WCS

Web**C**am**S**cheinern

Program documentation
Version 1.31
Docurelease 1.5
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Contents

1. What is WCS?

The abbreviation WCS stands for **W**eb**C**am**S**cheinern. The German verb "scheinern" refers to a telescope polar alignment method devised by astronomer Julius Scheiner (1858 – 1913), commonly known as "drift alignment." WCS employs a webcam to assist in drift alignment of a polar-mounted telescope. Additional information on the general principles of drift alignment may be found on the Internet, for example
http://andysshotglass.com/DriftAlignment.html
http://members.aol.com/kewtasheck/drift.html
http://members.aol.com/_ht_a/ccdastro/drift-align.htm
or in German at http://www.astronomie.de/technik/montierung/scheiner.htm

In astrophotography, to obtain clean images with round, small stars, it is vital that the polar or "right ascension" (RA) axis be pointed precisely at the celestial pole, in other words, oriented exactly parallel to the Earth's axis of rotation. If this is not the case, over time rotation of the Earth and the resulting apparent rotation of stars in the sky will result in displacement of stars in the telescope field of view. Long-exposure imaging becomes impossible; the images show trailed stars.

WCS serves as an aid to optimal adjustment of equatorial telescope mounts. Using WCS, errors in polar azimuth and polar elevation can be adjusted very quickly, even if Polaris is not visible (e.g. obstructing trees, buildings, or if observing in the southern hemisphere). The principle is to measure star drift of an inaccurately aligned mount with the aid of a webcam, and then calculate the amount of polar axis misalignment. For portable observing, repeated alignment at every new observing site becomes a burdensome chore. With the help of this program, the time consumed by the drift alignment procedure may be reduced to a minimum. There is no need to use expensive "astrometric" eyepieces. The program immediately displays, on the computer screen, the necessary correction. There is no need to experiment with unreliable counting of turns of adjustment screws, as may be required by other programs.

2. System requirements

WCS requires installation of the Microsoft .NET Framework, Version 1.1 or higher. If this is not already installed on the computer, it may be downloaded free of charge from Microsoft®. In addition, it requires a sensitive webcam with a video resolution of 640 x 480 pixels (e.g. Philips ToUcam Pro or Meade LPI).

Also required are a computer with an AMD or Intel processor, 400 MHz or faster, at least 196 MB of system memory, Windows 2000 or Windows XP.

2.1. Installation

Decompress the content of the WCS_131en.ZIP File into a new directory of your choice.

The following files will be unzipped:

WCS.exe	**The executable file**
Language.txt	The standard language file (initially German)
Language-EN.txt	English language file
Language-ITA.txt	Italian language file
Language-DE.txt	Copy of the standard language file (German)
Language-NL.txt	Dutch language file
Language-ES.txt	Spanish language file
C1.Win.C1Chart.dll	DLL program file
C1.Win.C1Chart3D.dll	DLL program file
C1.Common.dll	DLL program file
Dokumentation-EN.pdf	This document
WCS	Program links

If you don't need the other language files, you can delete them. Necessary for program operation are WCS.exe, Language.txt, and the three DLL files. By copying a different language file (for example, delete the original Language.txt and then copy or rename Language-EN.txt to Language.txt), you may operate the program in the language of your choice. By right-clicking on the program name (WCS.exe), you can set up a shortcut to the program in any folder of your choice, or create a desktop shortcut, to easily start the program. Alternatively, you can start it by double clicking the WSC icon in the program folder.
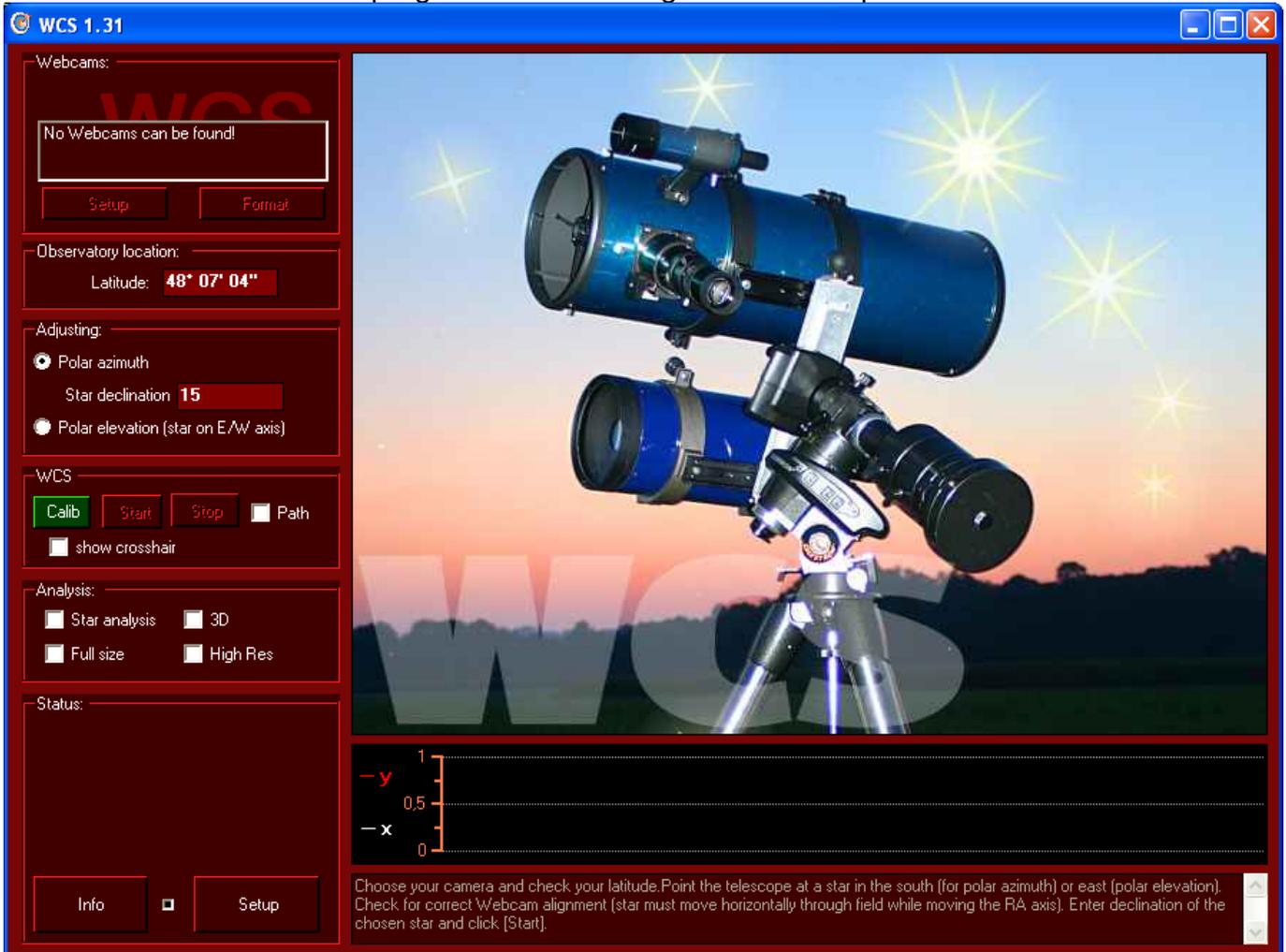
3. Starting the program
The application is started by double clicking the WCS icon.

Until unlocked with a registration key, the program starts with the following message:

Details on unlocking the program may be found in the section **"Request registration key."**
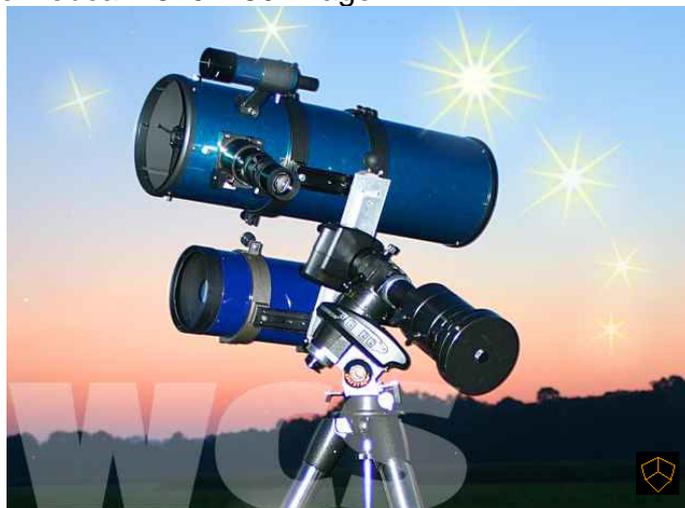
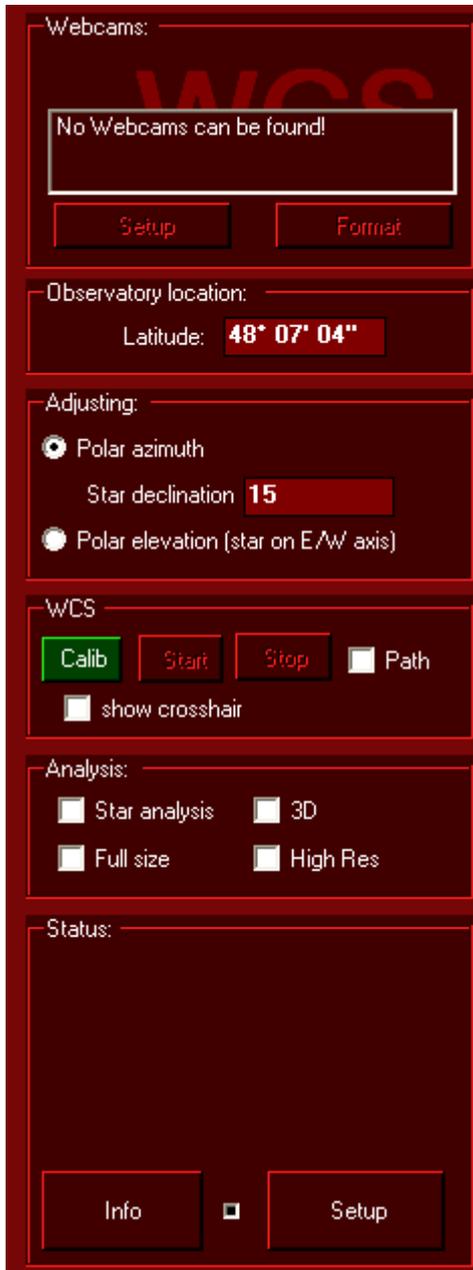Click on "OK" to launch the program. The following window will open:

The user interface consists of four sections: Operation, Webcam image, Visualization, and Help.

3.1. The Webcam image section:

This section displays the webcam 640x480 image.

3.2. Operation section:

- **Webcams:** Select the webcam to be used with WCS..
- **Observatory location:** Enter the geographic latitude of your observing location. Recognized formats are dd° mm' ss", dd° mm".mm and dd°.mm
- **Adjusting:** Select whether you wish to calculate correction for polar azimuth (adjusting your RA axis toward true north in the horizontal plane) or polar elevation (adjusting the height of your RA axis in the vertical plane). Enter the approximate declination of the star you are using for alignment. (Format dd° mm' ss", dd° mm".mm or dd°.mm)
- **WCS:** This starts or stops the adjustment process. The significance of "Inverse" and "Crosshairs" will be explained below.
- **Analysis:** WCS supports users by providing visual aids to assist in focusing webcams as precisely as possible. Sharper focus on an adjustment star means you can later guide on fainter stars. These aids may be activated with this button.
- **Status:** Measurement values are displayed here during active drift measurement. .
- **Info:** This button displays version information and allows users to register their program.

3.3. Visualization section:

Star drift in the x and y directions is displayed graphically in this section.
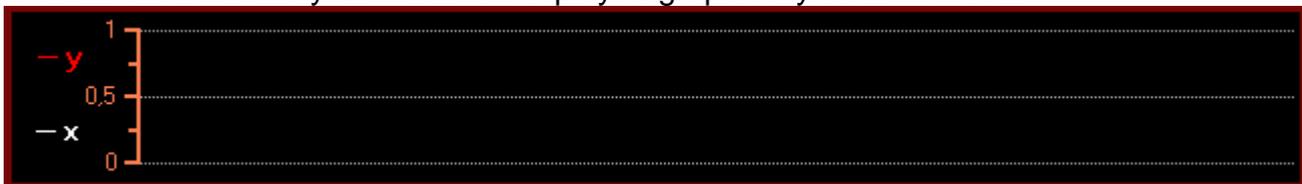
3.4. Help section:

This section displays the steps to be executed by the user.

Choose your camera and check your latitude.Point the telescope at a star in the south (for polar azimuth) or east (polar elevation). Check for correct Webcam alignment (star must move horizontally through field while moving the RA axis). Enter declination of the chosen star and click [Start].

4. Program operation

4.1. Setup:

General:

In the Setup section, you can change the timing behavior of WCS in generating images. For slow PCs, image generation should be slowed down (move slider to right) to avoid problems.

What stars are being used, are there diagonals in the optical path?

Here you can select whether you are adjusting the polar axis azimuth using a star in the north or south, or the polar axis elevation using a star in the east or west. If there are prism(s) or star

diagonal(s) in the optical path, which would lead to erroneous corrections, this may be reversed by selecting "Invert."

Deviation calculation, in arc seconds:

If this mode is activated, deviation displayed in the status window is not expressed in pixels but rather in arc seconds. To do this, the program must know the system (effective) focal length as well as the imaging chip's pixel dimensions. Pixel size may be entered automatically by selecting a camera from the pre-defined list, or selecting "Other" and manually entering pixel dimensions.

4.2. Star selection and mounting the webcam:

For alignment, begin by selecting a star in the south. Display the webcam image of the star on your monitor. In order to minimize the effects of atmospheric refraction, it makes sense to select a star relatively high above the horizon. With your webcam mounted on your main telescope's focuser, use the finder telescope to point at the star. Click on "Start" and move the telescope to place your selected star approximately in the center of your webcam display.

In order for drift calculation to be carried out correctly, it is important to align the webcam axes. The "Display adjustment crosshairs" function superimposes guide lines on the webcam image to help check and adjust orientation (rotation position) of your webcam. The camera should be mounted so that when moving in RA (for example, by using the guiding buttons on your telescope control), the star moves precisely horizontally, along the guide lines. Later, after you're finished with WCS, you can continue to use this camera alignment with the guiding program of your choice.

4.3. Calibration of camera orientation Alternatively, as of WCS Version 1.31, you can calibrate the orientation of your webcam. Click on the green "Calib" button, to the left of the "Start" button. Move a star into the left, green zone in your display (see illustration, below) and click on the star to set the first reference point. Next, the software will show a green calibration zone on the right side of the display. Using your telescope's RA slow motion controls, move the star into this green zone. Click on the star to set the second reference point. Orientation calibration is now complete; the software knows at what rotational angle the camera is mounted in your focuser, and takes this into account when carrying out subsequent calculations.

First reference point, star in left green zone

Second reference point, star in right green zone

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Note: calibration is possible within a range of about 30° of camera rotation. If the star moves out of the display when moving in RA, move the first reference point up or down (click on "Stop" and start a fresh calibration) so that the star remains on screen for the second, right-side reference point. If the star still drifts out of the field, the camera is rotated too far and its orientation on the telescope must be corrected accordingly.

If you plan to use a guiding program after performing WCS polar alignment, remember that you will still have to orient the camera if your guiding software doesn't support calibration.


4.4. Adjusting polar azimuth:

In the box for "Star declination" enter the approximate declination of the star you have chosen to use for drift alignment. The more accurately you enter this value, the more accurately the program can calculate your mount's polar misalignment.

Next, click on the star to select it. A set of crosshairs will appear, showing the star coordinates in your display at the beginning of the measurement process. The program then continuously evaluates the image to determine how far the polar axis has to be shifted east- or westward in order to point precisely toward true (geographic) north.
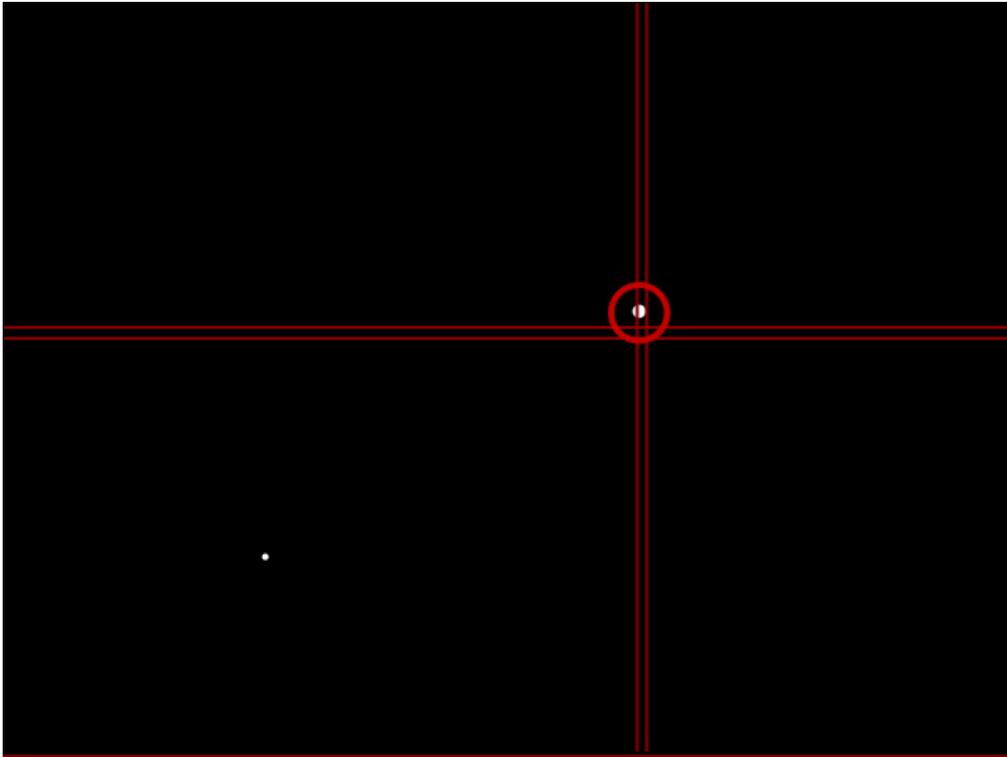
Wait a few minutes to allow the program to determine a trend in drift. For roughly aligned mounts, this may take as little as 60 seconds.

Next, click on the "Correction" button. Using the guide lines overlaid on your webcam image display, the mount may be adjusted in azimuth to move the star from the red "start line" to fall between the two green "target lines." To do this, use the mechanical adjusting screws on your mount.
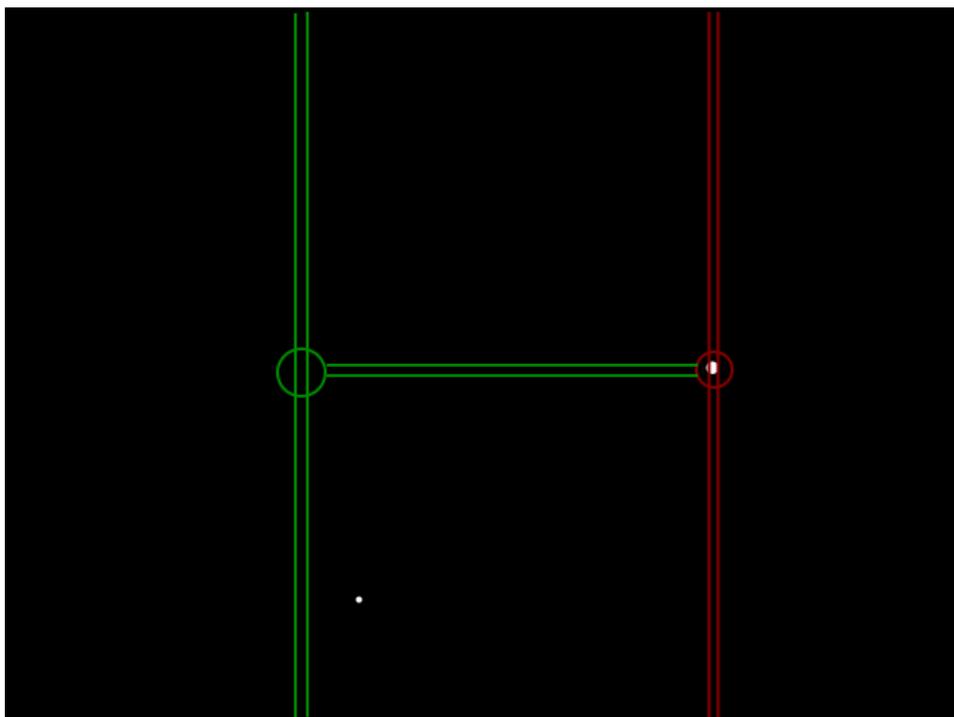
For major misalignment, this correction process may need to be carried out several times. The Help window will display how many times the star image needs to be moved from the red to the green lines. Always use your telescope slow motion controls to return the star to the red "starting lines," and then turn the mechanical adjustment screws to move the star to the green "target lines." Repeat by moving the telescope with your slow motion controls to bring the star

back to the red lines, and repeat the process for the required number of iterations. (Turn azimuth adjustment screws to move the star to the target lines, etc).

Check your new azimuth configuration by clicking on "Stop" and then again clicking on "Start" to initiate a new drift measurement. If the calculated error is now greater than before, you probably corrected in the wrong direction. This may result from your telescope configuration. Check your setup or correct your selection of an alignment star.

Hint: If you are using prisms or diagonals, or using a telescope configuration which reverses the correction, and you find that the error has doubled, go to the program Setup section and in the "Correction direction" set the option to "Invert."

Repeat the polar azimuth measurement and polar azimuth alignment process until you are satisfied with your alignment accuracy. In other words, the star should not drift out of the crosshairs in the vertical direction (Y axis). Movement along the horizontal direction (X axis) is mostly due to drive and worm/worm gear errors, and does not have any effect on polar alignment.

4.5. Adjusting polar elevation:

After completing polar azimuth alignment, select a star in the east. Activate the radio button "Polar elevation." The declination of the star is not relevant for this adjustment, and no value needs to be entered. After again measuring drift, the Correction button is pressed. The program now knows the misalignment of the polar axis. To correct this, again point at a star in the south with your finder telescope and center it in the webcam display. Use your telescope slow motion controls to place the star between the two red "starting lines." Next, turn the mount's polar elevation screw until the star is between the two "target lines." Your telescope should now have optimum polar alignment. To check, simply go through the entire process again.

For polar elevation alignment, again, if the misalignment is too great to display in the webcam image, the polar elevation must be adjusted several times.

Hint: In the event of large polar axis misalignment, to avoid the need for repeated shifts between east/west and north/south alignment stars, you may try to get a rough polar elevation alignment using the east/west alignment star, and only then using a north/south star for final precise adjustment. For this purpose, a guide for the amount of change is the correction circle for polar elevation correction. As before, move the mount to shift the star from the small red circle to the large green circle.

Again, if the error increases, go back to Setup and change the option under "Direction of correction" to "invert."


4.6. Status information

During drift measurement, calculated and observed values are displayed in the status window. These have the following significance:

Origin [x/y]	The star's on-screen coordinates at the beginning of measurement. This value does not change during the measurement.
Current [x/y]	Current position of the star (coordinates of the center of the red circle marking the star).
X px x Y px	Star image dimensions in pixels. The smaller these values are, the closer you are to best focus.
Difference [dx/dy]	Deviation in pixels between current position and origin.
B	Brightness of the brightest pixel in the star image. The higher this value, the closer you are to best focus.
Start time & current time	Time at the beginning of measurement, and current time.
dt	Measuring time in seconds
ddA	Actual calculated correction value for RA or DEC.
MW5	Average of the last five correction values (ddA).

5. Best focus:

For later manual or autoguiding on faint stars, it is important to achieve the best possible focus. WCS offers focusing support by graphically displaying a magnified representation of a selected star's brightness distribution. This may be viewed two dimensionally or three dimensionally. The status window displays the maximum brightness of the brightest pixel, or the star image size in x and y coordinates. The greater the brightness and smaller the star image, the better the focus.
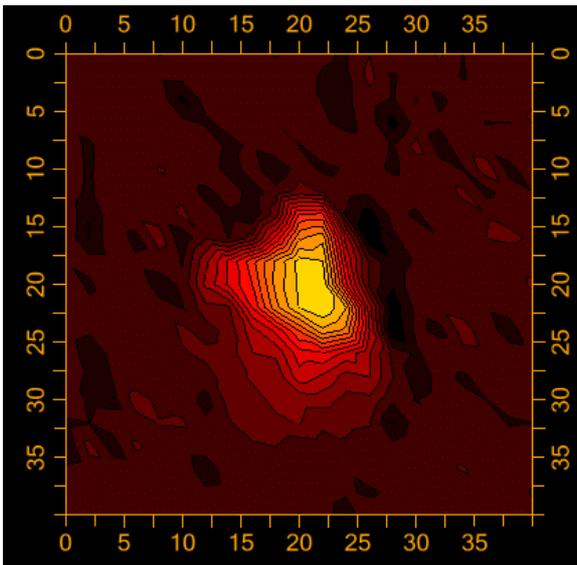
Example:: 2D representation of brightness distribution
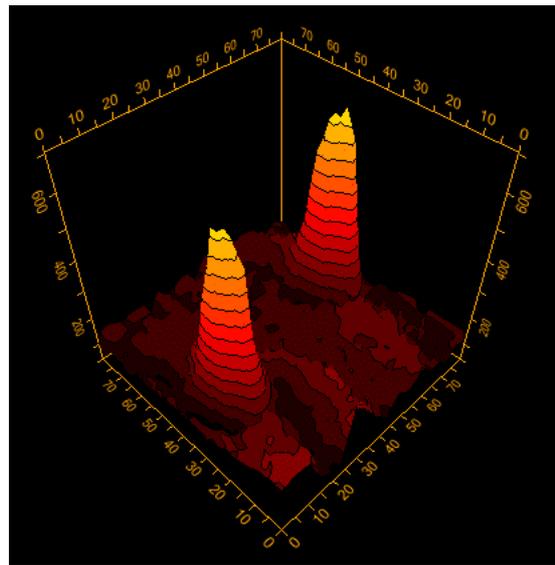
Example: 3D representation of brightness distribution

The 2D representation serves to visualize the brightness distribution. The more compact the yellow zone, the better the focus. For the 3D representation, the greater the brightness (the taller the "mountain"), the better the focus.

You can activate analysis of a star image by checking **"Star analysis"** in the Analysis window. The analysis display will appear at the lower right corner.

If the **"Full size"** option is selected, the window will be superimposed over the webcam image, with a resolution of 640x480.

The **"3D"** button permits switching between the 2D and 3D displays.

On very fast computers, the **"High Res"** option permits even more precise rendering of star brightness and size. Because it takes up significant processor resources, this option may not be suitable for older computers with slower processors.

Note: *When changing focus, the star may change position in the webcam display. Especially in the case of Schmidt-Cassegrain telescopes, mirror shift may result in significant image shift, which will affect drift results. After focusing, the measurement process should be restarted, and the focus not disturbed until the process has been completed (press Stop, and then Start).*

If you activate the **"Drift"** option in the Analysis section, the display will show the drift path of the star since measurement was initiated.

6. Request registration key:

The trial version is good for 30 days. For use after the trial period, the program must be purchased. A registration key is needed to activate the program. This may be purchased over the Internet for 21.00 Euros. To purchase the registration key, select the **"Info"** button at lower left of the WCS window:
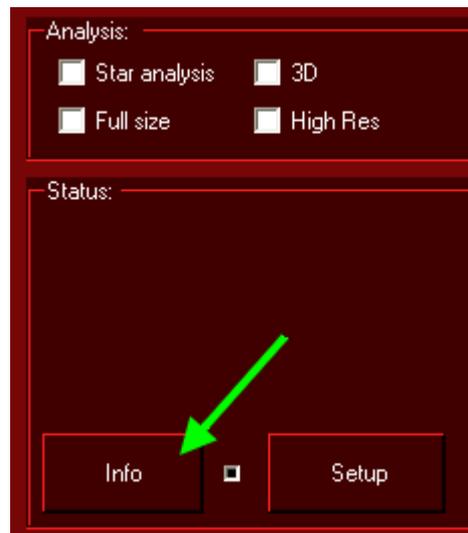
In the resulting Info window, click on **"Register"**
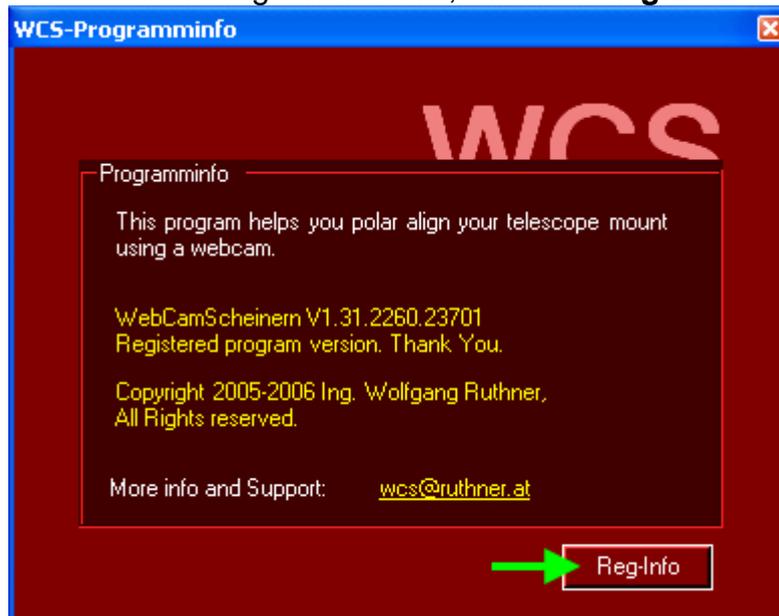
Enter your registration data – **first name, last name,** and **e-mail address** in the following form:

- If your computer is **connected to the Internet,** click on the button "Purchase program for 21 EUR => request key". Your registration information is automatically passed to the server.

- If your computer is **not connected to the Internet**, please click on the green left arrow (**<=**). Your activation key appears in the lower right corner. You will need this for later online registration. The link for manual registration may be found at **http://wcs.ruthner.at**.

- If paying via Paypal, the activation key will be automatically sent to you **immediately** after payment. If paying by bank transfer, the activation key will be sent via e-mail after the transfer is posted to account.

Thank you for your interest in WCS.