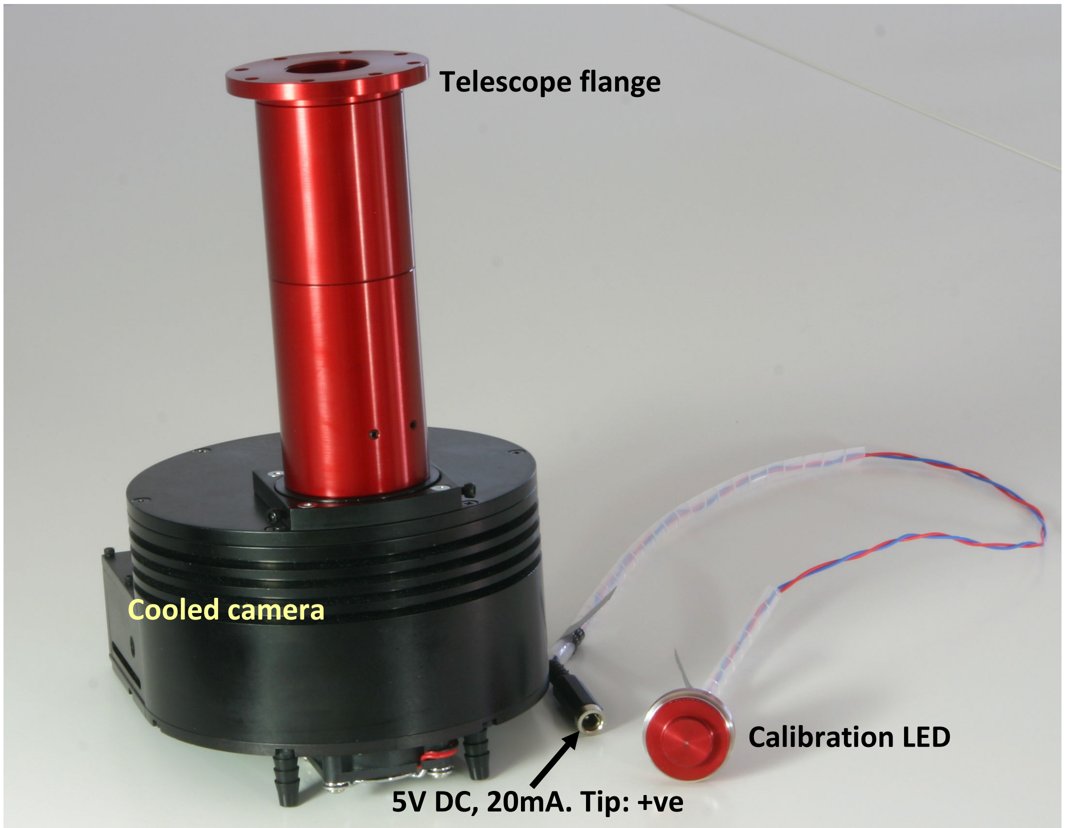
Puntino Minisensor: setup and use

Version 1.0
August 2011


1. Puntino Minisensor: overview



Puntino minisensor

1. Puntino Minisensor can test telescopes from about F/2 to F/18
2. The current Puntino Minisensor is designed for a telescope of focal ratio F/6
3. The Shack-Hartmann lenslet array has a pitch of 0.3mm and focal length 41mm
4. It has a collimator of focal length 50mm with an aperture of 9mm, giving 30x30 spots with the reference source
5. With the F/6 telescope, the pupil diameter is 50/6=8.3mm, giving 28x28 spots
6. The reference image is taken with a LED with a pinhole of 10µ
7. The peak wavelength of emission of the reference image is 623±15nm

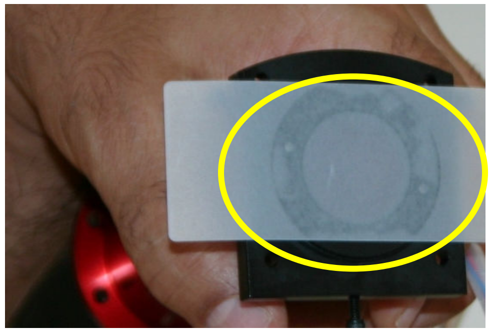
2. Sensoft: overview

Sensoft controls the SH camera and performs the Shack-Hartmann analysis

Important points:

1. **Reference image**: This is the calibration image used to remove the aberrations of the optics inside Puntino Minisensor
2. **Mir image**: This is the SH image from the telescope
3. **Coll**: Used to collimate the light from the telescope in loop mode
4. **Align**: For alignment of the Mirror and Reference images
5. **Loop (coma)**: Very useful for alignment of M1 and M2 by looking at the coma plot in loop mode
6. **Loop (Ast):** Very useful for adjustment of telescope supports looking at the Ast plot in loop mode
7. **Loop (aberrations)**: For following Zernike aberrations in loop mode
8. **Loop (WF zonal - AQ)**: For following zonal WF in loop mode after subtraction of tilt or tilt and defocus. Called AQ (Actual Quality)
9. **Loop (WF zonal - PQ)**: For following zonal WF in loop mode after subtraction of first seven Zernike terms: tilt, defocus, coma, 3^{rd} order spherical aberration, astigmatism, triangular coma and quadratic astigmatism. Called PQ (Potential Quality)
10. **Loop (WF modal - AQ)**: For following modal WF in loop mode after subtraction of tilt or tilt and defocus

3. Unpacking and setting up Puntino Minisensor

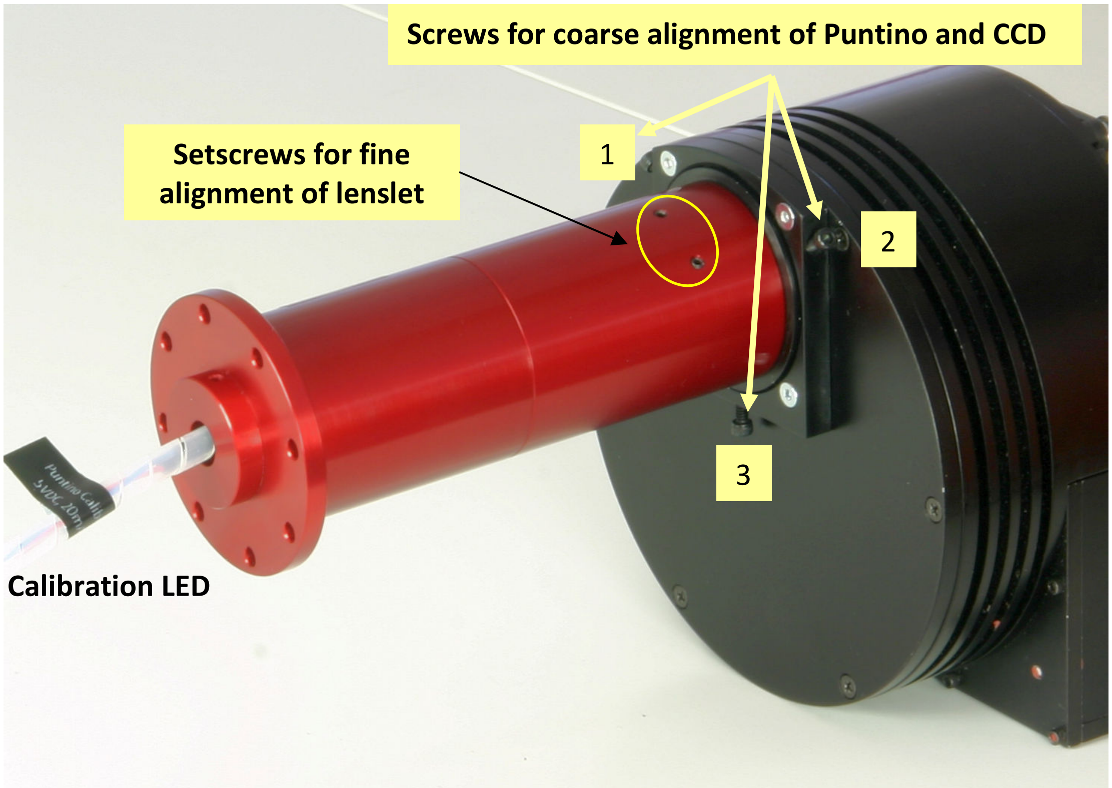


1. Unpack Puntino Minisensor.
2. The calibration LED is packaged separately
3. Remove the protective adapter and tape as shown above from the ‘D’-mount
4. Using 4 screws, mount the ‘D’-mount on the SBIG camera body
5. Screw in the calibration LED mount into the Puntino Minisensor body till the end (Tip: Hold the wire vertical as you rotate the mount)

Inserting the calibration LED

6. Connect a 5V DC power supply to the LED and check that it is working
7. Connect the SBIG camera to the PC and start Sensoft and get the SH image

4. Alignment of Puntino lenslet with rows & columns of CCD



Steps:

1. Screw-in the calibration LED mount into the telescope flange
2. Connect a 5VDC (> 50mA) power supply to the LED
3. Switch on-the camera
4. Use Sensoft to get the Live SH image using 2x2 or 3x3 binning (if available)
5. After unscrewing the T-mount adapter, rotate it along with Puntino along with the till the spots are aligned along the rows of the CCD
6. The tolerance for the alignment is about 2 pixels from the center of the extreme left to the extreme right spot
7. Once Puntino has been aligned, tighten the screws
8. If required, do fine alignment using the two set screws on the body of Puntino
9. To allow easier circulation of air inside Puntino, the lenslet array mount is held only by the two set-screws. Though it fits snugly into the housing, avoid unscrewing the screws completely to avoid it slipping out.

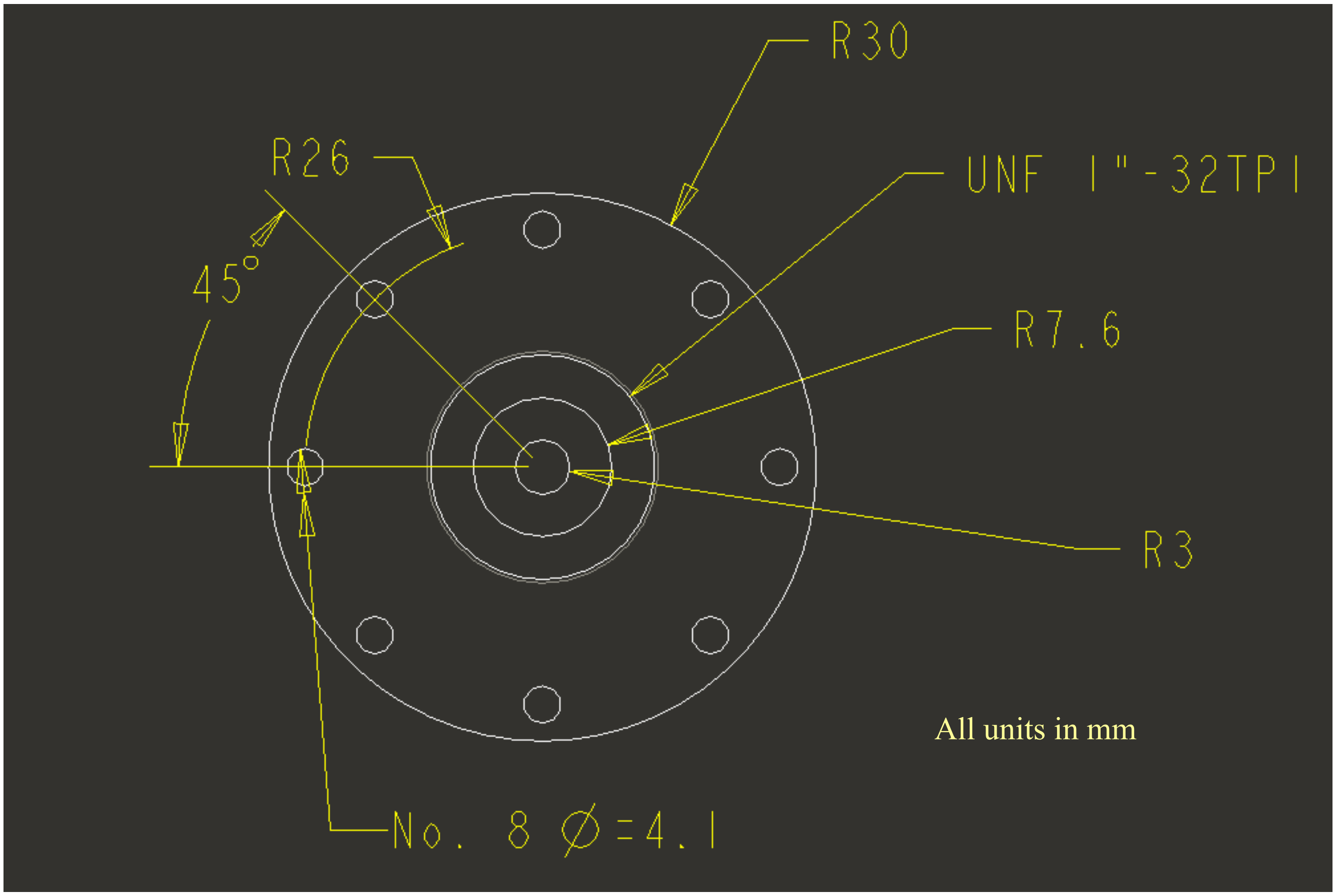
5. Considerations on the reference image

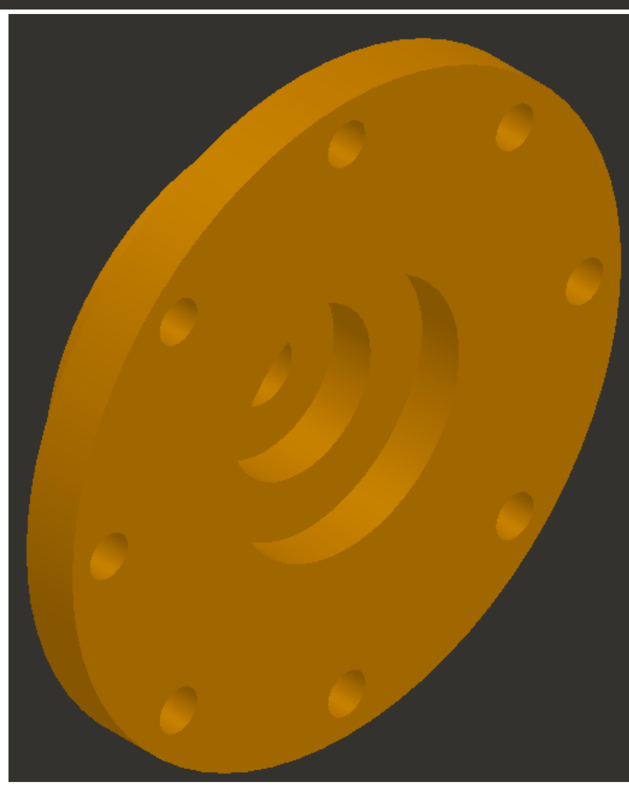
1. The reference image should be well exposed without being saturated
2. The recommend exposure time is approximately 30 seconds for the F/6 Puntino
3. The reference image can be saved on the PC and Sensoft will pick it up automatically
4. In general only the defocus will change with temperature, so you can use one reference image taken at the start of the night
5. If you do not change anything (rotation of the Puntino Minisensor with respect to the CCD), then the same reference image can be used subsequently. The key point is to avoid rotation
6. You may, in the long run, take a series of calibration images during the night (or at different temperatures) and storing them on the PC. You can then ask the software to pick up the correct reference image according to the current temperature that you are observing at

Appendix A: Some Definitions

1. **Zonal wavefront (WF):** Wavefront constructed after numerical integration of the residuals. This is the ‘real’ WF. It includes low frequency symmetrical effects (represented by Zernike coefficients) as well as high frequency effects (that cannot be represent by Zernike aberrations, e.g. ripple and micro ripple)
2. **Modal wavefront (WF):** Obtained after summing up the Zernike coefficients obtained from the SH analysis. Thus, they only represent the low frequency symmetrical aberrations that can be represented by Zernike coefficients
3. **Actual Quality (AQ)**: WF after subtracting tilt or tilt and defocus (that are computed from the Zernike analysis) from the raw WF
4. **Loop (WF zonal - PQ)**: WF after subtracting first seven Zernike terms: tilt, defocus, coma, 3^{rd} order spherical aberration, astigmatism, triangular coma and quadratic astigmatism from the raw WF

Appendix B: Telescope flange dimensions





Appendix C: Position of focal plane

The focal plane is 8mm from the outer flange as shown below