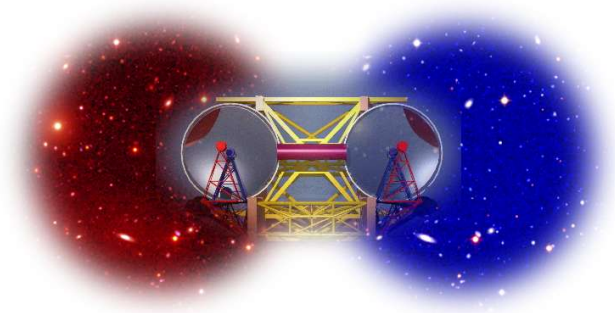
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Large Binocular Camera


Large Binocular Camera Tracking LBC-Software Application Reference Manual

Author: Stefano Gallozzi

date: 2004-09-17

email: gallozzi@mporzio.astro.it

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Tracking LBC-Software Application, Reference Manual

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Tracking LBC-Software Application

Author: Stefano Gallozzi
 e-mail: gallozzi@mporzio.astro.it

1 - Overview of the Package

The tracking module of the LBC-Control Software System controls images acquisition from technical cameras and their reduction. On each exposure start, as soon as the shutter is completely open, technical cameras start a loop of images acquisition with increasing exposure times until a suitable stars pattern is found or the shutter is closed. As soon as the pattern has been found, all the subsequent exposures are processed with that pattern as a reference to obtain guiding information both for telescope and rotator. While processing images for guiding, it is possible to perform the active optics operations (low and high order, not described here).

Now we focus on the real application. It is composed of two different executables which perform the following operations:

tracking_first.exe -> reads an input ascii-file, saves a reference catalog and an output ascii-file.

tracking_next.exe -> reads an input ascii-file, saves a catalog, performs the cross correlation of a catalog with the reference one, saves an output ascii-file and saves a guide-gif star.

Another executable is present in the zip-archive (**trackdebug.exe**), which performs the same operations of the tracking_next application but for only one chip, so no rotation is calculated.


2 - Tracking_First Description

This is a stand-alone C-program which receives an input file and returns an output file.

It is used as a first step of the tracking procedure in the LBC-control system and works on the technical-chip files.

The main goals of the application are:

- creating a standard sextractor-ascii-file reference catalog.
- extracting the best stellar sources from the catalog.

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- calculating the mean FWHM and the mean BACKGROUND from the best sources.
- returning an output file, similar to the input one.

2.1 - Prerequisites

To prevent windows and linux differences in absolute patterns these programs must be placed in the "[D:\](#)" directory.

This program needs to work a standalone windows-executable of the SExtractor program (Bertin & Arnouts, 1996) with its own configuration files, the windows c-fitsIO.dll file, the input ascii-file of configuration and two input ascii-files for the relative dimension between prescan/scan/overscan region in the two chip files, the four fits image of technical chips (2 fitsimage + pre/overscan and 2 flatfieldimage + pre/overscan).

2.2 - Installation

To install all the package simply go to the main "[D:\](#)" directory and unzip the archive "[tracking.VERSION.zip](#)", where VERSION is the current version of the package.

Take a look on the 'prerequisites' chapter for directory presenze in the [D:\](#) path.


You should have these directories:

- [D:\track](#)
- [D:\flat](#)
- [D:\tmp](#)
- [D:\conf](#)

2.3 - General First-Tracking Steps

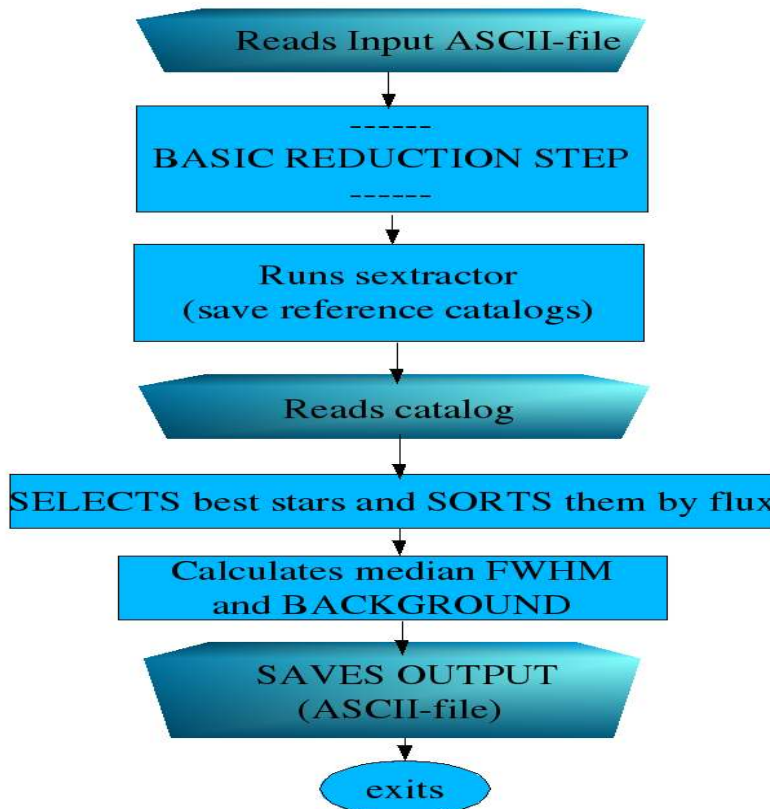
The first-tracking steps are the following:


- reading the input ascii-file "track_first.in" (see app. 2A)
- reading the prescan/overscan size from the ascii-files "scan1.dat" and "scan2.dat"
- getting fits image dimension from fits keyword
- performing basic reduction step on fits image (see app. 2B)
- running sextractor on the images and saving the source reference catalogs "refCatalog1.cat" and "refCatalog2.cat" (see app. 2C).

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- reading catalogs, selecting the best stars (see app. 2C), and sorting them in the flux value
- calculating the mean FWHM and BACKGROUND for best stars
- saving output ascii-file "track_first.out" (see app. 2A)

All these tracking_first steps are summarized in the following picture. In the app. 2D is summarized a more detailed flow chart of the operation performed by the main program.



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2.4 – Testing the application

A wide test was performed on this program using two technical LBC-simulated chips to test the efficiency and stability of the application.

Two tech-chip fits images used were generated by the LBC-image simulator as a mixture of real objects from gsc2 catalog pointing the RA=16:34:00.00 and DEC=-17:22:00.00 coordinates plus the contribution of simulated stars and galaxies with faintLimit=18 (see pictures, object fits images and the corresponding flat-fields).


The average simulation time for running is about 2.5 seconds on a Athlon XP2000 with 512Mb of Ram.

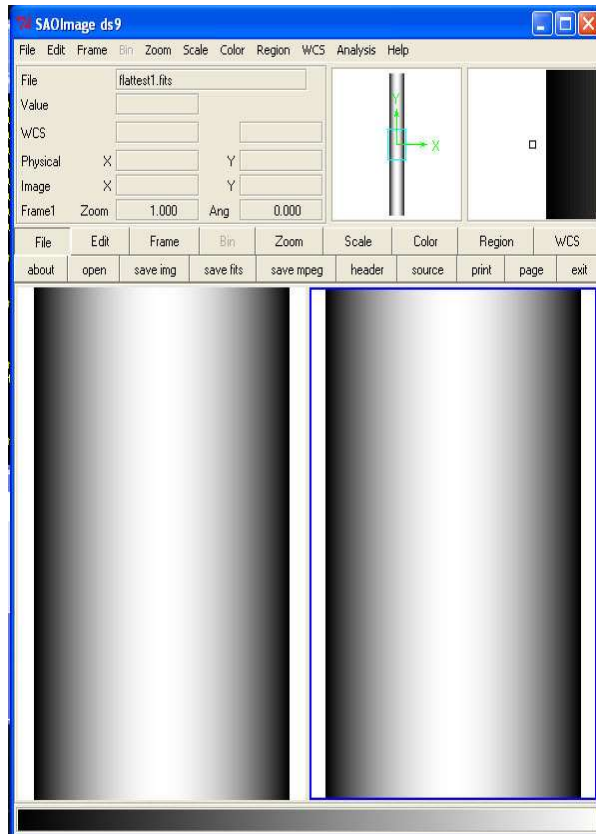
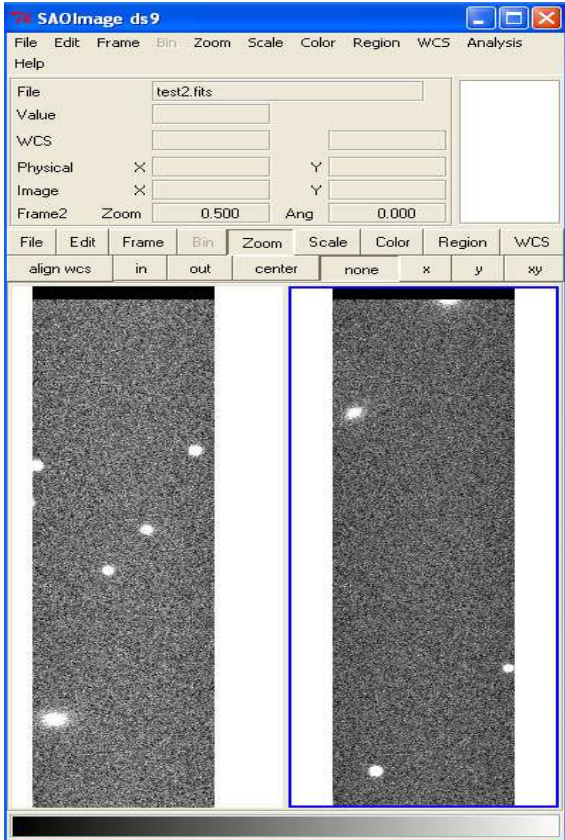
The output file is shown here:

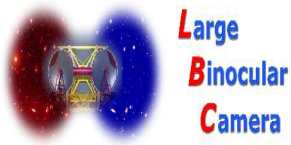
```

---
0.0,0.0,0.0
79.4,558.0,302.47,1.54
79.4,558.0,302.47,1.54
10.725000
-0.572204
8
127.2,998.4,235.39,1.52
127.2,998.4,235.39,1.52
10.565714
-0.582626
7
---
```

The first line represents the offsetX/Y and rotation of the image. Since it is the reference image the three quantities are null (by definition). In the first chip 8 good stellar sources were found with a medianFWHM=10.7250 and medianBACK=-0.572204 and in the second chip 7 good stellar sources with a medianFWHM=10.565714 and medianBACK=-0.582626. For the two chips, the recorded stellar parameters in the 2nd and 3rd line are the same, which means that the stars are not saturated.

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App. 2A: Input and Output Files

The input scan files (“scan1.dat” and scan2.dat”) for fits-image configuration looks like this:

```
-----
57  2048  57
-----
```


Where the only line is composed of three quantities (integer numbers) which represent the size of prescan; scan and overscan region of the images.

These are very important configuration files because the correct setting of these values lead to a correct basic reduction step: the mean BIAS value is calculated for each fits-image row by the median pixels value of the prescan and overscan regions.

The input ascii-file (“track_first.in”) for configuration is similar to this:

```
-----
29.44,235.52,0.0
test1.fits
flattest1.fits
1724.08,235.52,0.0
test2.fits
flattest2.fits
550,200
580,280
-----
```

Where the 1st line is the X(arsec),Y(arsec),Theta(degree) offset and rotation for first technical-chip, the 2nd line is the filename of the input fits image for the first technical-chip, the 3rd line is the filename of the input flatfield fits image for the first technical-chip, the 4th line is the X(arsec),Y(arsec),Theta(degree) offset and rotation for the second technical-chip, the 5th line is the filename of the input fits image for the second technical-chip, the 6th line is the filename of the input flatfield fits image for the second technical-chip, the 7th and 8th lines identify the box to skip for tracking operations on the second technical-chip.

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All the configuration files are located in the "D:\conf\" path.


The output ascii-file ("track_first.out") is similar to this:

```

-----
0.0,0.0,0.0
79.367000,558.032000,302.473000,1.539820
106.428000,1612.226000,129.917000,1.411430
10.725000
-0.572204
8
127.217000,998.414000,235.388000,1.522110
162.585000,2103.264000,51.164600,0.993091
10.565714
-0.582626
7
-----

```

Where the 1st line is OffsetX(arsec), OffsetY(arsec) and rotationAngle (degree) from the reference catalog which are all null by definition, the 2nd line is the X,Y,flux and maximum of a star even if it is saturated, the 3rd line are the same quantities for the first non saturated star (it may be the same star), the 4th line is the median FWHM, the 5th line is the median BACKGROUND, the 6th line is the number of best stars in the first technical-chip; the lines from 7th to 11th are the same quantities for the second technical-chip.


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App. 2B: Basic reduction Steps

The general reduction steps performed by this program are the following:

- taking a look in the "D:\tmp\" directory for filename presence.
- calculating the median of prescan and overscan of each fits-image and setting it as the medianBIAS of the image.
- calculating for each pixel of the image the two quantities:
 - outimage = (fitsimage-medianBIAS)/flatimage**
 - saturation = (65536.0-medianBIAS)/flatimage**
- saving output reduced fits file in the "D:\tmp\" directory.

All the flatfield filenames are located in the "D:\flat\" directory.

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App. 2C: Best stars selection algorithm

The general algorithm for best stars selection performed by this program consists in reading the SExtractor generated catalog and parsing it for flux, classtar and flag keywords:

```
if (flag==0 && classtar>0.9 && flux>10.0) => bestStar
```

After this generic check, all the best source vectors are sorted in their flux.

If Maximum of a star is greater than its saturation level the star is marked as saturated.

If no good star is found, the program prints an error message and exits.

To configure properly sextractor under windows an executable binary file of sextractor batch program for win32 systems is needed. It must be placed in the same directory of the executable tracking programs. The configuration files for SExtractor (placed in the "D:\conf\" directory) must be standard SExtractor files and the parameter (default.param) file must contain the following keyword in the same order:

```
-NUMBER
-X_IMAGE
-Y_IMAGE
-FWHM_IMAGE
-FLUX_BEST
-FLUX_MAX
-BACKGROUND
-CLASS_STAR
-FLAGS
```

The "default.sex" file name must be similar to the following:

```
---
# Default configuration file for SExtractor V1.2b14 - > 2.0
# EB 23/07/98
# (*) indicates parameters which can be omitted from this config file.

#----- Catalog -----
CATALOG_NAME  image.cat      # name of the output catalog
CATALOG_TYPE  ASCII         # "NONE", "ASCII_HEAD", "ASCII", "FITS_1.0"
                                     # or "FITS_LDAC"
```


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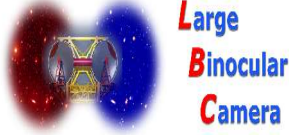
#----- Memory (change with caution!) -----

MEMORY_OBJSTACK 2000 # number of objects in stack
 MEMORY_PIXSTACK 100000 # number of pixels in stack
 MEMORY_BUFSIZE 1024 # number of lines in buffer

#----- Miscellaneous -----

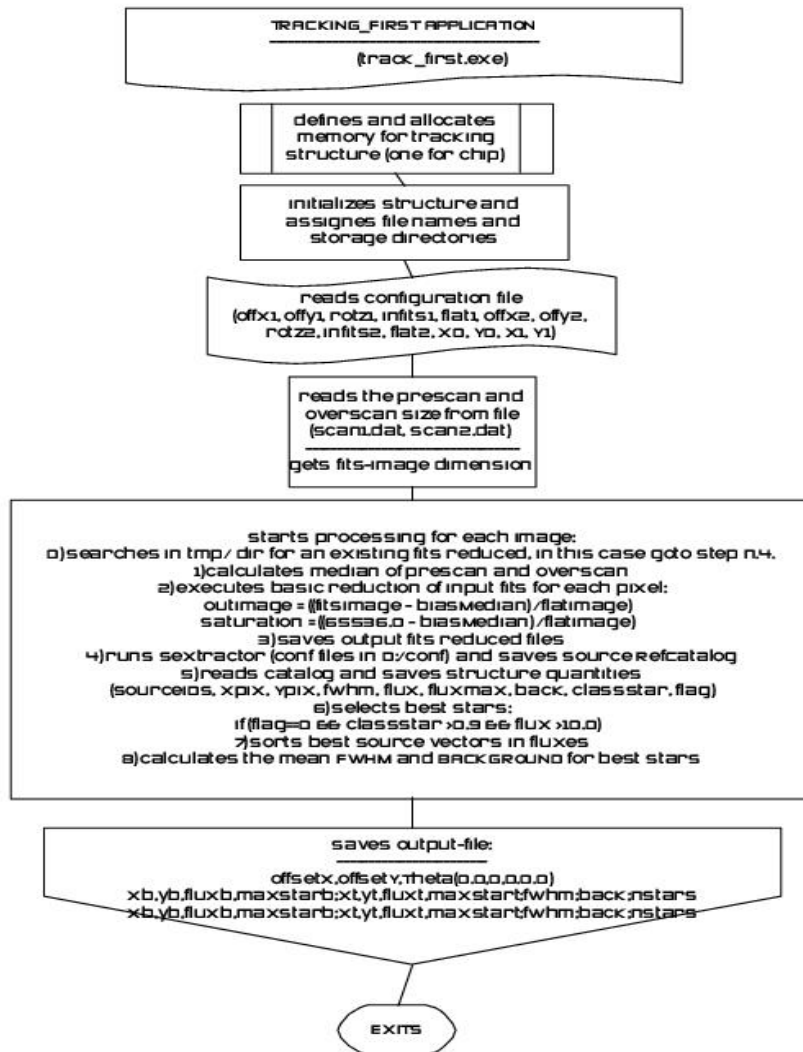
VERBOSE_TYPE NORMAL # can be "QUIET", "NORMAL" or "FULL" (*)


#----- New Stuff -----

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App. 2D: Detailed Application operations

In the following picture all the operations performed by the program are described.



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3 – Tracking-Next Description

This is a stand-alone C-program which receives an input file and returns an output file.

It is used as the second step of the tracking procedure in the LBC-control system and works on the technical-chip files.

The main goals of the application are:

- creates standard sextractor-ascii-file catalogs.
- extracts the best star sources from the catalogs.
- calculate the mean FWHM and the mean BACKGROUND from the best sources.
- calculates offset(X/Y) and rotation(Theta) from the reference catalog.
- saves a guide gif star (possibly from the first technical-chip) centered on the same X₀,Y₀ position taken from the reference output first_track.out file.
- returns an output file, similar to the input one.

3.1 - Prerequisites

To prevent windows and linux differences in absolute patterns these programs must be placed in the “D:\” directory.

This program needs to work a standalone windows-executable of sextractor program with its own configuration files, the windows c-fitsIO.dll file , the input ascii-file of configuration and two input ascii-files for the relative dimension between prescan/scan/overscan region in the two chip files, the four fits images of technical chips (2 fitsimages + pre/overscan and 2 flatfield images + pre/overscan). To perform cross-correlation between catalog a reference catalog, one for each technical chip is needed.

To export the guide gif star on windows platform the ImageMagik package is needed. Thus provides the “convert” program to convert the fits image into a gif file; it is also possible to use directly the convert.exe batch program provided with the track_next application.


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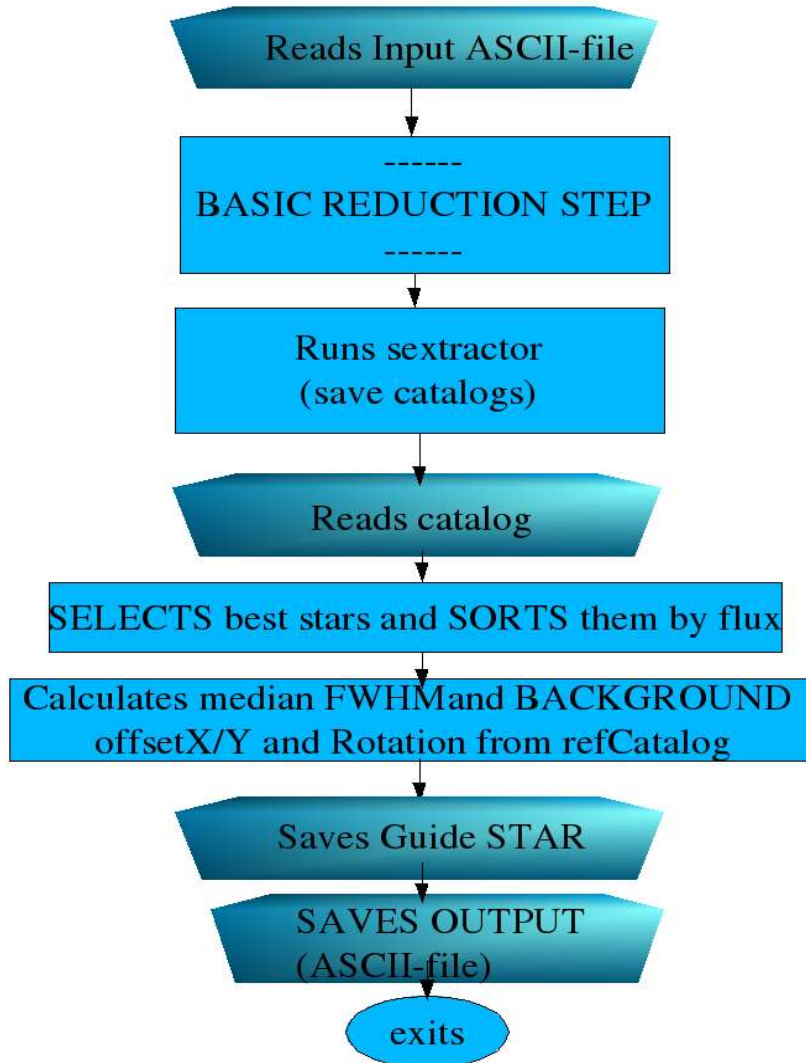
3.2 - General Next-Tracking Steps


The tracking_next steps are the following:

- reads the input ascii-file "track_next.in" (see app. 3A)
- reads the input ascii-file "track_first.out" (see app. 2A) for reference stellar objects coordinates.
- reads the prescan/overscan size from the ascii-files "scan1.dat" and "scan2.dat" (see app. 3A)
- gets fits image dimension from fits keyword
- performs basic reduction step on fits image (see app. 3B)
- runs sextractor on the images and save source catalogs "Catalog1.cat" and "Catalog2.cat" performing a cross-correlation with reference catalogs.
- reads catalogs, selects the best stars (see app. 3C), and sorts them in the flux value
- calculates the mean FWHM and BACKGROUND for best stars
- calculates the offset and rotation from the reference catalog
- exports a guide gif star "D:\track\guide.gif" centered always on the same X/Y position.
- saves output ascii-file "track_next.out" (see app. 3A)

All these tracking_next steps are summarized in the following picture. In the app. 3D is summarized a more detailed flow chart of the operation performed by the main program.

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3.3 – Testing the application

Two wide tests were performed on this program using two technical LBC-simulated chips to test the efficiency and stability of the application.

FIRST TEST – traslation and rotation

The two tech-chip fits reference images used were generated by the LBC-image simulator as a mixture of real objects from gsc2 catalog pointing the RA=16:34:00.00 and DEC=-17:22:00.00 coordinates plus the contribution of simulated stars and galaxies with faintLimit=18 (see pictures, object fits images and the corresponding flat-fields).

With these reference images the application processed several pairs of fits simulated images with these characteristics:

```

-----
XSHIFT                YSHIFT                ANGLE (degree)
0.0pxls (0.0arsec)    0.0pxls (0.0arsec)    0.0pxls (0.0)
--TRASLATION--
1.1pxls (0.253arsec)  -2.5pxls (-0.575arsec) 0.0pxls (0.0)
--ROTATIONS--
0.0pxls (0.0arsec)    0.0pxls (0.0arsec)    0.01458pxls (0.000222)
0.0pxls (0.0arsec)    0.0pxls (0.0arsec)    0.1458pxls (0.00222)
0.0pxls (0.0arsec)    0.0pxls (0.0arsec)    1.458pxls (0.0222)
0.0pxls (0.0arsec)    0.0pxls (0.0arsec)    13.14pxls (0.2)
--ROTO-TRASLATION--
2.3pxls (0.529arsec)  1.7pxls (0.391arsec)  -0.0091pxls (-0.000139)
-----

```

The rotation angles were transformed in pixels at the star distance from the center of the optical plane:

$$(\text{Chip_Distance} * 0.5 + X_{0\text{star}})$$


The average simulation time for running is about 2 seconds on a single processor machine (Athlon XP2000 with 512Mb of Ram).

The *first simulation* performed on a pair of images offsetted of dX=1.1 and dY=-2.5 pixels, returned the following result:

```

0.231599047619,-0.690115000000,0.000000000000
78.415,561.000,498519.000,19604.900
78.415,561.000,498519.000,19604.900
4.237142857143
-220.52100
7
126.224,1001.392,273831.000,10780.600
126.224,1001.392,273831.000,10780.600

```

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4.236666666667
 -828.93133
 3

The *second simulation*, performed on a pair of images only rotated of $d\theta=0.01458$ pixels (0.000222deg) from the optical axis of the FOV, returned the following result:

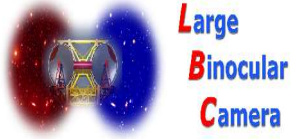
0.016790000000,-0.015796071429,0.000251848212
 79.413,558.019,498608.000,19610.400
 79.413,558.019,498608.000,19610.400
 4.241428571429
 -220.56357
 7
 127.220,998.387,274122.000,10827.000
 127.220,998.387,274122.000,10827.000
 5.345000000000
 -834.06625
 4

The *third simulation*, performed on a pair of images only rotated of $d\theta=0.1458$ pixels (0.00222deg) from the optical axis of the FOV, returned the following result:

0.1400615119048,-0.018044047619,0.002228092101277
 71.484,572.637,498311.000,18848.700
 71.484,572.637,498311.000,18848.700
 4.255714285714
 -220.70229
 7
 120.928,983.988,274716.000,11077.799
 120.928,983.988,274716.000,11077.799
 5.286666666667
 -832.30567
 6

The *fourth simulation*, performed on a pair of images only rotated of $d\theta=1.4582$ pixels (0.0222deg) from the optical axis of the FOV, returned the following result:

0.1386459166667,-0.018827142857,0.0225784335555
 71.553,572.496,498191.000,18467.500
 71.553,572.496,498191.000,18467.500
 4.242857142857
 -220.728285714286
 7
 120.985,984.134,274709.000,11059.400
 120.985,984.134,274709.000,11059.400

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5.271666666667
 -832.28750
 6

The fifth *simulation*, performed on a pair of images only rotated of $d\theta=13.1368$ pixels (0.2°) from the optical axis of the FOV, returned the following result:

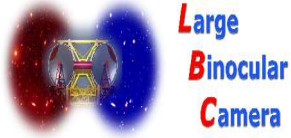
1.248368809524,-0.021488571429,0.203410942391
 72.347,571.057,497745.000,19771.700
 72.347,571.057,497745.000,19771.700
 4.248571428571
 -220.786428571429
 7
 121.601,985.568,274312.000,10448.500
 121.601,985.568,274312.000,10448.500
 5.253333333333
 -832.25533
 6

The *final simulation*, performed on a pair of images translated and rotated of $dX=2.3$, $dY=1.7$ pixels and $d\theta=-2.2$ pixels, returned the following result:

0.46401,0.22931,0.00013943
 77.404,557.009,498427.000,19567.300
 77.404,557.009,498427.000,19567.300
 4.242857
 -220.625000
 7
 125.215,997.398,273754.000,10801.900
 125.215,997.398,273754.000,10801.900
 5.202500
 -833.94000
 4

To verify the goodness of the simulation it was performed a *final test on the reference image* and the result is the following:

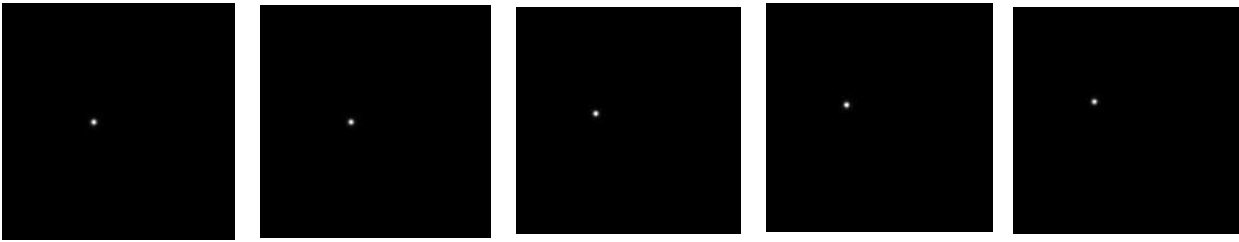
0.007327,-0.011755,-0.001342
 79.421,558.006,498607.000,19588.300
 79.421,558.006,498607.000,19588.300
 4.240000
 -220.564000
 7
 127.225,998.399,274153.000,10799.800
 127.225,998.399,274153.000,10799.800
 5.357500

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-834.067250

4

Here are the gif-Guide images produced in the rotation tests (0.0deg, 0.000222deg, 0.00222deg, 0.0222deg and 0.2deg):

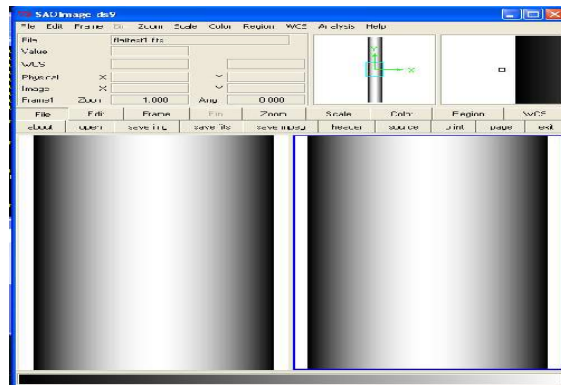
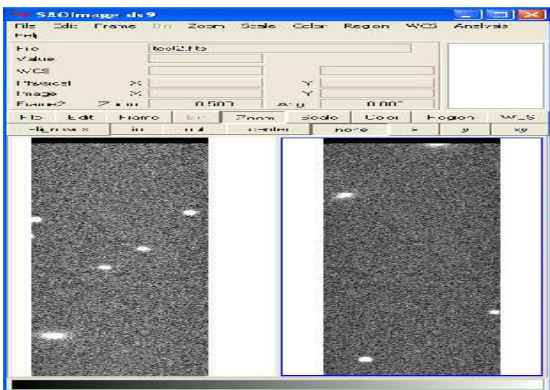


These are the results of the rotation tests for the images:

#InputROT(deg)	InputROT(pxls)	OutputROT(deg)	errRot(deg)	errRot(rad)	errRot(pxls)
0.000222	0.01458	0.00025184	0.0000298	0.00000052011	0.002
0.00222	0.14582	0.00222809	0.00000809	0.00000014119	0.0005
0.0222	1.4582	0.0225784	0.0003784	0.000006604	0.025
0.2	13.1368	0.20341	0.0034109	0.000059532	0.224

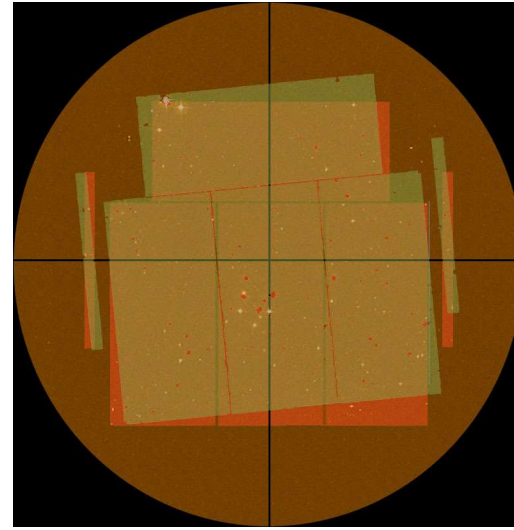
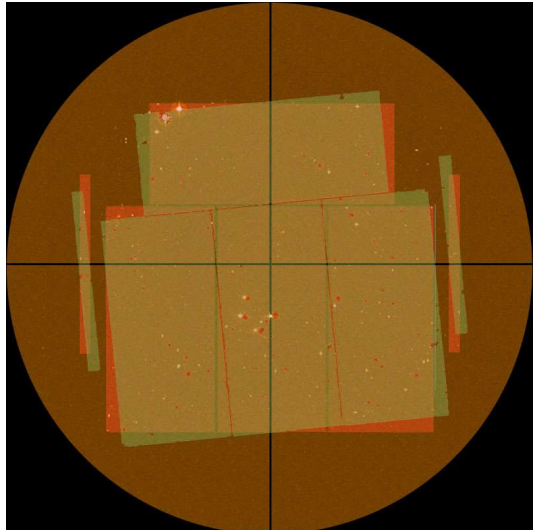
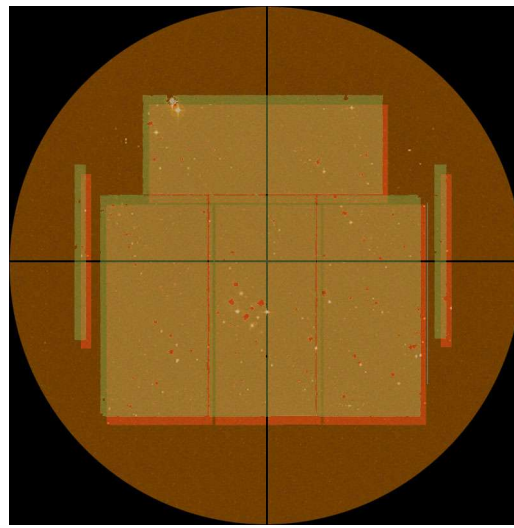
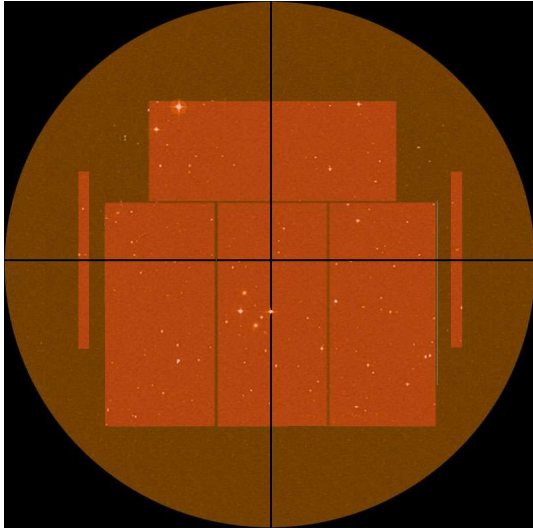
We can find that the mean error in the offset calculation is about **~0.01 arsec** (~0.04pxls) while **~9.13*10⁻⁴degree** (~0.06pxls) is the mean error in the rotation angle calculation.

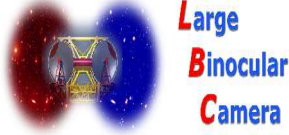
Here is the reference fits image with the corresponding flat field used for these tests:



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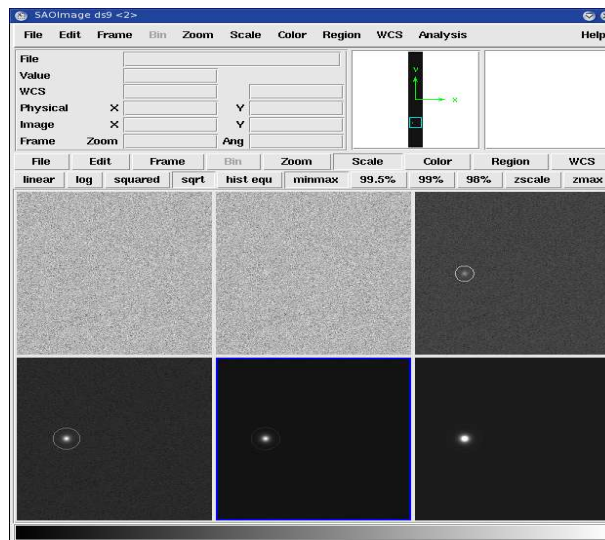
The following pictures represent the FOV of the whole LBC-camera regarding the possible offsets and rotations.



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SECOND TEST – variable Seeing and ExposureTime

The two tech-chip fits reference images used were generated by the LBC-image simulator as a mixture of real objects from gsc2 catalog pointing the RA=16:34:00.00 and DEC=-17:22:00.00 coordinates plus the contribution of simulated stars and galaxies with faintLimit=16.0 mag (see following object fits images).



Two set of images of the same field pointing the same coordinates were produced with faintLimit=16.0 with only a single star in the first technical Chip in function of the Seeing and the ExposureTime.

The results of the simulation are the following:

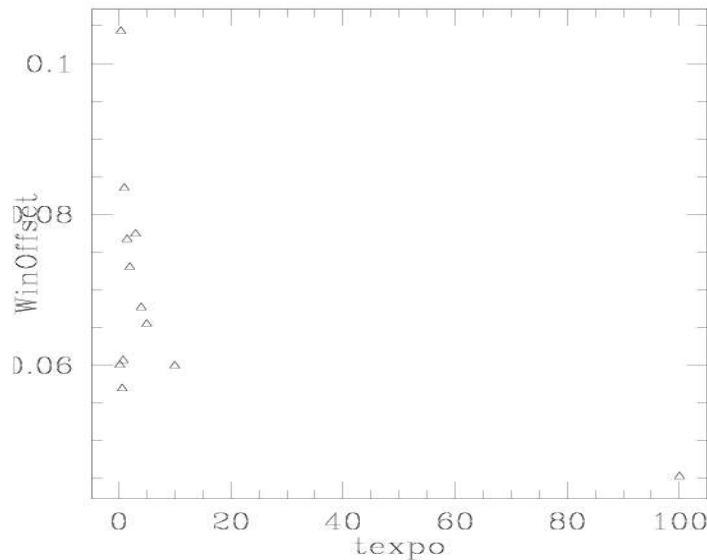
#	expo	dx	dy	offset	offsetarsec
#	0.001	0.054	-0.026	0.05993	0.01378
	0.01	0.054	-0.026	0.05993	0.01378
	0.1	0.054	-0.026	0.05993	0.01378
	0.2	0.054	-0.026	0.05993	0.01378
	0.4	0.054	-0.026	0.05993	0.01378
	0.6	0.054	-0.026	0.05993	0.01378
	0.8	0.054	-0.026	0.05993	0.01378
	1.0	0.054	-0.026	0.05993	0.01378
	1.5	0.054	-0.026	0.05993	0.01378
	2.0	0.054	-0.026	0.05993	0.01378

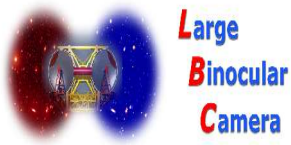
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3.0	0.054	-0.026	0.05993	0.01378
4.0	0.054	-0.026	0.05993	0.01378
5.0	0.054	-0.026	0.05993	0.01378
10.0	0.054	-0.026	0.05993	0.01378
100.0	0.054	-0.026	0.05993	0.01378

#	expo(s)	dx(px ls)	dy(pxls)	offset(pxls)	offsetarsec
#					
	0.2	0.052	-0.030	0.06003	0.01381
	0.4	0.101	-0.026	0.10430	0.02399
	0.6	0.054	-0.018	0.05692	0.01309
	0.8	0.059	-0.014	0.06064	0.01395
	1.0	0.079	-0.027	0.08349	0.0192
	1.5	0.071	-0.029	0.07669	0.01764
	2.0	0.067	-0.029	0.07301	0.01679
	3.0	0.068	-0.037	0.07741	0.01781
	4.0	0.056	-0.038	0.06768	0.01557
	5.0	0.054	-0.037	0.06546	0.01506
	10.0	0.054	-0.026	0.05993	0.01378
	100.0	0.033	-0.031	0.04528	0.01041

As we can see the offset calculation is not affected by the seeing variation; while the variation of the exposure time produces low variations of the baricenter identification in the sextractor application; which leads to the same mean error calculated in the first test (see following graphics).



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App. 3A: Input and Output Files

The input scan file ("scan1.dat" and scan2.dat") for fits-image configuration looks like this:

```
-----
57  2048  57
-----
```

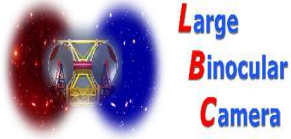
Where the only line is composed of three quantities (integer numbers) which represent the size of prescan; scan and overscan region of the images.

These are very important configuration files because the correct setting of these values lead to a correct basic reduction step: the mean BIAS value is calculated for each fits-image row by the median pixels value of the prescan and overscan regions.

The input ascii-file ("track_next.in") for configuration is similar to this:

```
-----
29.44,235.52,0.0
test1.fits
flattest1.fits
1724.08,235.52,0.0
test2.fits
flattest2.fits
550,200
580,280
-----
```

Where the 1st line is the X(arsec),Y(arsec),Theta(degree) offset and rotation for first technical-chip, the 2nd line is the filename of the input fits image for first thecnical-chip, the 3rd line is the filename of the input flatfield fits image for first technical-chip, the 4th line is the X(arsec),Y(arsec),Theta(degree) offset and rotation for second technical-chip, the 5th line is the filename of the input fits image for second thecnical-chip, the 6th line is the filename of the input flatfield fits image for second technical-chip, the 7th and 8th lines identify the box to skip for tracking operations on the second technical-chip.

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All the configuration files are located in the "D:\conf\" path.
 We remember that the coordinate of the technical chips are the following in pixels:

```

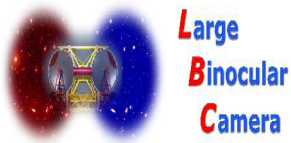
Technical chips Width x Height = 256 x 2048
  phu_tech1.hdr:DETSEC = '[1:256,1280:3328]' / Detector section
  phu_tech2.hdr:DETSEC = '[7368:7624,1280:3328]' / Detector section
starting from the X0_1 and X0_2 coordinates there are also 57 lines in the Y axes for
each tech-chip which represent the prescan and overscan regions.
  
```

The output ascii-file ("track_next.out") is similar to this:

```

-----
0.007327,-0.011755,-0.275110
79.421000,558.006000,498607.000000,19588.300000
79.421000,558.006000,498607.000000,19588.300000
4.240000
-220.564000
7
127.225000,998.399000,274153.000000,10799.800000
127.225000,998.399000,274153.000000,10799.800000
5.357500
-834.067250
4
-----
  
```

Where the 1st line is OffsetX(arsec), OffsetY(arsec) and rotationAngle (degree) from the reference catalog, the 2nd line is the X,Y,flux and maximum of a star even if it is saturated, the 3rd line are the same quantities for the first non saturated star (it may be the same star), the 4th line is the median FWHM, the 5th line is the median BACKGROUND, the 6th line is the number of best stars in the first technical-chip; the lines from 7th to 11th are the same quantities for the second technical-chip.


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App. 3B: Basic reduction Steps

The general reduction steps performed by this program are the following:

- take a look in the "D:\tmp\" directory for filename presence.
- calculate the median of prescan and overscan of each fits-image and set it as the medianBIAS of the image.
- For each pixel of the image calculate the two quantities:
 - outimage = (fitsimage-medianBIAS)/flatimage**
 - saturation = (65536.0-medianBIAS)/flatimage**
- save output reduced fits file int the "D:\tmp\" directory.

All the flatfield filename are located in the "D:\flat\" directory.

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App. 3C: Best stars selection algorithm

The general algorithm for best stars selection performed by this program consists in reading the sextractor generated catalog and parsing it for flux, classtar and flag keywords:

if (flag==0 && classtar>0.9 && flux>10.0) => bestStar

After this generical check all the best source vectors are sorted in their flux.

If the Maximum of a star is greater than its saturation level the star is marked as saturated.

If no one good star is found, the program prints an error message and exits.

To configure properly sextractor under windows an executable binary file of sextractor batch program for win32 systems is needed. It must be placed in the same directory of the executable tracking programs. The configuration files for sextractor (placed in the "D:\conf\" directory) must be standard sextractor files and the parameter "default.assoc" file must contain the following keyword in same order:

```

NUMBER
X_IMAGE
Y_IMAGE
FWHM_IMAGE
FLUX_BEST
FLUX_MAX
BACKGROUND
VECTOR_ASSOC(2)
VECTOR_ASSOC(3)
CLASS_STAR
FLAGS

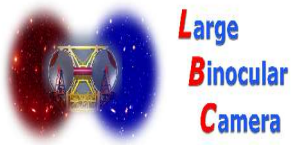
```

The "defaultASSOC.sex" file name must be similar to the following:

```

- - -
# Default configuration file for SExtractor V1.2b14 - > 2.0
# EB 23/07/98
# (*) indicates parameters which can be omitted from this config file.
#----- Catalog -----
CATALOG_NAME  image.cat      # name of the output catalog
CATALOG_TYPE  ASCII         # "NONE", "ASCII_HEAD", "ASCII", "FITS_1.0"

```

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or "FITS_LDAC"

PARAMETERS_NAME conf/default.assoc # name of the file containing catalog contents

#----- Extraction -----

DETECT_TYPE CCD # "CCD" or "PHOTO" (*)
FLAG_IMAGE flag.fits # filename for an input FLAG-image
DETECT_MINAREA 5 # minimum number of pixels above threshold
DETECT_THRESH 10.0 # <sigmas> or <threshold>,<ZP> in mag.arcsec-2
ANALYSIS_THRESH 10.0 # <sigmas> or <threshold>,<ZP> in mag.arcsec-2

FILTER Y # apply filter for detection ("Y" or "N")?
FILTER_NAME conf/default.conv # name of the file containing the filter

DEBLEND_NTHRESH 32 # Number of deblending sub-thresholds
DEBLEND_MINCONT 0.005 # Minimum contrast parameter for deblending

CLEAN Y # Clean spurious detections? (Y or N)?
CLEAN_PARAM 1.0 # Cleaning efficiency

MASK_TYPE CORRECT # type of detection MASKing: can be one of
"NONE", "BLANK" or "CORRECT"

#----- Photometry -----

PHOT_APERTURES 5 # MAG_APER aperture diameter(s) in pixels
PHOT_AUTOPARAMS 2.5, 3.5 # MAG_AUTO parameters: <Kron_fact>,<min_radius>

SATUR_LEVEL 50000.0 # level (in ADUs) at which arises saturation

MAG_ZEROPOINT 0.0 # magnitude zero-point
MAG_GAMMA 4.0 # gamma of emulsion (for photographic scans)
GAIN 2.09 # detector gain in e-/ADU.
PIXEL_SCALE 0.23 # size of pixel in arcsec (0=use FITS WCS info).

#----- Star/Galaxy Separation -----

SEEING_FWHM 1.2 # stellar FWHM in arcsec
STARNNW_NAME conf/default.nnw # Neural-Network_Weight table filename

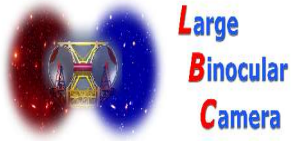
#----- Background -----

BACK_SIZE 64 # Background mesh: <size> or <width>,<height>
BACK_FILTERSIZE 3 # Background filter: <size> or <width>,<height>

BACKPHOTO_TYPE GLOBAL # can be "GLOBAL" or "LOCAL" (*)
BACKPHOTO_THICK 24 # thickness of the background LOCAL annulus (*)

#----- Check Image -----

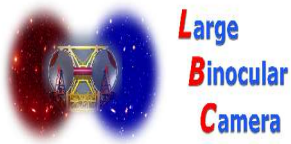
CHECKIMAGE_TYPE NONE # can be one of "NONE", "BACKGROUND",
"MINIBACKGROUND", "-BACKGROUND", "OBJECTS",
"-OBJECTS", "SEGMENTATION", "APERTURES",
or "FILTERED" (*)

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```

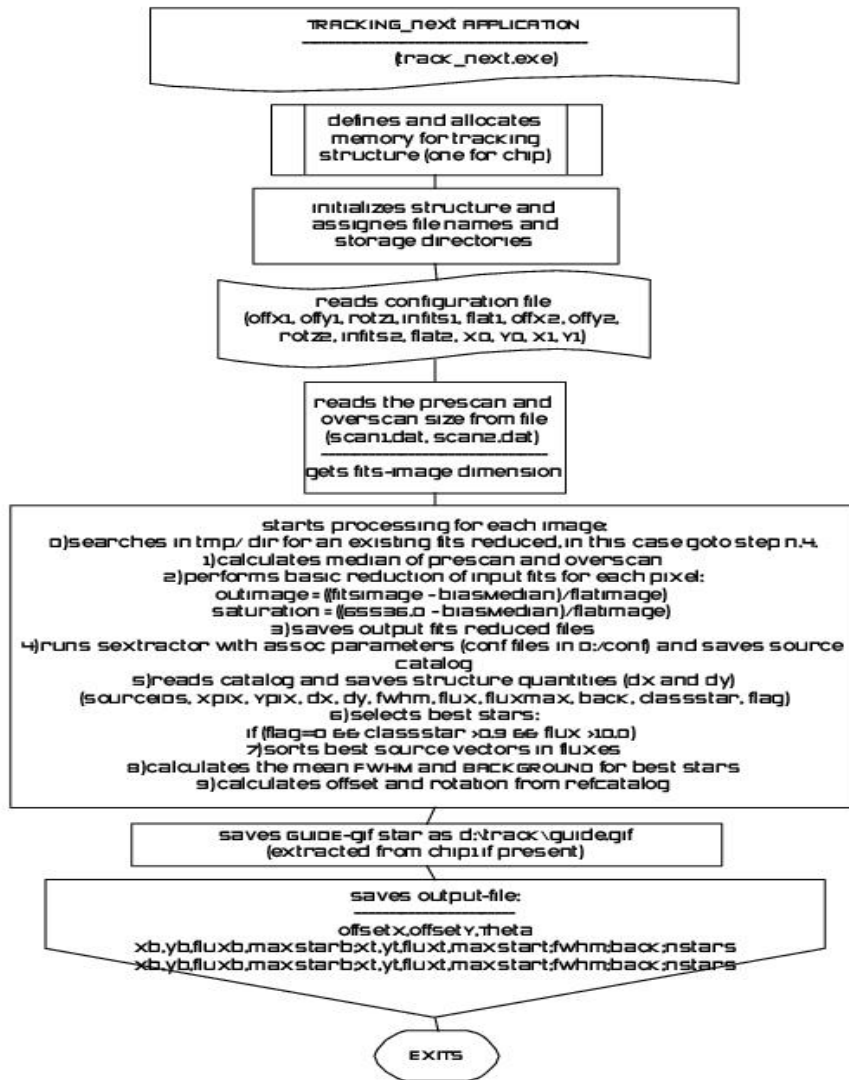
CHECKIMAGE_NAME      check.fits      # Filename for the check-image (*)
#----- Memory (change with caution!) -----
MEMORY_OBJSTACK      2000           # number of objects in stack
MEMORY_PIXSTACK      100000          # number of pixels in stack
MEMORY_BUFSIZE 1024   # number of lines in buffer
#----- Miscellaneous -----
VERBOSE_TYPE   NORMAL      # can be "QUIET", "NORMAL" or "FULL" (*)
#----- New Stuff -----
ASSOC_DATA      0
ASSOC_RADIUS    100.0
ASSOC_TYPE      NEAREST
ASSOCSELEC_TYPE MATCHED
#
---
```

it is possible to find the ASSOC parameters for catalog cross-reference; the more important is the ASSOC_RADIUS set as 100.0 by default.

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App. 3D: Detailed Application operations

In the following picture all the operations performed by the program are described.



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4 - Conclusions

The tracking_first and tracking_next programs have passed preliminar tests on August 2004 and are going to be integrated in the LBC Blue Channel Camera Control System on the LBT telescope.

The official-software repository-URL is:

http://lbc.mporzio.astro.it/tracking_version.zip

Last version:

http://antu.mporzio.astro.it/tracking_sett2004.zip

REFERENCES

1. A. Di Paola et al., LBT Double Prime Focus Camera Control Software.

Acknowledgements

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S.G.