vison Documentation

Release 0.1

Ruyman Azzollini

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README

vison Euclid VIS Ground Calibration Pipeline

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This Python package "vison" is the pipeline that will be used at MSSL for ground calibration of the VIS detection chains, including one ROE, one RPSU and three CCDs.

CHAPTER

TWO

INSTALLATION

The package is distributed via github. The repository is hosted at:

https://github.com/ruymanengithub/vison

Detailed instructions:

Installation

Cloning *vison* from the repository using *git*

If you don't have *git* installed in your system, please follow this link first.

Here we will follow these instructions to clone the repository to your own computer. Follow the link for instructions in other operative systems.

Step-by-step:

- Go to https://github.com/ruymanengithub/vison.
- Click on the green "Clone or download" button.
- In the Clone with HTTPs section, click to copy the clone URL for the repository.
- Open a Terminal.
- Change the current working directory to the location where you want the cloned directory to be made.
- Type `git clone`, and then paste the URL you copied in Step 1.

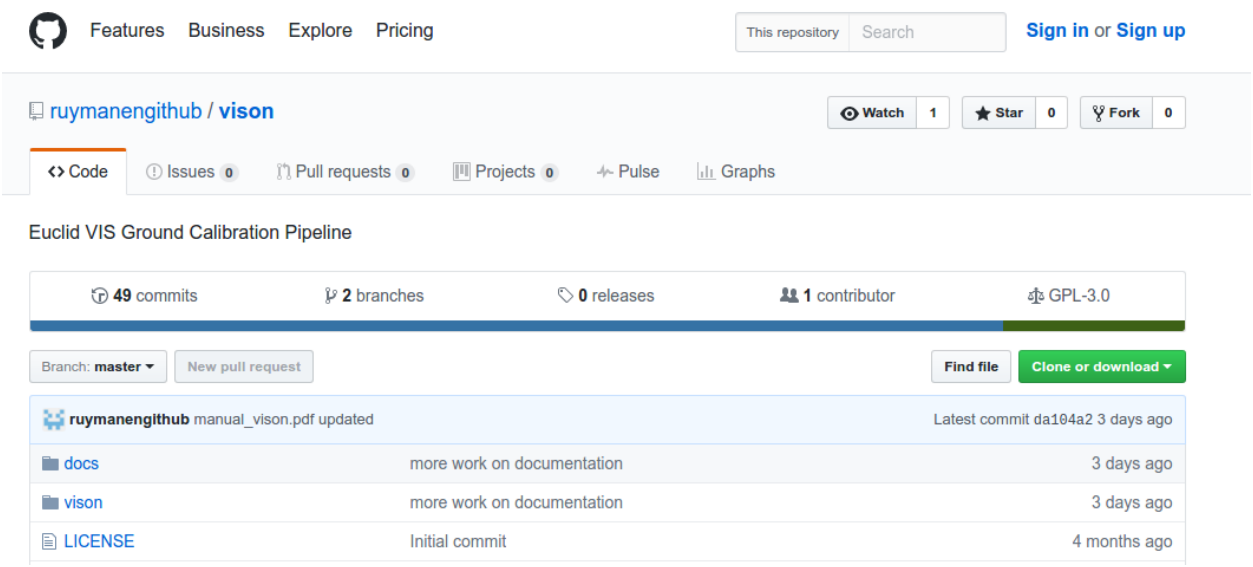
```
~$ git clone https://github.com/ruymanengithub/vison
```

- Press Enter. Your local clone will be created.

Installation

We recommend installing the code through a *conda* environment, with a specific list of packages, so you can be sure you have all the needed dependencies.

First, if you don't have *conda* already installed in your system already, follow the instructions in this link.



Installing conda and creating *vison* environment

Once you have succesfully installed conda, we will create an environment that will allow you to install the pipeline and meet all its dependencies.

Step-by-Step:

- change directory to your copy of the vison repository:

```
~$ cd vison
```

- Under the 'conda' sub-folder, you will find two text files:

```
~$ cd conda
~$ ls
  env-conda_vison.txt  env-pip_vison.txt
```

- Then execute the following command to create a new conda environment, *vison*:

```
~$ conda create -n vison --file env-conda_vison.txt
```

- When prompted, type "y" and return to install the listed packages.
- Activate the new environment

```
~$ source activate vison
```

- Install the packages that are accessed via *pip*, within the conda environment:

```
~$ pip install -r env-pip_vison.txt
```

Installing *vison*

Finally, to install the *vison* pipeline itself, we will go back to the folder we downloaded from the github repository:

```
~$ cd ../
~$ ls
conda  docs  LICENSE  manual_vison.pdf  README.md  setup.cfg  setup_distutils.py␣
↪setup.py  vison
```

Then do the actual installation, via:

~$ python setup.py install

Now the vison package will be accessible from anywhere in your system, whenever you start python from within the *vison* conda environment. For example:

- open a new terminal and go to your home directory

```
~$ cd
```

- activate the vison environment:

```
~$ source activate vison
```

- start the python interpreter and import vison:

```
~$ source activate vison
~$ python
>>> import vison
>>> dir(vison)
['Eyegore', 'FlatFielding', 'Pipe', 'Report', '__all__', '__builtins__', '__doc__
↪', '__file__',
'__name__', '__package__', '__path__', '__version__', 'analysis', 'data',
↪'datamodel',
     'eyegore', 'pipe', 'point', 'support']
```

Dependencies

Instructions to acquire a copy of the "conda" environment that provides all dependencies is included in the package. See *Installation* instructions for details.

CHAPTER

THREE

PIPELINE CORE

Pipeline

master.py

This is the main script that will orchestrate the analysis of Euclid-VIS FM Ground Calibration Campaign.

The functions of this module are:

- Take inputs as to what data is to be analyzed, and what analysis scripts are to be run on it.
- Set the variables necessary to process this batch of FM calib. data.
- Start a log of actions to keep track of what is being done.
- Provide inputs to scripts, execute the analysis scripts and report location of analysis results.

Some Guidelines for Development:

- Input data is "sacred": read-only.
- Each execution of Master must have associated a unique ANALYSIS-ID.
- All the Analysis must be divided in TASKS. TASKS can have SUB-TASKS.
- All data for each TASK must be under a single directory (TBC).
- All results from the execution of FMmaster must be under a single directory with subdirectories for each TASK run.
- **A subfolder of this root directory will contain the logging information:** inputs, outputs, analysis results locations.

Created on Wed Jul 27 12:16:40 2016

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

class `vison.pipe.master.`**`Pipe`**(*inputdict*, *dolog=True*)
Master Class of FM-analysis

`run`()

FlatFielding.py

Flat-fielding Utilities.

Created on Fri Apr 22 16:13:22 2016

@author: raf

class vison.pipe.FlatFielding.**FlatField**(*fitsfile=''*, *data={}*, *meta={}*)

parse_fits()

vison.pipe.FlatFielding.**fit2D**(*xx*, *yy*, *zz*, *degree=1*)

vison.pipe.FlatFielding.**get_ilum**(*img*, *pdegree=5*, *filtsize=15*, *filtertype='median'*, *Tests=False*)

vison.pipe.FlatFielding.**get_ilum_splines**(*img*, *filtsize=25*, *filtertype='median'*, *Tests=False*)

vison.pipe.FlatFielding.**produce_IndivFlats**(*infits*, *outfits*, *settings*, *runonTests*, *processes=6*)

vison.pipe.FlatFielding.**produce_MasterFlat**(*infits*, *outfits*, *mask=None*, *settings={}*)

Produces a Master Flat out of a number of flat-illumination exposures. Takes the outputs from produce_IndivFlats.

vison.pipe.FlatFielding.**produce_SingleFlatfield**(*infits*, *outfits*, *settings={}*, *runonTests=False*)

CHAPTER

FOUR

DATA MODEL

Data Model

ccd.py

Data model for Euclid-VIS CCDs (ground testing at MSSL)

Created on Fri Nov 13 17:42:36 2015

Author Ruyman Azzollini

class `vison.datamodel.ccd.`**CCD**(*infits=None, extensions=[-1], getallextensions=False*)
Class of CCD objects. Euclid Images as acquired by ELVIS software (Euclid LabView Imaging Software).

The class has been extended to handle multi-extension images. This is useful to also "host" calibration data-products, such as Flat-Fields.

add_extension(*data*, *header=None*, *label=None*, *headerdict=None*)

divide_by_flatfield(*FF*, *extension=-1*)
Divides by a Flat-field

get_cutout(*corners*, *Quadrant*, *canonical=False*, *extension=-1*)
Returns a cutout from the CCD image, either in canonical or non-canonical orientation.

Parameters

- **corners** (*list (of int)*) – [x0,x1,y0,y1]
- **Quadrant** (*char*) – Quadrant, one of 'E', 'F', 'G', 'H'
- **canonical** (*bool*) – Canonical [True] = with readout-node at pixel index (0,0) regardless of quadrant. This is the orientation which corresponds to the data-readin order (useful for cross-talk measurements, for example). Non-Canonical [False] = with readout-node at corner matching placement of quadrant on the CCD. This is the orientation that would match the representation of the image on DS9.
- **extension** (*int*) – extension number. Default = -1 (last)

get_mask(*mask*)

get_quad(*Quadrant*, *canonical=False*, *extension=-1*)
Returns a quadrant in canonical or non-canonical orientation.

Parameters

- **Quadrant** (*char*) – Quadrant, one of 'E', 'F', 'G', 'H'
- **canonical** –

Canonical [True] = with readout-node at pixel index (0,0) regardless of quadrant. This is the orientation which corresponds to the data-reading order (useful for cross-talk measurements, for example). Non-Canonical [False] = with readout-node at corner matching placement of quadrant on the CCD. This is the orientation that would match the representation of the image on DS9.

Parameters **extension** (*int*) – extension number. Default = -1 (last)

get_stats (*Quadrant, sector='img', statkeys=['mean'], trimscan=[0, 0], extension=-1*)

getsectioncollims (*QUAD*)
Returns limits of sections: prescan, image and overscan

set_quad (*inQdata*, *Quadrant*, *canonical=False*, *extension=-1*)

simadd_flatilum (*levels={'H': 0.0, 'E': 0.0, 'G': 0.0, 'F': 0.0}*, *extension=-1*)

simadd_points (*flux*, *fwhm*, *CCDID='CCD1'*, *dx=0*, *dy=0*, *extension=-1*)

simadd_poisson (*extension=-1*)

simadd_ron (*extension=-1*)

sub_bias (*superbias*, *extension=-1*)
Subtracts a superbias

sub_offset (*Quad, method='row', scan='pre', trimscan=[3, 2], extension=-1*)

writeto (*fitsf*, *clobber=False*, *unsigned16bit=False*)

class vison.datamodel.ccd.**Extension** (*data*, *header=None*, *label=None*, *headerdict=None*)
Extension Class

vison.datamodel.ccd.**test_create_from_scratch** ()

vison.datamodel.ccd.**test_load_ELVIS_fits** ()

EXPLOGtools.py

class vison.datamodel.EXPLOGtools.**ExpLogClass** (*elvis='5.7.04'*)

addRow ()

iniExplog ()

writeto (*outfile*)

vison.datamodel.EXPLOGtools.**iniExplog** (*elvis*)

vison.datamodel.EXPLOGtools.**loadExpLog** (*expfile*, *elvis='5.7.04'*)
Loads an Exposure Log from file.

vison.datamodel.EXPLOGtools.**mergeExpLogs** (*explogList*, *addpedigree=False*)
Merges explog objects in a list.

vison.datamodel.EXPLOGtools.**test** ()
This Tests needs UPDATE (for data access and probably data format)

HKtools.py

House-Keeping inspection and handling tools.

History

Created on Thu Mar 10 12:11:58 2016

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.datamodel.HKtools.**HKplot**(*allHKdata*, *keylist*, *key*, *dtobjs*, *filename=''*, *stat='mean'*)
Plots the values of a HK parameter as a function of time.

Parameters

- **allHKdata** – HKdata = [(nfiles,nstats,nHKparams)]
- **keylist** – list with all HK keys.
- **key** – selected key.
- **tdeltahour** – time axis.

Returns None!!

vison.datamodel.HKtools.**filtervalues**(*values*, *key*)

vison.datamodel.HKtools.**iniHK_QFM**(*elvis='6.0.0'*)

vison.datamodel.HKtools.**loadHK_QFM**(*filename*, *elvis='5.8.X'*)
Loads a HK file

Structure: tab separated columns, one per Keyword. First column is a timestamp, and there may be a variable number of rows (readings).

Parameters

- **filename** – path to the file to be loaded, including the file itself
- **form** – format of HK file, given by version of "ELVIS"

Returns dictionary with pairs parameter:[values]

vison.datamodel.HKtools.**loadHK_preQM**(*filename*, *elvis='5.7.07'*)
Loads a HK file

It only assumes a structure given by a HK keyword followed by a number of of tab-separated values (number not specified). Note that the length of the values arrays is variable (depends on length of exposure and HK sampling rate).

Parameters

- **filename** – path to the file to be loaded, including the file itself
- **form** – format of HK file, given by version of "ELVIS"

Returns dictionary with pairs parameter:[values]

vison.datamodel.HKtools.**parseHKfiles**(*HKlist*, *elvis='5.7.07'*)

Parameters **HKlist** – list of HK files (path+name).

Returns [obsids],[dtobjs],[tdeltasec],[HK_keys], [data(nfiles,nstats,nHKparams)]

vison.datamodel.HKtools.**parseHKfname**(*HKfname*)
Parses name of a HK file to retrieve OBSID, date and time, and ROE number.

Parameters **HKfname** – name of HK file.

Returns obsid,dtobj=datetime.datetime(yy,MM,dd,hh,mm,ss),ROE

vison.datamodel.HKtools.**reportHK**(*HKs*, *key*, *reqstat='all'*)
Returns (mean, std, min, max) for each keyword in a list of HK dictionaries (output from loadHK).

Parameters

- **HK** – dictionary with HK data.
- **key** – HK key.

Reqstat what statistic to retrieve.

vison.datamodel.HKtools.**synthHK**(*HK*)

Synthetizes the values for each parameter in a HK dictionary into [mean,std,min,max].

Parameters **HK** – a dictionary as those output by loadHK.

Returns dictionary with pairs parameter:[mean,std,min,max]

QLAtools.py

Quick-Look-Analysis Tools.

History

Created on Wed Mar 16 11:31:58 2016

@author: Ruyman Azzollini

vison.datamodel.QLAtools.**dissectFITS**(*FITSfile*, *path=''*)

vison.datamodel.QLAtools.**getacrosscolscut**(*CCDobj*)

vison.datamodel.QLAtools.**getacrossrowscut**(*CCDobj*)

vison.datamodel.QLAtools.**getsectionstats**(*CCDobj*, *QUAD*, *section*, *xbuffer=(0, 0)*, *ybuffer=(0, 0)*)

vison.datamodel.QLAtools.**plotAcCOLcuts**(*dissection*, *filename=None*, *suptitle=''*)

vison.datamodel.QLAtools.**plotAcROWcuts**(*dissection*, *filename=None*, *suptitle=''*)

vison.datamodel.QLAtools.**plotQuads**(*CCDobj*, *filename=None*, *suptitle=''*)

vison.datamodel.QLAtools.**reportFITS**(*FITSfile*, *outpath=''*)

CHAPTER

FIVE

ANALYSIS (SHARED)

Analysis (Shared)

ellipse.py

Auxiliary module with functions to generate generalized ellipse masks.

author Ruyman Azzollini

contact r.azzollini@ucl.ac.uk

vison.analysis.ellipse.**area_superellip**(*r*, *q*, *c=0*)
Returns area of superellipse, given the semi-major axis length

vison.analysis.ellipse.**dist_superellipse**(*n*, *center*, *q=1*, *pos_ang=0.0*, *c=0.0*)
Form an array in which the value of each element is equal to the semi-major axis of the superellipse of specified center, axial ratio, position angle, and c parameter which passes through that element. Useful for super-elliptical aperture photometry.

Inspired on dist_ellipse.pro from AstroLib (IDL).

Note: this program doesn't take into account the change in the order of axes from IDL to Python. That means, that in 'n' and in 'center', the order of the coordinates must be reversed with respect to the case for dist_ellipse.pro, in order to get expected results. Nonetheless, the polar angle means the counter-clock wise angle with respect to the 'y' axis.

Parameters

- **n** – shape of array (N1,N2)
- **center** – center of superellipse radii: (c1,c2)
- **q** – axis ratio r2/r1
- **pos_ang** – position angle of isophotes, in degrees, CCW from axis 1
- **c** – boxyness (c>0) /diskyness (c<0)

vison.analysis.ellipse.**effective_radius**(*area*, *q=0*, *c=0*)
Returns semi-major axis length of superellipse, given the area

Guyonnet15.py

Library with functions that implement the algorithms described in Guyonnet+15. "Evidence for self-interaction of charge distribution in CCDs" Guyonnet, Astier, Antilogus, Regnault and Doherty 2015

Notes:

- I renamed “x” (pixel boundary index) to “b”, to avoid confusion with

cartesian “x”. - In paper, X belongsto [(0,1),(1,0),(0,-1),(-1,0)]. Here

b is referred to as cardinal points “N”,”E”,”S”,”W”. It is linked to matrix index ib, running between 0 and 3.

Created on Thu Sep 22 11:38:24 2016

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.analysis.Guyonnet15.**correct_estatic**(*img*, *aijb*)

Corrects an image from pixel-boundaries deformation due to electrostatic forces. Subtracts delta-Q.

Parameters

- **img** – image, 2D array
- **aijb** – Aijb matrix, 3D array

Returns array, img - delta-Q

vison.analysis.Guyonnet15.**degrade_estatic**(*img*, *aijb*)

Degrades an image according to matrix of pixel-boundaries deformations. Follows on Eq. 11 of G15. Adds delta-Q.

Parameters

- **img** – image, 2D array
- **aijb** – Aijb matrix, 3D array

Returns array, img + delta-Q

vison.analysis.Guyonnet15.**fpred_aijb**(*p*, *i*, *j*, *ib*)

‘The smoothing model assumes that a_{ij}^x coefficients are the product of a function of distance from the source charge to the considered boundary (r_{ij}) and that it also trivially depends on the angle between the source-boundary vector and the normal to the boundary (theta_{i,j}^x)’

Eq. 18

Parameters

- **p** – parameters of the radial function (list of 2)
- **i** – pixel coordinate i
- **j** – pixel coordinate j
- **ib** – boundary index [0, 1, 2, 3]

Returns f(rij)cos(theta_ij^x)

vison.analysis.Guyonnet15.**frdist**(*i*, *j*, *ib*)

Distance from the source charge to considered boundary “b”

Parameters

- **i** – pixel coordinate i
- **j** – pixel coordinate j
- **ib** – boundary index [0, 1, 2, 3]

Returns distance r(ijb)

vison.analysis.Guyonnet15.**ftheta_bound**(*i*, *j*, *ib*)

'[theta_i,j^X is] the angle between the source-boundary vector and the

normal to the boundary'.

Parameters

- **i** – pixel coordinate i
- **j** – pixel coordinate j
- **ib** – boundary index [0, 1, 2, 3]

Returns theta_i,j^x

vison.analysis.Guyonnet15.**fun_p**(*x*, **p*)
auxiliary function to 'solve_for_psmooth'

vison.analysis.Guyonnet15.**generate_GaussPSF**(*N*, *sigma*)
Create a circular symmetric Gaussian centered on the centre of a NxN matrix/image.

vison.analysis.Guyonnet15.**get_Rdisp**(*img*, *aijb*)
Retrieves map of relative displacements of pixel boundaries, for input img and Aijb matrix.

See G15 - Eq. 6

Parameters

- **img** – image, 2D array
- **aijb** – aijb matrix, 3D array NxNx4

Returns array, relative displacements all boundaries of pixels in img

vison.analysis.Guyonnet15.**get_deltaQ**(*img*, *aijb*, *writeFits=False*)
Retrieves deltaQ map for input image and aijb matrix.

See G15 - Eq. 11

Parameters

- **img** – image, 2D array
- **aijb** – Aijb matrix, 3D array
- **writeFits** – save FITS file with resulting dQ map (optional)

Returns array, matrix with delta-Q for each pixel in img, given aijb

vison.analysis.Guyonnet15.**get_kernel**(*aijb*, *writeFits=False*)
'kernel' is an array (2N-1)x(2N-1)x4. Each plane kernel[:,:,b] is a 2D array with the displacement coefficients aijb, in all directions around a pixel at (0,0).

Parameters

- **aijb** – array, matrix with displacements in 1st quadrant
- **writeFits** – save kernel to 4 FITS files

Returns kernel matrix, (2N-1)x(2N-1)x4

vison.analysis.Guyonnet15.**plot_map**(*z*, *ii*, *jj*, *title=''*)

vison.analysis.Guyonnet15.**plot_maps_ftheta**(*f*, *ii*, *jj*, *suptitle=''*)

vison.analysis.Guyonnet15.**show_disps_CCD273**(*aijb*, *stretch=5.0*, *peak=28571.428571428572*, *N=25*, *sigma=1.6*, *title=''*, *figname=''*)

vison.analysis.Guyonnet15.**solve_for_A_linalg**(*covij*, *var=1.0*, *mu=1.0*, *doplot=False*, *psmooth=None*, *returnAll=False*)

Function to retrieve the A matrix of pixel boundaries displacements, given a matrix of pixel covariances, variance, and mu.

if var==1 and mu==1, it is understood that covij is the correlation matrix.

See section 6.1 of G15.

Parameters

- **covij** – array, squared matrix with pixel covariances.
- **var** – float, variance of the flat-field.
- **mu** – float, mean value of the flat-field.
- **doplot** – if True, plot the fit of the fpred(ijb) function
- **psmooth** – coefficients of the fpred(aijb) function (Eq. 18)
- **returnAll** – bool, controls return values

Returns if returnAll == True, return (aijb, psmooth), otherwise return aijb only

vison.analysis.Guyonnet15.**solve_for_psmooth**(*covij*, *var*, *mu*, *doplot=False*)

Solving (p0,p1) parameters in Eq. 18 using covariance matrix and measured covariance matrix.

Parameters

- **covij** – array, covariance matrix
- **var** – float, variance
- **mu** – float, expected value of pixel values ("mean" of flat-field)
- **doplot** – bool, if True, plot data and best fit model

Returns best-fit parameters, and errors: 2 tuples of 2 elements each

vison.analysis.Guyonnet15.**test0**()

vison.analysis.Guyonnet15.**test_getkernel**()

vison.analysis.Guyonnet15.**test_selfconsist**()

vison.analysis.Guyonnet15.**test_solve**()

CHAPTER

SIX

MONITORING (“EYEGORE”)

Monitoring (“Eyegore”)

Fig. 6.1: You must be Igor...

eyegore.py

eyegore

data acquisition monitoring script for vison package.

‘- You must be Igor... - No, it’s pronounced “Eye-gore”.’

Created on Thu Feb 2 15:27:39 2017

Author Ruyman Azzollini

class `vison.eyegore.eyegore.`**`ExpLogDisplay`**(*parent*, *path*, *elvis='6.0.0'*)

changeNumeric(*data*)
if the data to be sorted is numeric change to float

get_data()

isNumeric(*s*)
test if a string s is numeric

search_EXPLOG()

sortBy(*tree*, *col*, *descending*)
sort tree contents when a column header is clicked

class vison.eyegore.eyegore.**Eyegore**(*path*, *interval=3000*)

class vison.eyegore.eyegore.**HKDisplay**(*parent*, *path*, *elvis='6.0.0'*)

get_data()

search_HKfile()

select_HKkeys()

class vison.eyegore.eyegore.**ImageDisplay**(*parent*, *path*)

gen_render()

get_data()
PENDING

CHAPTER

SEVEN

POINT-SOURCE ANALYSIS

Point-Source Analysis

basis.py

author Ruyman Azzollini

contact r.azzollini _at_ ucl.ac.uk

Created on Thu Apr 20 18:56:40 2017

display.py

Display Library for Point-Source Analysis

requires matplotlib

author Ruyman Azzollini

contact r.azzollini _at_ ucl.ac.uk

Created on Fri Apr 21 14:02:57 2017

vison.point.display.**show_spots_allCCDs**(*spots_bag*, *title=''*, *filename=''*, *dobar=True*)

gauss.py

Gaussian Model of Point-like Sources

Simple class to do Gaussian Fitting to a spot.

requires NumPy, astropy

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

Created on Thu Apr 20 16:42:47 2017

class vison.point.gauss.**Gaussmeter**(*data*, *log=None*, ***kwargs*)
Provides methods to measure the shape of an object using a 2D Gaussian Model.

Parameters

- **data** (*np.ndarray*) – stamp to be analysed.

- **log** (*instance*) – logger
- **kwargs** (*dict*) – additional keyword arguments

Settings dictionary contains all parameter values needed.

fit_Gauss()

models.py

Models (Point-Like Sources)

Library module with models for processing of point-source imaging data.

requires NumPy

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

Created on Wed Apr 19 11:47:00 2017

vison.point.models.**fgauss2D**(*x*, *y*, *p*)

A gaussian fitting function where p[0] = amplitude p[1] = x0 p[2] = y0 p[3] = sigmax p[4] = sigmay p[5] = floor

photom.py

Aperture Photometry of point-like objects

Simple class to do aperture photometry on a stamp of a point-source.

requires NumPy

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

Created on Thu Apr 20 14:37:46 2017

class vison.point.photom.**Photometer**(*data*, *log=None*, ***kwargs*)

Provides methods to measure the shape of an object.

Parameters

- **data** (*np.ndarray*) – stamp to be analysed.
- **log** (*instance*) – logger
- **kwargs** (*dict*) – additional keyword arguments

Settings dictionary contains all parameter values needed.

doap_photom(*centre*, *rap*, *rin=-1.0*, *rout=-1.0*, *gain=3.5*, *doErrors=True*, *subbgd=False*)

get_centroid(*rap=None*, *full=False*)

TODO: add aperture masking

measure_bgd(*rin*, *rout*)

sub_bgd(*rin*, *rout*)

shape.py

Quadrupole Moments Shape Measurement

Simple class to measure quadrupole moments and ellipticity of an object.

requires NumPy, PyFITS

author Sami-Matias Niemi, Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

class `vison.point.shape.`**Shapemeter**(*data*, *log=None*, ***kwargs*)
Provides methods to measure the shape of an object.

Parameters

- **data** (*np.ndarray*) – stamp to be analysed.
- **log** (*instance*) – logger
- **kwargs** (*dict*) – additional keyword arguments

Settings dictionary contains all parameter values needed.

circular2DGaussian(*x*, *y*, *sigma*)
Create a circular symmetric Gaussian centered on x, y.

Parameters

- **x** (*float*) – x coordinate of the centre
- **y** (*float*) – y coordinate of the centre
- **sigma** (*float*) – standard deviation of the Gaussian, note that sigma_x = sigma_y = sigma

Returns circular Gaussian 2D profile and x and y mesh grid

Return type dict

ellip2DGaussian(*x*, *y*, *sigmax*, *sigmay*)
Create a two-dimensional Gaussian centered on x, y.

Parameters

- **x** (*float*) – x coordinate of the centre
- **y** (*float*) – y coordinate of the centre
- **sigmax** (*float*) – standard deviation of the Gaussian in x-direction
- **sigmay** (*float*) – standard deviation of the Gaussian in y-direction

Returns circular Gaussian 2D profile and x and y mesh grid

Return type dict

measureRefinedEllipticity()
Derive a refined iterated polarisability/ellipticity measurement for a given object.

By default polarisability/ellipticity is defined in terms of the Gaussian weighted quadrupole moments. If self.shsettings['weighted'] is False then no weighting scheme is used.

The number of iterations is defined in self.shsettings['iterations'].

Returns centroids [indexing stars from 1], ellipticity (including projected e1 and e2), and R2

Return type dict

quadrupoles(*image*)
Derive quadrupole moments and ellipticity from the input image.

Parameters **img** (*ndarray*) – input image data

Returns quadrupoles, centroid, and ellipticity (also the projected components e1, e2)

Return type dict

writeFITS(*data*, *output*)
Write out a FITS file using PyFITS.

Parameters

- **data** (*ndarray*) – data to write to a FITS file
- **output** (*string*) – name of the output file

Returns None

spot.py

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

Created on Thu Apr 20 15:35:08 2017

class vison.point.spot.**Spot**(*data*, *log=None*, ***kwargs*)
Provides methods to do point-source analysis on a stamp. Aimed at basic analysis:

•Photometry

•Quadrupole Moments

•Gaussian Fit

Parameters

- **data** (*np.ndarray*) – stamp to be analysed.
- **log** (*instance*) – logger
- **kwargs** (*dict*) – additional keyword arguments

Settings dictionary contains all parameter values needed.

lib.py

FM-Calib. Campaign.

Library module with useful data and functions for processing of point-source imaging data.

Created on Wed Apr 5 10:21:05 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.point.lib.**fwcentroid**(*image*, *checkbox=1*, *maxiterations=30*, *threshold=1e-05*, *halfwidth=35*, *verbose=False*, *full=False*)

Implement the Floating-window first moment centroid algorithm chosen for JWST target acquisition.

See JWST-STScI-001117 and JWST-STScI-001134 for details.

This code makes no attempt to vectorize or optimize for speed; it's pretty much just a straight verbatim implementation of the IDL-like pseudocode provided in JWST-STScI-001117

image [array_like] image to centroid

checkbox [int] size of moving checkbox for initial peak pixel guess. Default 1

maxiterations [int] Max number of loops. Default 30

halfwidth [int] Half width of the centroid box size (less 1). Specify as a scalar, or a tuple Xhalfwidth, Yhalfwidth. Empirical tests suggest this parameter should be at *least* the PSF FWHM for convergence, preferably some small factor larger

threshold [float] Position threshold for convergence

(ycen, xcen) [float tuple] Measured centroid position. Note that this is returned in Pythonic Y,X order for use as array indices, etc.

-Marshall Perrin 2011-02-11

vison.point.lib.**get_Gauss_spot**()

measurements:'i0_G','ei0_G','flu_G','eflu_G', 'x0_G','ex0_G','y0_G','ey0_G', 'sx_G','esx_G','sy_G','esy_G', 'e1','e2','e','R2'

vison.point.lib.**get_Quadrupoles_spot**()
measurements:'e1','e2','e','R2'

vison.point.lib.**get_photom_spot**(*stamp*, *x0*, *y0*)
measurements:'apflu','eapflu','bgd','ebgd'

Point-Source Scripts

Point-Source Scripts

FOCUS00

VIS Ground Calibration TEST: FOCUS00

Focus analysis script

Tasks:

- Select exposures, get file names, get metadata (commandig, HK).
- Check quality of data (integrated fluxes are roughly constant, matching expected level).
- Subtract offset level.
- Divide by Flat-field.
- **Crop stamps of the sources on each CCD/Quadrant.**
  - save snapshot figures of sources.
- **for each source (5 x Nquadrants):**

    - measure shape using Gaussian Fit
- Find position of mirror that minimizes PSF sizes
- **Produce synoptic figures:** source size and ellipticity across combined FOV (of 3 CCDs)
- Save results.

Created on Mon Apr 03 16:21:00 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.point.FOCUS00.**basic_analysis_FOCUS00**(*DataDict*, *Report*, *inputs*, *log=None*, *debug=False*)

Performs basic analysis on spots: - 2D Gaussian Model shape measurements - Quadrupole Moments shape measurements

vison.point.FOCUS00.**filterexposures_FOCUS00**(*inwavelength*, *explogf*, *datapath*, *OBSID_lims*, *structure={'Ncols': 6*, *'col6': {'Mirr_pos': 70.2*, *'Exptime': 10.0*, *'N': 2}*, *'col4': {'Mirr_pos': 70.0*, *'Exptime': 10.0*, *'N': 2}*, *'col5': {'Mirr_pos': 70.1*, *'Exptime': 10.0*, *'N': 2}*, *'col2': {'Mirr_pos': 69.8*, *'Exptime': 10.0*, *'N': 2}*, *'col3': {'Mirr_pos': 69.9*, *'Exptime': 10.0*, *'N': 2}*, *'col1': {'Mirr_pos': 69.8*, *'Exptime': 0*, *'N': 5}}*, *elvis='5.7.04'*)

Loads a list of Exposure Logs and selects exposures from test FOCUS00.

The filtering takes into account an expected structure for the acquisition script.

The datapath becomes another column in DataDict. This helps dealing with tests that run overnight and for which the input data is in several date-folders.

vison.point.FOCUS00.**generate_Explog_FOCUS00**(*wavelength*, *struct*, *elvis='6.0.0'*, *date=datetime.datetime(1980*, *2*, *21*, *7*, *0)*)

vison.point.FOCUS00.**generate_FITS_FOCUS00**(*wavelength*, *explog*, *datapath*, *elvis='6.0.0'*)

vison.point.FOCUS00.**generate_Fake_FOCUS00**(*wavelength*, *date=datetime.datetime(1980*, *2*, *21*, *7*, *0)*, *rootpath=''*)

Generates Fake FOCUS00 data

vison.point.FOCUS00.**generate_HK_FOCUS00**(*explog*, *datapath*, *elvis='6.0.0'*)

vison.point.FOCUS00.**get_FOCUS00_structure**(*wavelength*)

vison.point.FOCUS00.**get_basic_spot_FOCUS00**(*stamp*, *x0*, *y0*, *log=None*, *debug=False*)

TODO: # get basic statistics, measure and subtract background # update centroid # do aperture photometry # pack-up results and return

vison.point.FOCUS00.**get_shape_spot_FOCUS00**(*stamp*, *x0*, *y0*, *method='G'*, *log=None*, *debug=False*)

TODO: # get basic statistics, measure and subtract background # update centroid # do aperture photometry # pack-up results and return

vison.point.FOCUS00.**meta_analysis_FOCUS00**(*DataDict*, *RepDict*, *inputs*, *log=None*)

Analyzes the relation between PSF shape and mirror position.

vison.point.FOCUS00.**prep_data_FOCUS00**(*DataDict*, *Report*, *inputs*, *log=None*, *debug=False*)

Takes Raw Data and prepares it for further analysis. Also checks that data quality is enough.

vison.point.FOCUS00.**run**(*inputs*, *log=None*)
Test FOCUS00 master function.

PSF0X

VIS Ground Calibration TEST: PSF0X

PSF vs. Fluence, and Wavelength PSF01 - nominal temperature PSF02 - alternative temperatures

Tasks:

- Select exposures, get file names, get metadata (commandig, HK).
- Check exposure time pattern matches test design.
- Check quality of data (rough scaling of fluences with Exposure times).
- Subtract offset level.
- Divide by Flat-field.
- **Crop stamps of the sources on each CCD/Quadrant.**
  - save snapshot figures of sources.
- **for each source:**
  - measure shape using weighted moments
  - measure shape using Gaussian Fit
  - Bayesian Forward Modelling the optomechanic+detector PSF
- Produce synoptic figures.
- Save results.

Created on Thu Dec 29 15:01:07 2016

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.point.PSF0X.**basic_analysis_PSF0X**(*DataDict*, *RepDict*, *inputs*, *log=None*)
Performs basic analysis on spots: - Gaussian Fits: peak, position, width_x, width_y

vison.point.PSF0X.**bayes_analysis_PSF0X**(*DataDict*, *RepDict*, *inputs*, *log=None*)

Performs bayesian decomposition of the spot images:

- optomechanic PSF and detector PSF.

Also measures R2, fwhm and ellipticity of "extracted" detector PSF.

vison.point.PSF0X.**filterexposures_PSF0X**(*inwavelength*, *explogf*, *datapath*, *OBSID_lims*, *structure={'Ncols': 6, 'col6': {'Exptime': 18.0, 'N': 3}, 'col4': {'Exptime': 10.0, 'N': 10}, 'col5': {'Exptime': 15.0, 'N': 4}, 'col2': {'Exptime': 1.0, 'N': 20}, 'col3': {'Exptime': 5.0, 'N': 18}, 'col1': {'Exptime': 0, 'N': 5}}*, *elvis='5.7.04'*)
Loads a list of Exposure Logs and selects exposures from test PSF0X.

The filtering takes into account an expected structure for the acquisition script.

The datapath becomes another column in DataDict. This helps dealing with tests that run overnight and for which the input data is in several date-folders.

vison.point.PSF0X.**meta_analysis_PSF0X**(*DataDict*, *RepDict*, *inputs*, *log=None*)
Analyzes the relation between detector PSF and fluence.

vison.point.PSF0X.**prep_data_PSF0X**(*DataDict*, *RepDict*, *inputs*, *log=None*)
Takes Raw Data and prepares it for further analysis. Also checks that data quality is enough.

vison.point.PSF0X.**run**(*inputs*, *log=None*)
Test PSF0X master function.

CHAPTER

EIGHT

SUPPORT CODE

Support Code

IO related functions.

requires PyFITS

requires NumPy

author Sami-Matias Niemi

contact r.azzollini_at_ucl.ac.uk

vison.support.files.**cPickleDump**(*data*, *output*)
Dumps data to a cPickled file.

Parameters

- **data** – a Python data container
- **output** – name of the output file

Returns None

vison.support.files.**cPickleDumpDictionary**(*dictionary*, *output*)
Dumps a dictionary of data to a cPickled file.

Parameters

- **dictionary** – a Python data container does not have to be a dictionary
- **output** – name of the output file

Returns None

vison.support.files.**cPickleRead**(*file*)
Loads data from a pickled file.

Euclid-VIS Calibration Programme Pipeline: vison

Reporting Utilities.

History

Created on Wed Jan 25 16:58:33 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

class vison.support.report.**Content**(*contenttype=''*)

class vison.support.report.**Figure**(*figpath*, *textfraction=0.7*, *caption=None*, *label=None*)

generate_Latex()
Generates LaTeX as list of strings.

class vison.support.report.**Section**(*Title=''*, *level=0*)

generate_Latex()

class vison.support.report.**Table**(*tableDict*, *formats={}*, *names=[]*, *caption=None*)

PENDING:

- adjust width of table to texwidth:

esizebox{ extwidth}{!}{

... end{tabular}}

- include option to rotate table to show in landscape

generate_Latex()
Generates LaTeX as list of strings.

class vison.support.report.**Text**(*text*)

generate_Latex()

Just a collection of LaTeX templates for use in report.py

History

Created on Mon Jan 30 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.support.latex.**generate_header**(*test*, *model*, *author*)

These functions can be used for logging information.

Warning: logger is not multiprocessing safe.

author Sami-Matias Niemi

contact r.azzollini_at_ucl.ac.uk

version 0.3

class vison.support.logger.**SimpleLogger**(*filename*, *verbose=False*)
A simple class to create a log file or print the information on screen.

write(*text*)
Writes text either to file or screen.

vison.support.logger.**setUpLogger**(*log_filename*, *loggername='logger'*)
Sets up a logger.

Param log_filename: name of the file to save the log.

Param loggername: name of the logger

Returns logger instance

CHAPTER

NINE

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PYTHON MODULE INDEX

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