window.

Here is an overview about the sequence, in which the images are taken for the mosaic, depending on the start position:

Start in the upper left corner. The numbers in the blue area specify the sequence number of the mosaic image. It's the image you see in the Preview Window when you start capturing.

Size	2x2	2x2	3x3	4x4	5x5	6x6
2x2	1	4	5	16	17	
2x2	2	3	6	15	18	
3x3	9	8	7	14	19	
4x4	10	11	12	13	20	
5x5	25	24	23	22	21	
6x6	26	...				

Start image is the center of the image :

Size	Etc.	5x5	3x3	3x3	3x3	5x5	Etc.
Etc.							
5x5		21	20	19	18	17	
3x3		22	7	6	5	16	
3x3		23	8	1	4	15	
3x3		24	9	2	3	14	
5x5		25	10	11	12	13	
Etc.		26	...				

Start image is top middle:

Size	Etc.	5x5	3x3	3x3	3x3	5x5	Etc.
3x3		10	9	1	3	25	26
3x3		11	8	2	4	24	...
3x3		12	7	6	5	23	
5x5		13	16	17	20	22	
5x5		14	15	18	19	21	
Etc.							
Etc.							

With this sequence it can be achieved that an result mosaic is always the best possible rectangle, even if you abort the capturing.

To combine the images you may use HuginPanorama. With 40% overlap it usually works automatically.



Image 8: Example of a moon mosaic, original size 2100x2100 pixel, captured with 40% overlap. Combined of 25 images, each with 640x480 pixel

4.3.4 Guiding when Capturing Images or Videos

When capturing images you can:

- use the control box for manual guiding
- use the keyboard for manual guiding
- click on a position in the Preview Window to guide
- activate autoguiding

When recording videos you can:

- use the control box for manual guiding
- use the keyboard for manual guiding
- click on a position in the Preview Window to guide
- activate autoguiding is not supported as well as using zoom

4.3.5 Webcams with RAW Format

There are two options to use webcams with RAW format:

- Display and save the images in RAW format. In this case you must convert them later to RGB.
- Alternatively, Fokuspokus can convert the images on-the-fly. In this case the images will be displayed and saved as RGB. They are only deBayered without further processing.

You can decide on the options window, which mode you want to use. When using the direct conversion, you must try out, which of the four methods fit to your camera. Also, your computer should not be too slow for that.

Videos cannot be converted directly.

[Here](#) you can find further information about webcams with RAW format.

4.4 Capture Images from a DSLR

On tab DSLR there is an interval timer to capture images from a DSLR. For images with short exposure times you can also use the program of the manufacturer, of course. From here you can control long exposures from 1 second to 1 hour using the bulb functionality of your camera.

You need a special cable to connect your camera with your notepad or PC to use this functionality. Instructions how to build such cables are available in the internet, for example in Rajiva's forum. Those cables connect the parallel port of the PC with the socket for the cable release of the camera. It is not sufficient to connect the camera with USB only. You can use also the serial port or the interface of the mount instead of the parallel port. But you need another cable in this case.

Number of images: defines the number of images in the series

Exposure time: This is the exposure time for each exposure of the series. Behind this, you can see the total exposure time = number of images * exposure time.

Mirror lock-up: Mark this when you activated mirror lock-up in the camera. The program calculates the two seconds additionally for the exposure. Using a Canon camera, you must activate mirror-lockup in the camera menu and activate the self-timer of the camera.

Noise-reduction: Activate this, if you have activated noise-reduction in the camera.

You can specify a time which is needed to **save** the image or to transfer it to your computer. So you can avoid that the next exposure starts before the previous one is completely finished. To have real interval shots you can enter also a longer timer here, for example when you want to take pictures of a moon or sun eclipse.

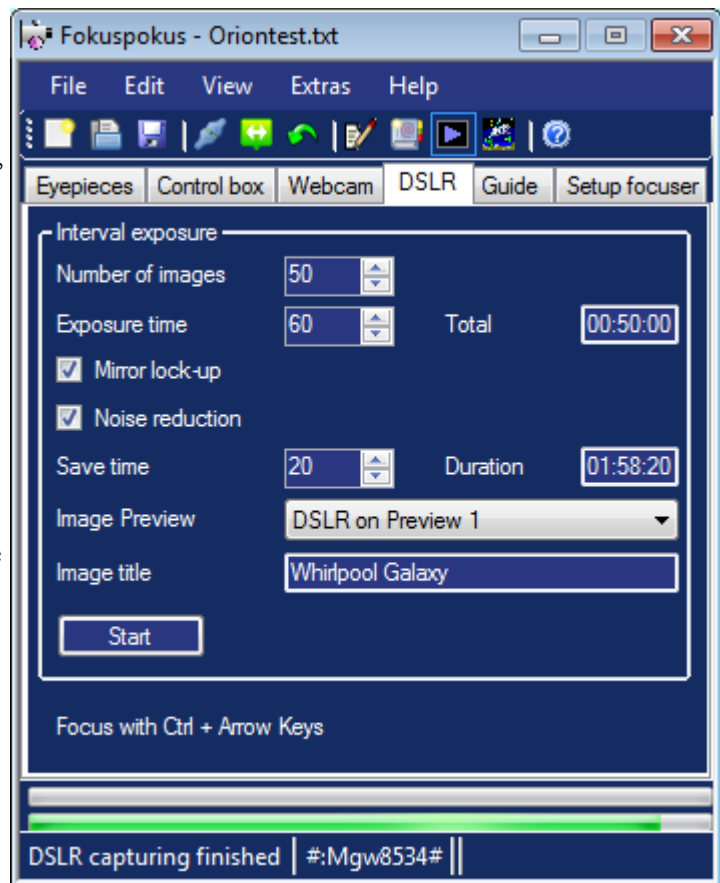


Image 9: Capturing images from a DSLR

Surely you want to display a **preview of the images** directly, so you can specify the source of the images and in which preview window you want to display them. Use Preview 2, if you use autoguiding with a guide camera at the same time.

Press the start button to capture the images. For each image you can see the number of the image, the remaining time and status (exposure, noise reduction, saving) in the status line. The specified image title will be stored in the exif data of the image and in the Logbook.

Press Stop to cancel the series. The current image will be finished and saved.

Note: The images will be saved on your computer only, if it is connected with the camera via USB and you have started the manufacturer's connection software for the camera from the Preview Window. For Canon, EOSViewerUtility and from there EOS Capture must be started.

4.5 Autoguiding

Fokuspokus offers several options for autoguiding. In any case, set a target point in the Preview Window to which the lodestar will be guided. The lodestar is sought within the specified distance from the target point. The brightest star in this area is recognized as guiding star. For accurate tracking, it is necessary to specify the correct focal length of the telescope, the pixel size of the camera and, where appropriate, the use of a Barlow lens. The movement is depending on the declination. Therefore synchronize the mount with a planetarium program (Cartes du Ciel) to a star in the vicinity of the lodestar. Fokuspokus then reads the declination from the mount and it can calculate the exact impulse length needed for the movement to bring the lodestar to the target point. You can enter the declination manually on the preview window, if your mount cannot provide this information to Fokuspokus.

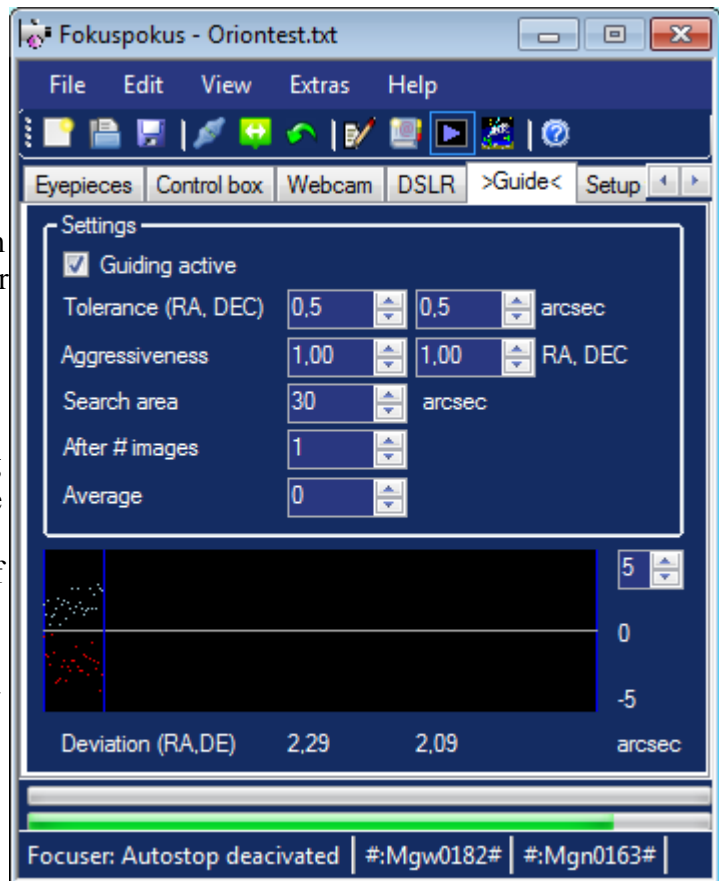


Image 10: Autoguiding

When autoguiding is switched on, the lodestar will be guided exactly to the target point and the position of the lodestar is determined subpixel exact. You can specify a tolerance within which no direction correction is made. If the lodestar moves beyond the tolerance, it will be guided exactly the target point, when the aggressiveness is set to 1.0. Less Aggressiveness mean less movement. This can help to avoid tracking the seeing. Or: Aggressiveness = 0.0 in Declination means, that there will be no guiding at all in Declination. "After number of images" should be set in a range, that a guiding impulse is triggered every 1 to 5 seconds. You can take the average of the lodestar position from the past n images. This helps to reduce guiding the seeing and noise webcams.

4.5.1 Guiding with a Webcam while capturing with a DSLR

If you guide with a webcam, while exposures with another camera are being carried out, you should set „After number of pictures“ in a way that guiding will be done every 1-5 seconds. Preview window 1 will be used for the webcam and preview window 2 can show the preview of the DSLR RAW image in this case. The guiding Webcam can work also in long exposure mode in this case with exposure times of a few seconds. In this case you should activate dark frame subtraction in preview window 1.

4.5.2 Guiding at Long Exposures with Webcam

If a webcam carries out long exposures guiding can be carried out between the images. So no additional guiding camera will be used in this case. Despite of inaccurate telescope orientation and periodic error the lodestar will be kept on position after each image. Every single image is of course just as sharp or blurred as without guiding. But when you overlay the images, you have a better

intersection.

The following processing steps are executed automatically:

- Long exposure with webcam, e.g. 15 seconds
- Search the lodestar on the result image
- Directional correction, e.g. 1678 msec
- Wait until the telescope movement decays. The time is specified in the options, e.g. 5 seconds
- Next long exposure

In this case you should specify some arc seconds tolerance, so that not after every image will be guided. This would result in longer time for the total series due to the pauses between the exposures.

4.5.3 Guiding at Long Exposures with DSLR

As is the case for a Webcam also the pictures downloaded by a DSLR can be used for guiding. A precondition is a program, which downloads the images after the exposure is finished, like for example PENTAX REMOTE Assistant. If program and download folder are adjusted in the options, they will be shown in the Preview Window and will be used for guiding. You should adjust the duration between the images that guiding is finished with beginning of the next exposure. This kind of guiding is useful at exposure times between 15 seconds and about 2 minutes.

The following steps are executed automatically:

- Image 1: Exposure e.g. 30 seconds
- Image 1: Darkframe 30 seconds
- Image 1: save and open in preview window
- Image 1: Detect lodestar and calculate guiding correction
- Image 2: Exposure
- Image 2: Darkframe. This time is used to guide the telescope with the calculated correction. There is also enough time to decay the movement
- Image 2: Save and open in preview window
- Then the cycle starts from the beginning

So the guiding is delayed to the next dark frame in this case. This means that you can guide only after every second image or you must decrease the Aggressiveness to 0.5. Then you can guide after each image.

4.5.4 Guiding with other Image Sources

In the Preview Window images can be indicated automatically, which are captured by an other source into a certain file. These can be used likewise for guiding. For test purposes arbitrary images can be opened and used for guiding (menu: Open and then use the forward and backward buttons in the function bar)

4.6 Other Features of the Main Window

4.6.1 The File Menu

New: Create a new file with eyepiece data. You can create multiple file for multiple telescopes.

Open: Open such a file

Save/Save as: Save a file with eyepiece data

Print: Print the eyepiece data as a table

Properties of the currently opened file. It shows the path of the file.

Close Fokuspokus

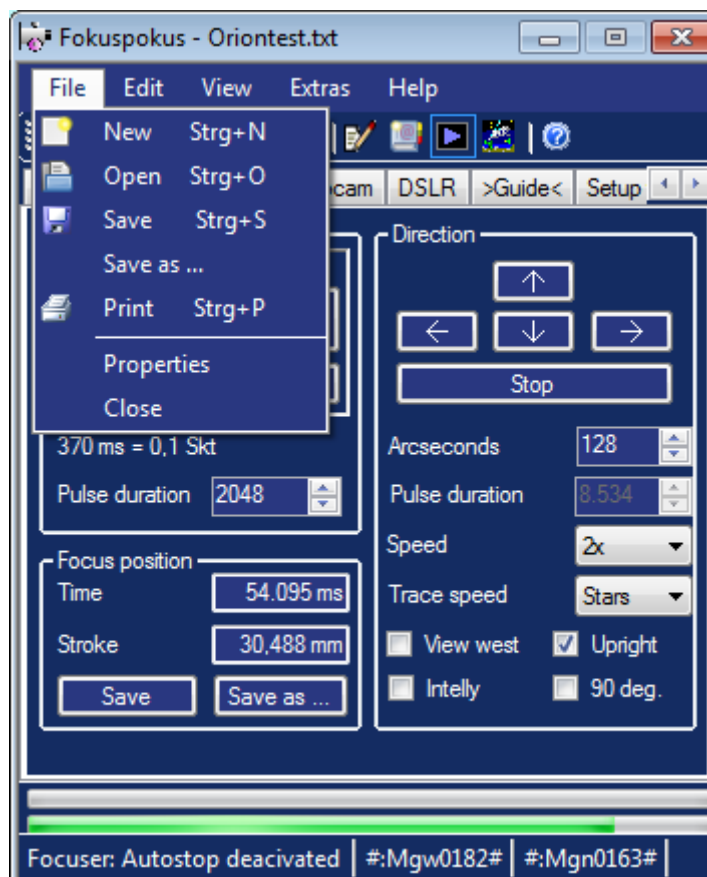


Image 11: The File Menu

4.6.2 Menu: Edit

Activate / deactivate autostop: Activating and deactivating the software stop. The software stops the focuser movement at the extreme inner or outer position which has been saved. It works only if it has been synchronized before. However this function is not absolutely reliable, as the focuser speed depends on the used voltage which may vary.

Connect: Try to connect to the mount using the LX200 protocol. The connection will be set up via the serial port. You can specify the port in the options dialog.

Disconnect: Disconnect from the mount, the port will be released, so another program could use it.

Undo last move: You may move the telescope into a wrong direction or the distance was chosen wrong. So the observed object may disappear from the window. Don't worry. Just choose „Undo last move“ and the last move will be done in reverse direction. So your observed object will not get lost so easy. You will see it on the window, where it appeared before your mistake. Then you can take time and try again.

PEC: This function is available only for MCU Update

PEC – Active: Shows, if the correction of the periodic error is activated by serial port. It activates or deactivates this function

PEC – Training – Stop: Stops PEC training and saves the PEC data to the mount

PEC – Training – Continue: Continue PEC training without deletion of the PEC data in the mount

PEC – Training – new: New PEC training. The PEC data in the mount will be deleted

PEC – Active (Paddle): shows, if PEC was activated by the paddle

PEC – Log: Logs the periodic error. A window appears as shown below.

The recording can be done in two formats:

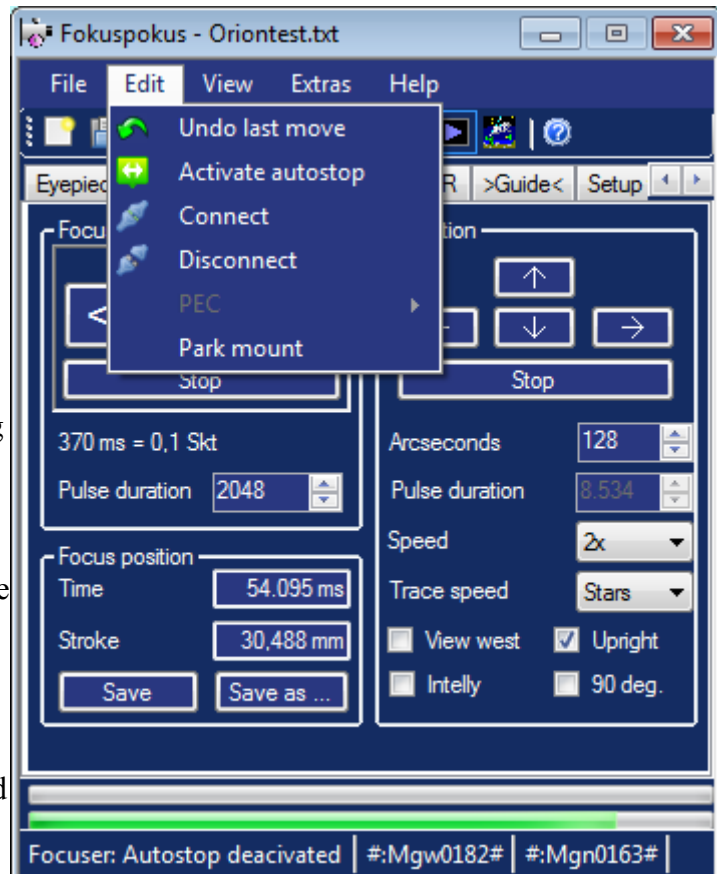


Image 12: Menu: Edit

- In the format of V4Control, which can be read and processed by ASPECT
- In a format compatible to K3CCDTOOLS. This can be analyzed by PEAS

You don't need to change the interval of two seconds. The declination will be taken from the mount. The deviation of the direction will be corrected automatically. In the next line you can see the result of the measurement. Press start and you will be asked where the data shall be saved. They will be saved, when you press close. In the last line you can see how long the measurement is going on.

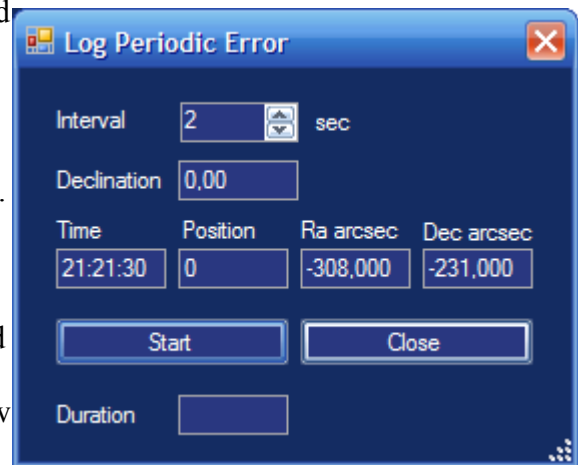


Image 13: Logging the periodic error

Park Mount: Save the position of the worm wheel to the mount and stop guiding. You need to do this only when you don't use the autopark function and you want to switch off the mount. You get a reminder to do so, when you close Fokuspokus.

4.6.3 Menu: View

Focuser: Show the focuser window.

Notepad: Opens Notepad. You can enter notes about your images there

Planetarium: Opens the planetarium program, e.g. Cartes du Ciel. The path for the planetarium program must be defined in the options.

When you open the planetarium program, the connection to the mount will be disconnected automatically. So you can easily connect the planetarium program to the mount and synchronize the mount or use the goto-functionality of the planetarium. When you close the planetarium program, Fokuspokus will connect automatically to the mount. When you use Cartes du Ciel, and you open it again, it will show the same area of the sky as before. For many function it is important to synchronize the mount on a star, as duration of the movement of the telescope in right ascension is depending on the declination. Relevant functions are the click-navigation, autoguiding, mosaic images and searching in the surrounding area.

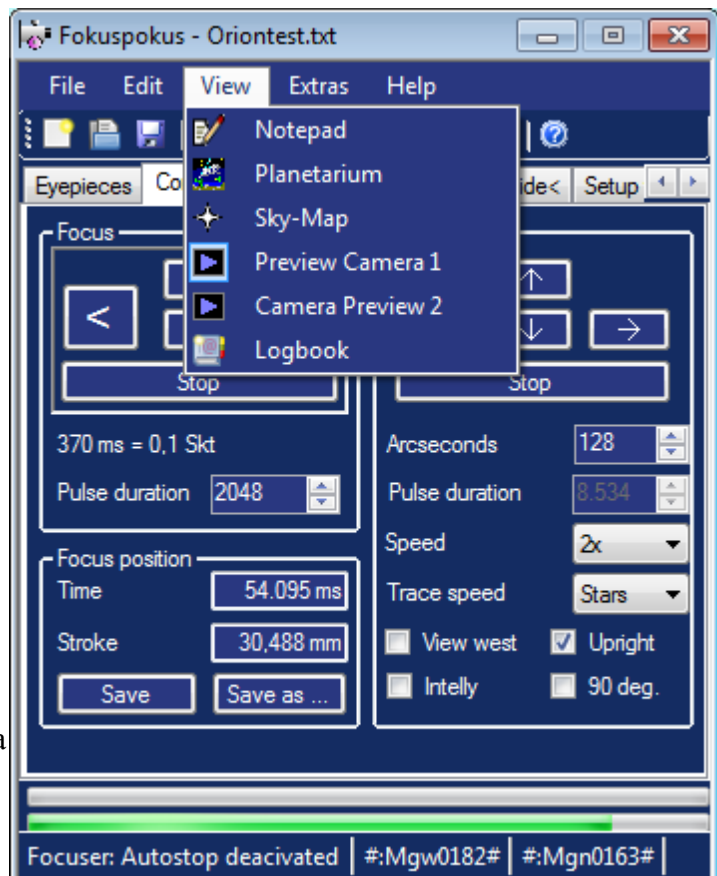


Image 14: Menu: View

Sky-Map: This feature is only available with connection to the internet. It shows the current telescope position in www.sky-net.org.

Camera Preview 1: opens the Preview Window to show images from webcam and DSLR usually.

Camera Preview 2: opens the second Preview Window. Main purpose of this window is the comparison of the image in Preview Window one with another image from disc. So it's easy to

position very exact on the same object at multiple nights. Alternatively, you can use Preview Window one for guiding with the webcam and window two to display the images captured with your DSLR.

Logbook: Opens the Logbook window

4.6.4 Menu: Extras

Settings: opens the options dialog for your program settings

Save and Load Settings: You can save your settings in a file and later reload it. Also your input for DSLR intervall captures and autoguiding will be saved.

4.6.5 Menu: Help

This menu can display the help document which you are currently reading, as well as some information about the program. It is also possible to check whether a newer version of Fokuspokus is available.

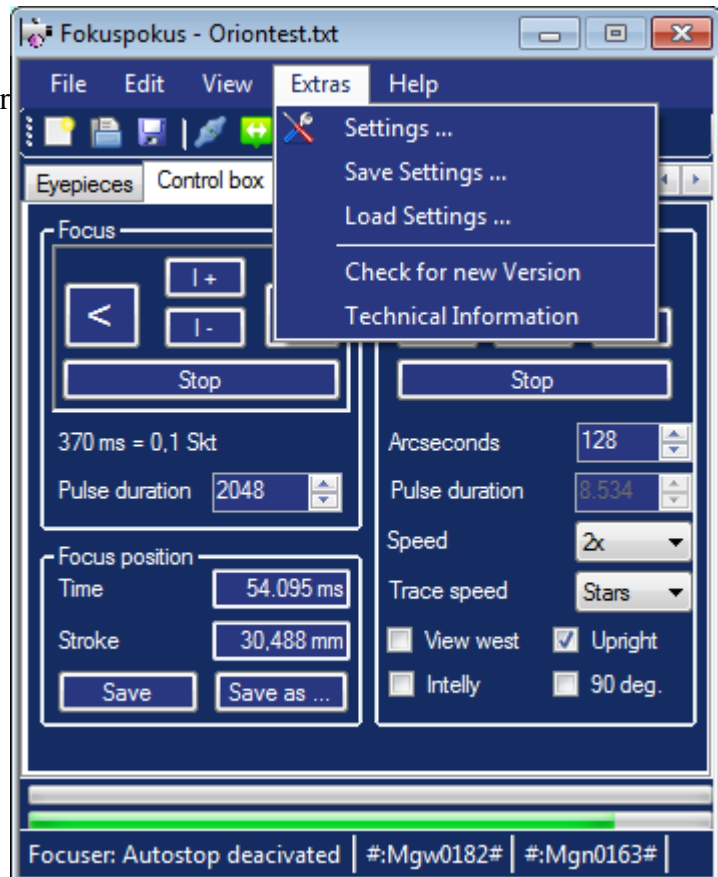


Image 15: Menu: Extras

5 Options

You can open the Options window from the main window menu extras - options. Here you can mainly set parameters for the interaction between Fokusfokus, the telescope and other programs.

After changing these settings you can apply them clicking OK, or click Cancel to discarded the changes. The Defaults button may be used to set the initial defaults from the installation. The settings are saved when you close the program in the Fokusfokus folder, file „SavedSettings.txt“. You can copy and rename this file to create several versions or backup copies. At program start, however, always "SavedSettings.txt" is used to restore the settings. With the button "Load" you can load the settings of the other versions or backup files.

5.1 View

Setting the language: automatic, according Windows language, German or English.

Define a **color**, in which the active button in the control box will appear

In addition, a **brief note** can be captured, which will appear in the control box in the focussing area. Since I have a scale at my focuser, I show a notice about the conversion between scale graduation and pulse duration.

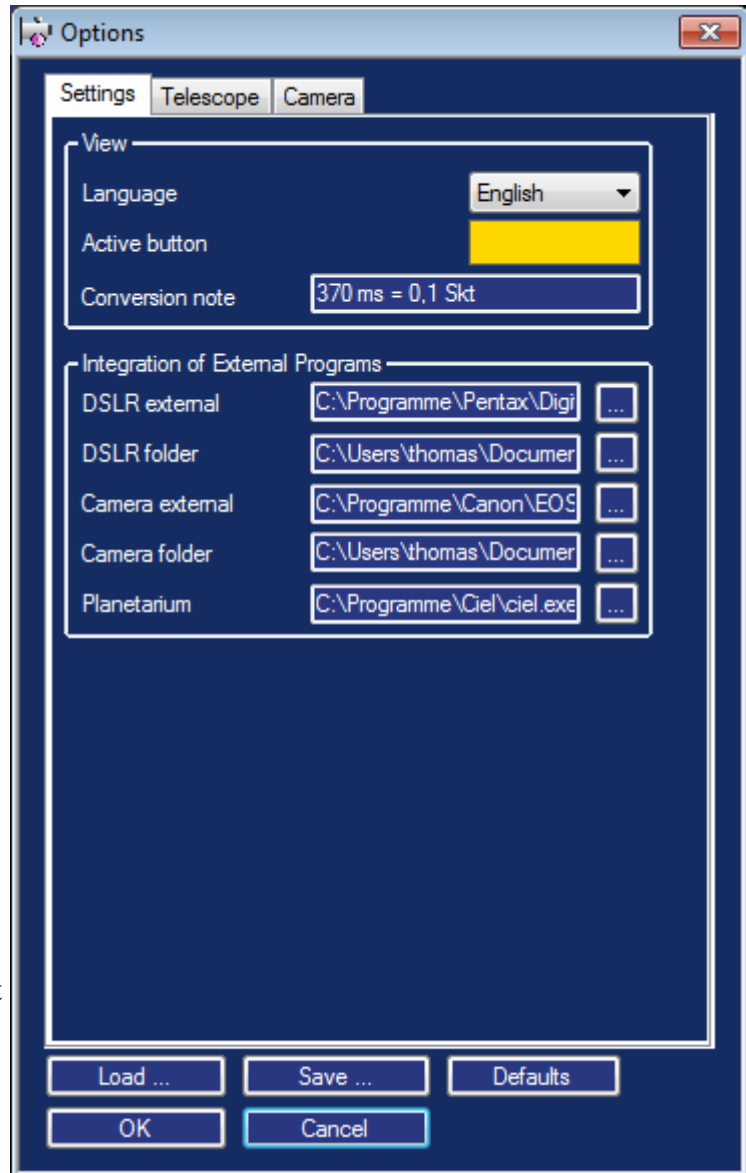


Image 16: The options dialog

5.2 External Programs

Here you can specify programs for the acquisition of images and the directory in which the programs download the images. So the images from the camera will be automatically displayed in the Preview Window.

Additionally, a planetarium program can be entered. With Cartes du Ciel, for example, you can very easy use the Goto functionality.

5.3 Telescope Control

This specifies which interface is used for the telescope control. For serial ports (COM) Lx200 can be used, enriched by some MCU-specific update commands. When using the parallel interface you can control only the focuser. The defined PINs are set and cleared in this case to control the focuser. Besides the usual parallel ports you can also use those with unusual addresses. Chose Port LPTx and specify the hexadecimal address in this case. The address can be found in the computer hardware - device manager at ports, LPT..., properties, resources, I / O area.

The direction focuser movement can be reversed here for LX200. That should normally not be necessary, because the used LX200 command clearly defines the direction. However, in exceptional case you can switch here instead of soldering cables.

Correction MCU speed 8x: If the telescope moves in right ascension, usually the tracking speed is taken into account. If you point to a star, and then move for example 1024 arc seconds to east and then back 1024 arc seconds to west you will get back to the same star. This works fine at all speeds except for 8x. At 8x, you will see that the star has moved while you moved the mount forward and back. I correct this problem when you flag this indicator. You can easily check if it is necessary. Either by moving east and west with speed 8x or by using the search functionality: when all surrounding fields have been reached, it should go back to the starting point. So is there a bright star in the center when you start, he must return to the center of the image at the end of the search. Is he right at the edge of the picture or outside, you should change the setting. On my MCU with firmware 3.59, I have to switch it on.

5.4 Telescope

Focal length, pixel size of the cameras and magnification factor of Barlow lens can be specified here for the calculation of the motion impulses. For more precise control you may information about backlash of focuser and mount. Due to the backlash a part of the motion is lost when the direction changes. This can be compensated by an prolongation of motion after change of direction.

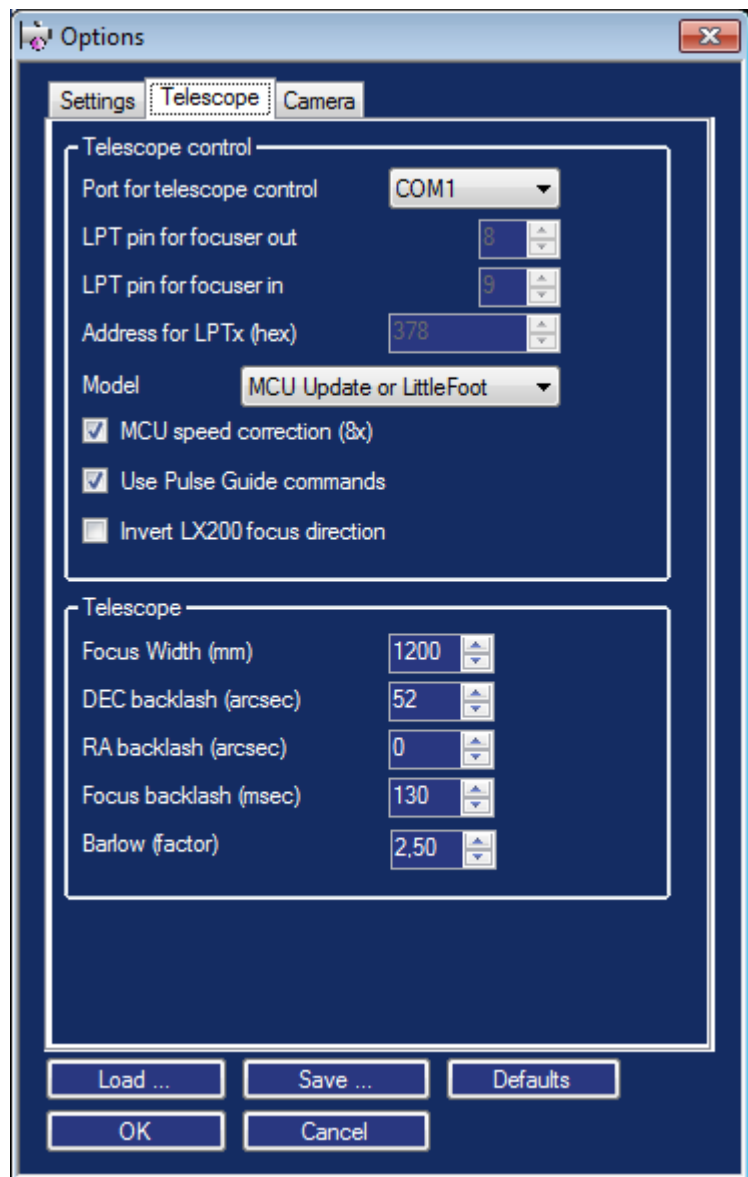


Image 17: The options dialog

This can be compensated by an prolongation of motion after change of direction.

5.4.1 Determination of the Focuser Backlash

The determination is not easy: Go from one side in small increments to the focus. Then you make a slightly bigger step in the same direction, e.g. 512 msec. This move has the full length without a backlash, as you go in the same direction. If you go back then with the same pulse duration, the focuser will most probably stop before the focus is reached. Now you should check, how much pulse you need to go to the focus. Once the backlash is properly adjusted, it will stop always exactly at the focus in this case. If the backlash setting is too large, it will move beyond the focus. It is now a question of patience to find a precise setting.

5.5 Determination of Backlash in RA and DEC

Direct the telescope to a bright star so that you can see it in the Preview Window. The star must be near the celestial equator, or you have to synchronize the mount so Fokuspokus can read the declination from the mount. For determination of the RA backlash then move the star from the left into the middle of the window, so the mount will do the next the motion into the same direction without backlash. Then go e.g. 128 arc seconds further to the right, in the same direction. This movement is without backlash. Then move 128 arc seconds left. If the star stops now 30 arc seconds right from the center it means that the game is 30 arc seconds. Then you can repeat the procedure with a Barlow until it fits exactly.

The determination of the backlash in DEC can be done accordingly.

Note: Also the firmware of MCU update has a logic to remove backlash. However in my version 3.59 this does not work in combination with pulse guide. So using pulse guide, do it here, else, do it in the mount. Don't do it twice.

5.6 DSLR

The program can release a digital reflex camera using the jack for the cable release. You need a special connecting cable for this which can find on the Internet. First, choose the port through which it sends a signal: parallel port or serial port. When using the parallel port you can adjust the port address and the pin to be used to control the release (release = shutter pin on).

Alternatively, a lx200-command of the serial port will be sent to the telescope. In this case you have only one cable from the laptop to the mount. The camera needs to be connected to the mount. As a

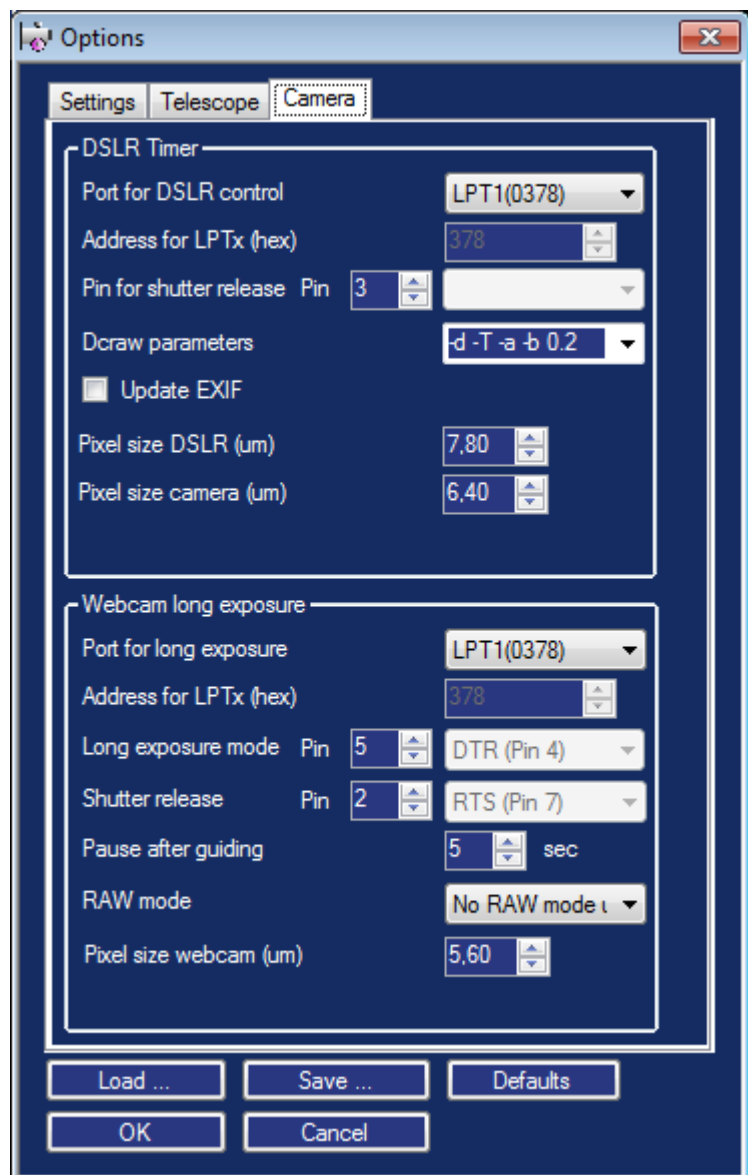


Image 18: The options dialog

first option, the fan-control can be used to trigger the camera. Of course this only makes sense if you do not have a fan connected. If you use Rajivas MCU update, another option is to use pin 14 of the MCU interface. In both cases, you need a cable with a special electronics to connect camera and mount. A description of such a cable is described in Rajivas support forum.

Never ever connect the camera directly to a port because the port sets about 5 volts and most probably this would damage the camera. The cable release jack of the camera expects, however, that the contact is closed. Therefore, there is a suitable circuit in between, which consists of a few parts (diode, transistor or optocouplers, resistors).

DCRAW Parameters: The decoding of RAW images of a DSLR is done by DCRAW. The parameters for decoding can be set here. It's recommended to use „-d -T -a -b 0.2“ for Canon.

5.7 Webcam Long Exposure

The control of long-term exposure is done via the parallel port. Enter the port and the port address. To avoid conflicts with other functions, you can adjust also the PIN used for the camera control. As described above under Guiding, the telescope can be aligned the exposures. So you can enter also a pause time which is needed for the telescope to stop moving. The next exposure will be done after the time needed for the guide pulse plus the pause time. The same applies for panoramic shots.

Note: As a **pixel size**, enter the effective pixel size, taking into account the current resolution of the camera. This can differ from the hardware pixel. For example, if you use a Toucam with 640x480 size then 5.6 micrometers are correct, which is also the hardware pixel size. However, if you use it with a resolution of 320x240 pixels then a pixel size of 11.2 would be correct.

Using a SK-1004x with format 640x480 pixels 7.65 micrometers is correct, although the physical pixel size is 9.8 x6.3.

6 The Preview Window

The Preview Window can show the preview from a webcam, captured images from a DSLR or images from disc.

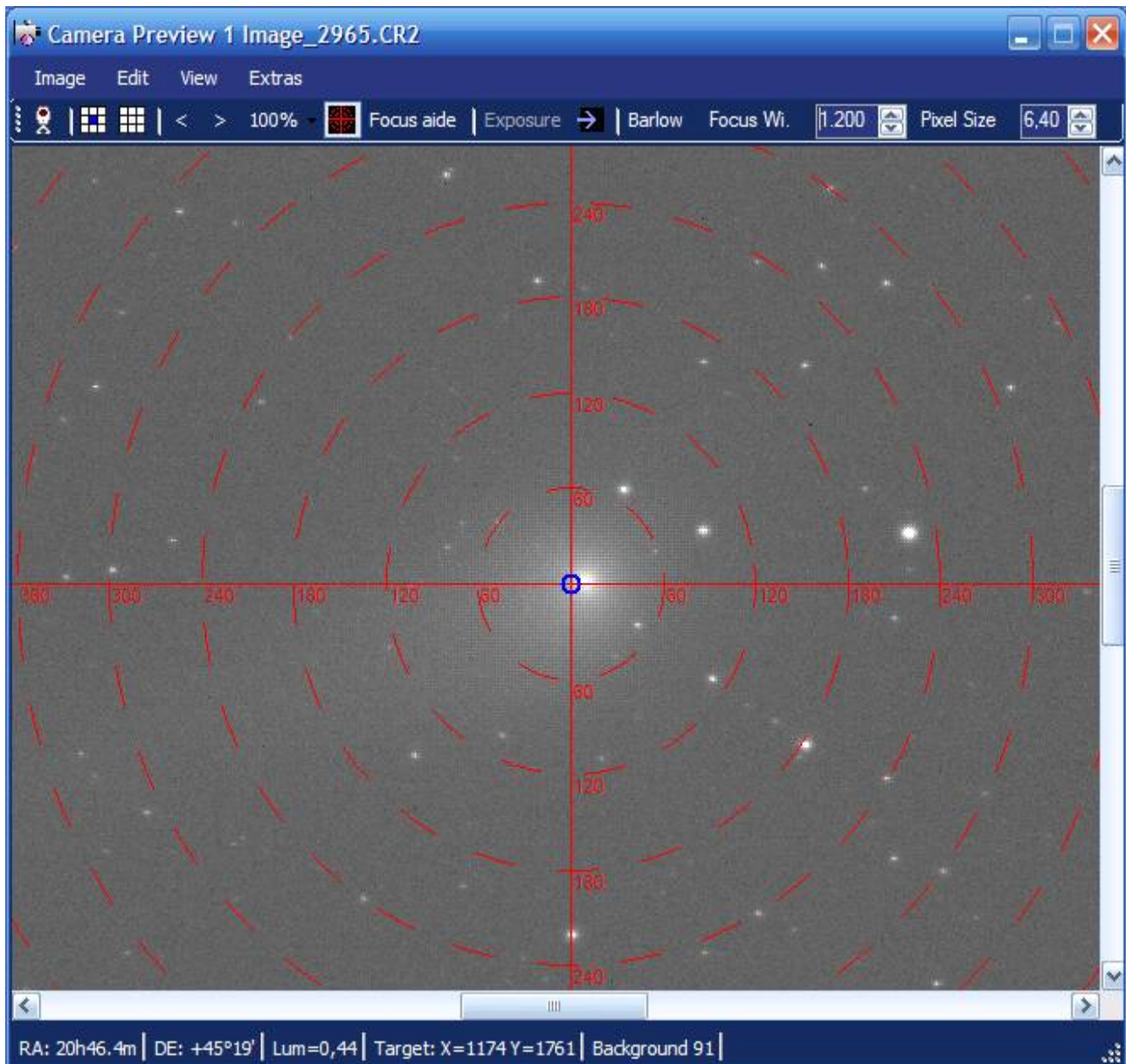


Image 19: Preview Window 1

6.1 Functions of the Preview Window

In the Preview Window there are simple functions to align the telescope, much easier than using the control buttons

Tip: many functions, such as click navigation or autoguiding can already be tested on the day when you open an image from disc. It is irrelevant for Fokuspokus whether an image is loaded from a camera or if it is opened from the hard disk. This makes sense of course only for test purposes and saves valuable observing time.

6.1.1 Click Navigation: Define and Navigate to a Target Point

A small blue circle in the image is the target point for the desired navigation. Per default, it is located in the middle of the image. By clicking with the right mouse button, you can put it to any position in the image. Then click with the left mouse button on another point in the image and the telescope will be moved so that this point will move to the target. This is called click navigation. This feature is available for any images available: both for the webcam and for DSLR images.

Example 1: After the first rough orientation of the telescope a star cluster is visible at the edge of the image and shall be moved to the center. As per default the target point is in the middle you just need to click on the center the star cluster and that's all. Take another picture to see that it's in the center now.

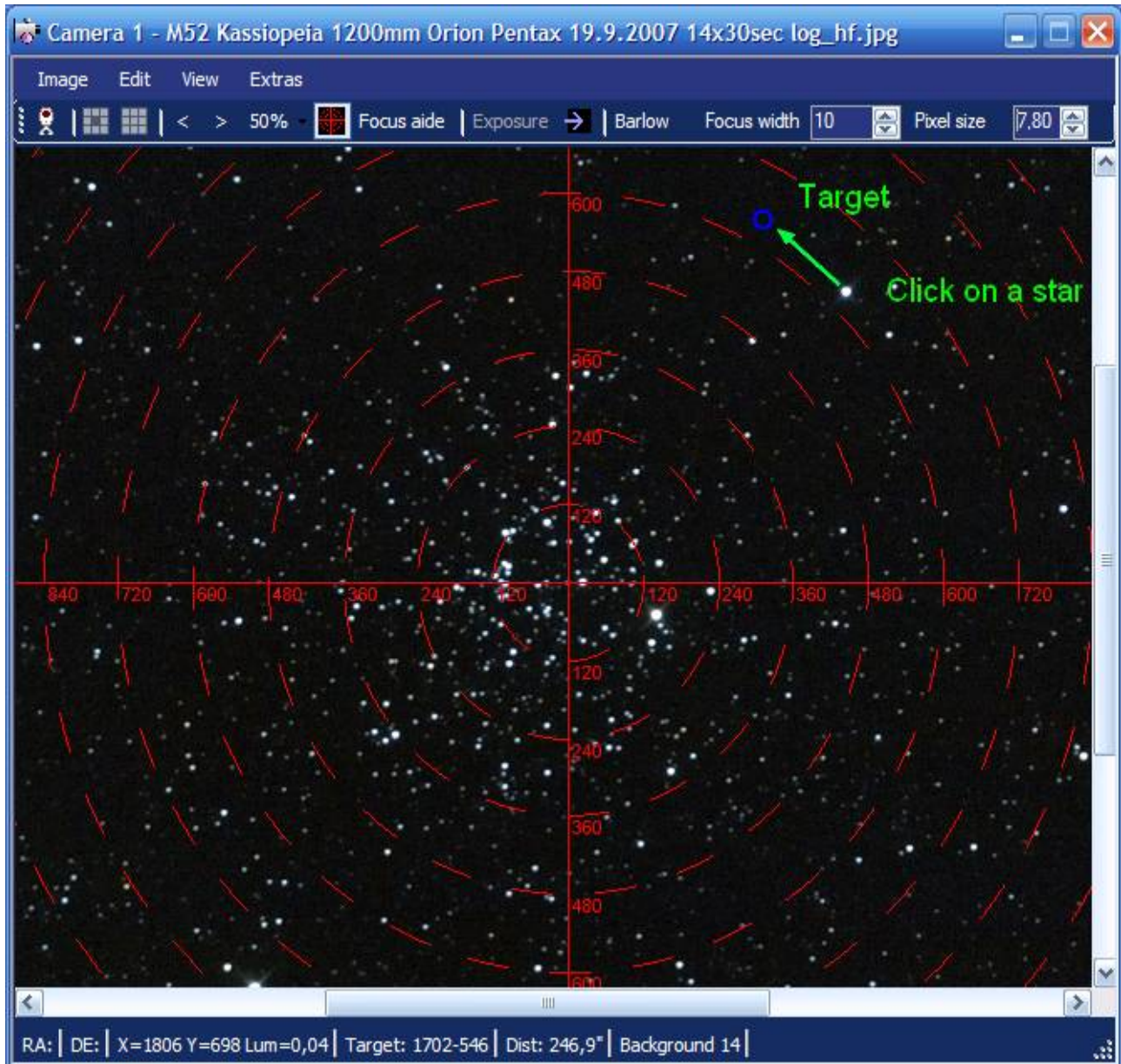


Image 20: Click on a star to move it to the target position

Example 2: An existing image series should be extended by further images. In the current images is a good lodestar on position $x = 1760 / y = 620$. You can see the cursor position and the position of the target point at the bottom of the Preview Window in the status bar. In this case, just point the target again to the position 1760/620 with a right mouse click, and then click on the lodestar. He

will be moved then to the target point. By using the two windows for preview 1 and preview 2 you can easily compare live picture and existing image..

If click navigation does not work, there may be two symptoms:

- The motion goes to the wrong direction. In this case check the settings in the main window (control box) for: „View West“, „Upright“ and „90 Degrees“. If the star already disappeared from the window due to this problem, you can use the function „Undo last movement“ to go to the previous position before you change the settings. You could check also the position of the camera in the focuser: To check this you can switch the mount off. A star should move then from left to right, if the camera is in upright position.
- The direction of the motion is correct, but it is too short or too far. Please check the settings for focus width, pixel size and Barlow. Is the value for the declination correct? You can see it in the status bar. If not, synchronize the mount to a star. The first time after the program started and after each connection to the mount the backlash will not be taken into account. In this case, just try again.
- Click navigation is available only for Preview Window 1.

6.1.2 Moving the Image in the Preview Window

If an image is bigger than the camera you can move it with the scrollbars. But there is an easier alternative: Press left mouse button and hold it so you can move the image directly while a hand is visible as cursor.

6.1.3 Informations in the Status Bar

In the status bar you can see the following informations:

- Declination – taken from the mount. You must synchronize the mount to a star to have a correct value
- Right ascension – read from the mount. You must synchronize the mount to a star to have a correct value
- The coordinates of the target point in the image
- When guiding is active you can see the distance of lodestar to target in pixels
- When using a webcam you can see the frame rate
- When capturing images with long exposure you can see the brightness of the background. When you have clear sky the value is low. When the conditions get worse, the value increases. This can save wasting time for capturing images when the seeing conditions are getting too bad.

6.2 Menu Functions of the Preview Window

6.2.1 Menu: Image

This menu specifies the source of the image which is displayed.

Open: Open an image from disc

Open from webcam: The connection to the webcam is setup and the preview image is displayed.

Open from DSLR (extern): A program for DSLR control will be started, as defined in the options dialog, for example Pentax Remote Assistant or EOSViewerUtility. When you then capture an image with this program, it will be displayed automatically in the Preview Window.

Open from camera(extern): The program for webcam control or DSLR control will be started, as defined in the options. Beside the above mentioned DSLR programs you could use K3CCDTOOLS or Qcfocus for webcam control. When you then capture an image with one of these this programs, it will be displayed automatically in the Preview Window.

Watch folder: Choose a folder to be watched with this function. Whenever an image is save in this folder - either by any program or manually - it will be opened and displayed in the Preview Window.

Save/Save as: Save the image that you currently see. You need this only in exceptional case.

Close: Close the Preview Window

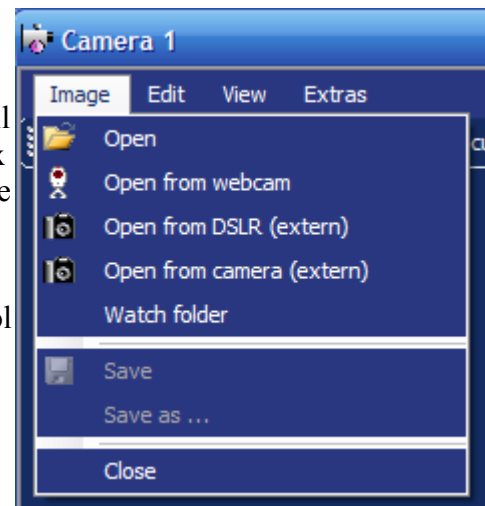


Image 21: Menu: Image

6.2.2 Menu: Edit

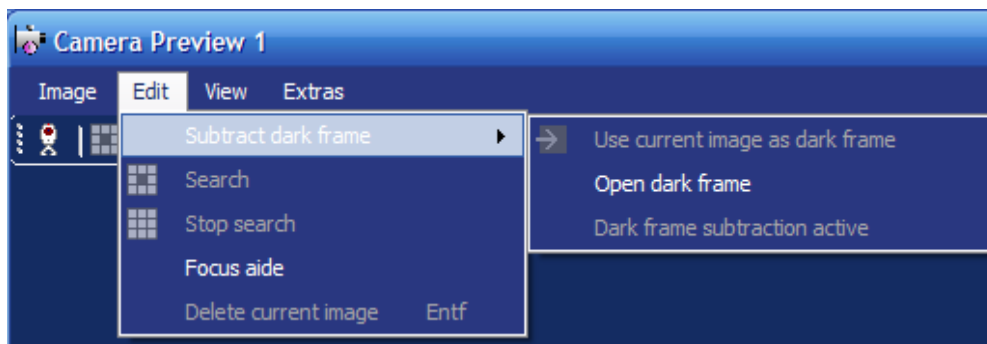


Image 22: Menu: Edit

Subtract dark frame: This submenu controls, if a dark frame subtracted from the image, when it is displayed. The subtraction is done only temporary for the display of the image to make faint objects better visible and usable for guiding. The saved images remain unchanged for later processing.

Use current image as dark frame: The image that you currently see will be taken as dark frame and subtracted from the next images. Use this function while you are capturing dark frames.

Note: When you capture dark frames after that, they will be displayed as black images.

Open dark frame: Open a dark frame from disc. Use this, if have captured dark frames before, and you are currently capturing light frames.

Dark frame subtraction active: shows, if currently dark frames are removed. You can switch off the dark frame removal here.

Search/End search: A webcam has only a very small field of view. So it may happen that the object you would like to observe is not visible after you have entered the webcam into the focuser. The search function help in this case: When you press the search button, the mount will be positioned to the 8 fields that surround the current visible field, with an overlap of only 10%. You must always press the button to go to the next field. The icon shows in which area you are currently searching. At the end the original position will be reached again. If you find the object you were

searching for, press „stop search“. Using a telescope with 1200mm focus length and a Toucam, you have a field of view of about 28 x 21 arc minutes instead of 10 x 7,7 without search.

Focus aide: When you activate the focus aide you will be asked to select a star. This star will be displayed in the upper left corner, magnified by factor 8. The position of the star in the magnified area will be kept stable, although if it moves in the preview area. The tracking function of autoguiding is used here, but the mount will not be moved. So you have a stable image, beside the influences of the atmosphere which may cause deformation of the star image.

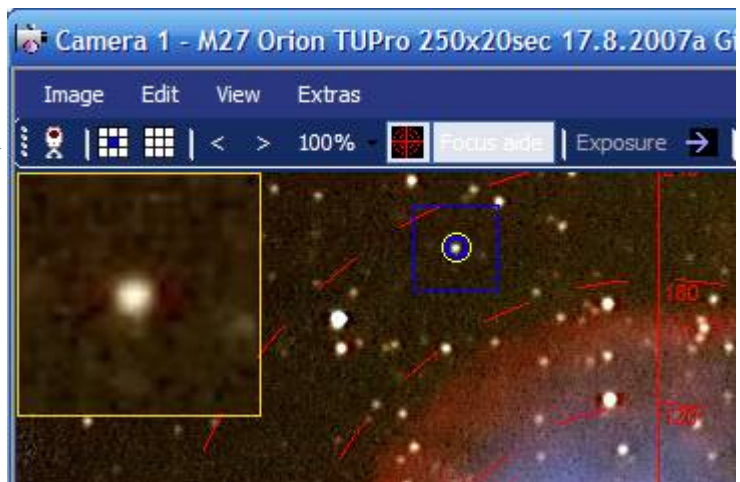


Image 23: Focus aide

Delete current image: The currently displayed image will be deleted. It will be moved to the Recycle Bin, but it will be displayed until the next image will be opened.

6.2.3 Menu: View

Preceding Image: If you have opened an image from disc, then the preceding image will be opened.

Next Image: If you have opened an image from disc, the next image will be opened.

Zoom: You can zoom in or zoom out the image. Senseless values are deactivated.

Reticle: Activate or deactivate the display of the reticle.

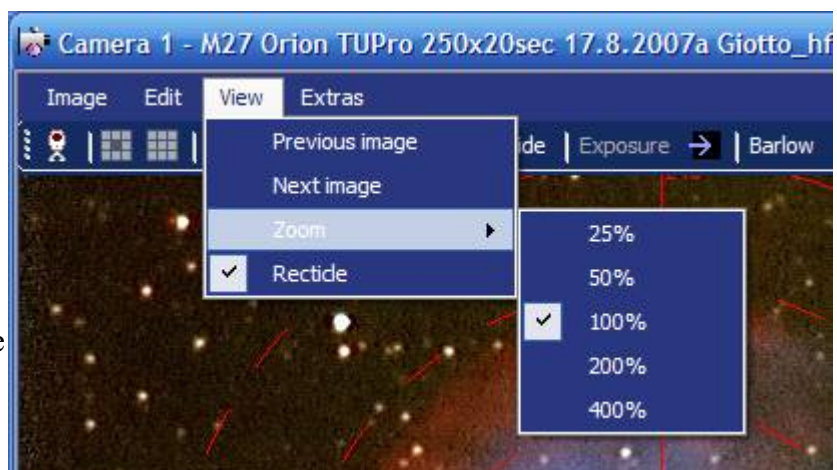


Image 24: Menu: View

6.2.4 Menu: Extras

Exposure: Shows the exposure dialog of the webcam. There you can adjust the exposure time, gain and frame rate.

Compression: Adjust the video compression.

Format: Here you can change the image resolution. Use the full resolution for best results.

Barlow: Specify, if you use a barlow lens or not. This information is needed for exact calculations.



Image 25: Menu: Extras

7 The Logbook

In the post processing of the images sometimes you may be not sure, which object is on which image. Especially with wide-angle images, it is sometimes not as easy to recognize the constellations. For this reason, usually you have an observation logbook to record the observation times and technical informations.

Fokuspokus automatically takes over this work: It automatically records all information for each image taken with the DSLR or webcam:

- Date and Time
- Action: Start or Stop for pressing the Start button or Stop button
- Position: right ascension and declination
- Remark: This field is not automatically filled. Here you can write the name of the object or any other information manually.
- Recordings: Planned number of images of the series or the number of video frames.
- Exposure: Exposure time or the video framerate.
- Filename: The filename of the first image of the series.
- Camera: Webcam, DSLR, camera (external) or watch folder.
- Focal length, Barlow, camera orientation, information about the RAW mode of the webcam and panorama images complement the logbook entry.

The logbook is saved as a text file in the folder: My Documents - Fokuspokus. A separate log file is created for each month. So year and month are part of the filename. The file name for February 2009 is: Logbook_2009-02.txt

7.1 Functions of the log window

- Open: The log of the current month displayed by default. However you can also open older logbooks, of course.
- Planetarium: The selected logbook entry is displayed with the planetarium program (Cartes du Ciel). The coordinates are in the middle of the displayed area and the width depends on the focal length. This function can also be started by double-click on a log line.
- Sky Map: When you are connected to the internet you can show the selected log line in www.sky-map.org . The coordinates are in the middle of the displayed area and the width depends on the focal length.
- Delete: All selected log entries will be deleted.
- Closing: The window is closed. When closing the window, all changes are saved automatically.

8 Frequently Asked Questions

8.1 DSLR: Shutter does not Release

Please check:

1. Is the camera connected properly to the computer? As described above, you must connect the camera jack for the remote control with the parallel port (with special electronic circuits in between). USB connection is not sufficient for this. The cables are described in the forum of Rajiva:
<http://forum.rajiva.de/forum/phpBB2/viewtopic.php?t=401&highlight=kabel+kollektion>
2. If you have connected with the parallel port, check the options of Fokuspokus. Is the specified port address correct (default: LPT1, 0378)? Check out the correct address in the windows device manager.
3. If it still does not work, check if you specified the correct pin in the settings, according to the cable.
4. If it still does not work as expected, check with an ohmmeter if the resistance between ground and control pin changes, when the program releases the shutter. The resistance should become less than 1000 Ohm. If it remains higher, you should change something in your cable electronics, e.g. use a smaller series resistor.
5. It is unlikely, but if it still does not work, then you have probably interchanged ground and tip in the cable.
6. If all that does not help: check if the camera is switched on.

8.2 DSLR: The Image is not Downloaded and Displayed

Please check:

1. Is camera und computer connected via USB?
2. Is the manufacturer's program for camera control started? Was it really started from the menu of the webcam window? If it was not started from there, the image will not be displayed. Using a Canon EOS 20D you should start EOSViewerUtility and then from there EOS Capture, even if you do not directly use it for releasing the camera shutter.
3. Is the folder, to which the camera images are downloaded the same as the folder where Fokuspokus watches for new images? Check the options in EOS Capture and Fokuspokus for that.

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