vison Documentation

Release 0.4+119.g8cde5f6

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Mar 09, 2018

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vison Euclid VIS Ground Calibration Pipeline

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issue 0.4+119.g8cde5f6

version 0.4+119.g8cde5f6

date Mar 09, 2018

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:

2.1 Installation

2.1.1 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.

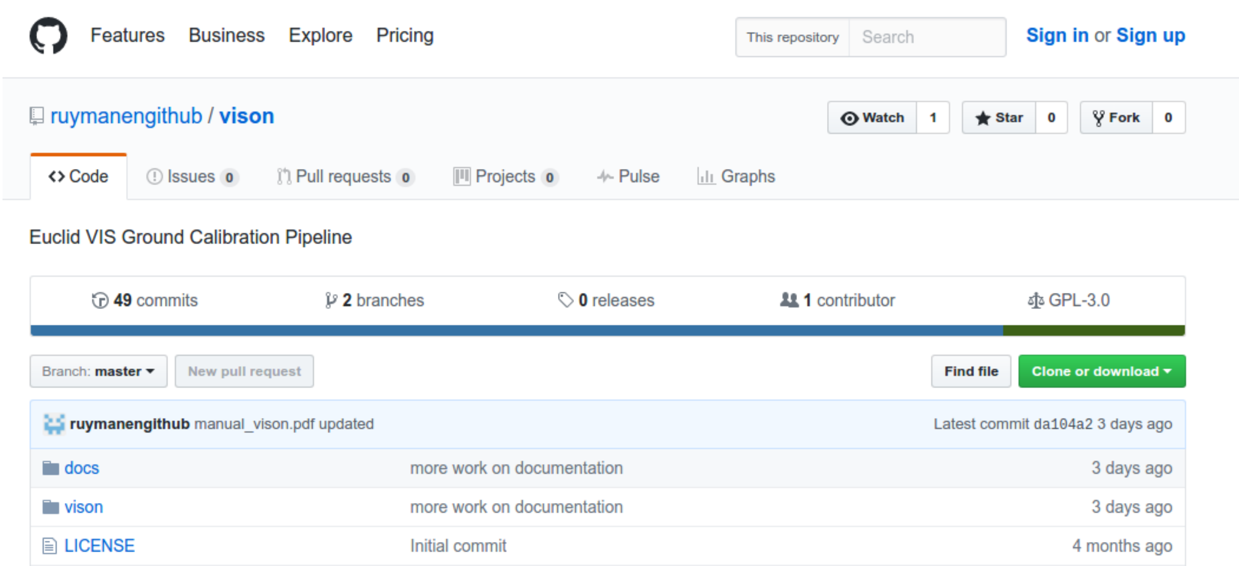
```
~$ git clone https://github.com/ruymanengithub/vison
```

- Press Enter. Your local clone will be created.

2.1.2 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 several text files:

```
~$ cd conda
~$ ls
  env-conda_vison_linux.txt  env-conda_vison_windows.txt
  env-conda_vison_old.txt  env-pip_vison_old.txt
  env-pip_vison.txt
```

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

Use the OS version that may correspond in your case (by now, only linux and windows versions available, and for 64 bits machines).

> **::** ~$ conda create -n vison –file env-conda_[OS].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']
```

2.2 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 classes.

3.1 Pipeline

3.1.1 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 day-folder.
- 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

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class `vison.pipe.master.`**`Pipe`**(*inputdict*, *dolog=True*, *drill=False*, *debug=False*, *startobsid=0*, *processes=1*)

Master Class of FM-analysis

class **`BIAS01`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

BIAS01: Basic analysis of data.

METACODE

```
f. e. ObsID:
   f.e.CCD:

       load ccdobj of ObsID, CCD

       with ccdobj, f.e.Q:
           produce a 2D poly model of bias, save coefficients
           produce average profile along rows
           produce average profile along cols
           save 2D model and profiles in a pick file for each OBSID-CCD
           measure and save RON after subtracting large scale structure

plot RON vs. time f. each CCD and Q
plot average profiles f. each CCD and Q (color coded by time)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds BIAS01 script structure dictionary.

###:param N: integer, number of frames to acquire. :param diffvalues: dict, opt, differential values. :param elvis: char, ELVIS version.

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

METACODE

```
f. each CCD:
   f. e. Q:
       stack all ObsIDs to produce Master Bias
       measure average profile along rows
       measure average profile along cols
plot average profiles of Master Bias f. each Q
produce table(s) with summary of results, include in report
show Master Bias (image), include in report
save name of MasterBias to DataDict, report
```

prep_data()

BIAS01: Preparation of data for further analysis. Calls task.prepare_images().

Applies: offset subtraction cosmetics masking

class Pipe.**CHINJ00**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds CHINJ00 script structure dictionary.

Parameters **diffvalues** – dict, opt, differential values.

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults(***kwargs*)

class Pipe.**CHINJ01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
            measure charge-inj. non-uniformity
            produce average profile across lines
            measure charge spillover into non-injection
            measure stats of injection (mean, med, std, min/max,␣
↪percentiles)

plot average inj. profiles along lines f. each CCD, Q and IG1
    save as a rationalized set of curves
plot average inj. profiles across lines f. each CCD, Q and IG1
    save as a rationalized set of  curves

plot charge injection vs. IG1
report injection stats as a table
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds CHINJ01 script structure dictionary.

#:param IDL: int, [mV], value of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param IG1s: list of 2 ints, [mV], [min,max] values of IG1. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data ()

NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**CHINJ02** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

Basic analysis of data. AS IT IS, REPEATS WHAT'S DONE IN THE CHECK_DATA. CONSIDER MERGING/SKIPPING

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
```

```
            [measure charge-inj. non-uniformity]
            [produce average profile across lines]
            [measure charge spillover into non-injection]
            measure stats of injection (mean, med, std, min/max,␣
↪percentiles)

[plot average inj. profiles along lines f. each CCD, Q and IG1]
[    save as a rationalized set of curves]
[plot average inj. profiles across lines f. each CCD, Q and IG1]
[    save as a rationalized set of  curves]

save&plot charge injection vs. IDL
report injection stats as a table
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds CHINJ02 script structure dictionary.

#:param IDLs: list of 2 ints, [mV], [min,max] values of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data ()
NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()
Finds the Injection Threshold for each CCD half.

METACODE

```
f.e.CCD:
    f.e.Q:
        load injection vs. IDL cuve
        find&save injection threshold on curve

report injection threshold as a table
```

set_inpdefaults (***kwargs*)

class Pipe.**DARK01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()
DARK01: Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
```

```
        f.e.Q:
            produce mask of hot pixels
            count hot pixels / columns
            produce a 2D poly model of masked-image, save coefficients
            produce average profile along rows
            produce average profile along cols
            measure and save RON after subtracting large scale structure
        save 2D model and profiles in a pick file for each OBSID-CCD

plot average profiles f. each CCD and Q (color coded by time)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds DARK01 script structure dictionary.

Parameters diffvalues – dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()
METACODE

```
f. each CCD:
    f. e. Q:
        stack all ObsIDs to produce Master Dark
        produce mask of hot pixels / columns
        count hot pixels / columns
        measure average profile along rows
        measure average profile along cols

plot average profiles of Master Bias f. each CCD,Q
show Master Dark (images), include in report
report stats of defects, include in report
save name of MasterDark to DataDict, report
save name of Defects in Darkness Mask to DD, report
```

prep_data ()
DARK01: Preparation of data for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset: save to pick, update filename
```

class Pipe.**FLAT0X** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds FLAT0X script structure dictionary.

Parameters diffvalues – dict, opt, differential values.

do_indiv_flats ()
METACODE

```
Preparation of data for further analysis and
produce flat-field for each OBSID.

f.e. ObsID:
    f.e.CCD:
```

```
        load ccdobj

        f.e.Q:

            model 2D fluence distro in image area
            produce average profile along rows
            produce average profile along cols

        save 2D model and profiles in a pick file for each OBSID-CCD
        divide by 2D model to produce indiv-flat
        save indiv-Flat to FITS(?), update add filename

plot average profiles f. each CCD and Q (color coded by time)
```

do_master_flat()

METACODE

```
Produces Master Flat-Field

f.e.CCD:
    f.e.Q:
        stack individual flat-fields by chosen estimator
save Master FF to FITS
measure PRNU and
report PRNU figures
```

do_prdef_mask()

METACODE

```
Produces mask of defects in Photo-Response
Could use master FF, or a stack of a subset of images (in order
to produce mask, needed by other tasks, quicker).

f.e.CCD:
    f.e.Q:
        produce mask of PR defects
        save mask of PR defects
        count dead pixels / columns

report PR-defects stats
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

prepare_images()

FLAT0X: Preparation of data for further analysis. Calls task.prepare_images().

Applies: offset subtraction [bias structure subtraction, if available] cosmetics masking

set_inpdefaults(***kwargs*)

class Pipe.**FOCUS00**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds FOCUS00 script structure dictionary.

#:param wavelength: int, [nm], wavelength. #:param exptime: int, [ms], exposure time. :param diffvalues: dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

prep_data ()

class Pipe.**NL01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds NL01 script structure dictionary.

#:param expts: list of ints [ms], exposure times. #:param exptinter: int, ms, exposure time of interleaved source-stability exposures. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 0 (Neutral Density Filter) :param diffvalues: dict, opt, differential values.

do_satCTE ()

METACODE

```
select ObsIDs with fluence(exptime) >~ 0.5 FWC

f.e. ObsID:
    CCD:
        Q:
            measure CTE from amount of charge in over-scan relative to␣
↪fluence

f.e. CCD:
    Q:
        get curve of CTE vs. fluence
        measure FWC from curve in ADU

report FWCs in electrons [via gain in inputs] f.e. CCD, Q (table)
```

extract_stats ()

Performs basic analysis: extracts statistics from image regions to later build NLC.

METACODE

```
create segmentation map given grid parameters

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            f.e. "img-segment": (done elsewhere)
                measure central value
                measure variance
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

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.

prep_data ()

Takes Raw Data and prepares it for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
        opt: [sub bias frame]
        opt: [divide by FF]
        opt: [mask-out defects]
```

produce_NLCs ()

METACODE

```
Obtains Best-Fit Non-Linearity Curve

f.e. CCD:
    f.e. Q:

        [opt] apply correction for source variability (interspersed␣
↪exposure
          with constant exptime)
        Build NL Curve (NLC) - use stats and exptimes
        fit poly. shape to NL curve

plot NL curves for each CCD, Q
report max. values of NL (table)
```

class Pipe.**PERSIST01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

Basic analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        use SATURATED frame to generate pixel saturation MASK
        measure stats in pix satur MASK across OBSIDs
         (pre-satur, satur, post-satur)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds PERSISTENCE01 script structure dictionary.

Parameters

- **exptSATUR** – int, saturation exposure time.
- **exptLATEN** – int, latency exposure time.
- **diffvalues** – dict, opt, differential values.

check_data ()

PERSIST01: Checks quality of ingested data.

METACODE

```
check common HK values are within safe / nominal margins
check voltages in HK match commanded voltages, within margins

f.e.ObsID:
    f.e.CCD:
        f.e.Q.:
            measure offsets in pre-, over-
```

```
            measure std in pre-, over-
            measure fluence in apertures around Point Sources

assess std in pre- (~RON) is within allocated margins
assess offsets in pre-, and over- are equal, within allocated  margins
assess fluence is ~expected within apertures (PS) for each frame (pre-
↪satur, satur, post-satur)


plot point source fluence vs. OBSID, all sources
[plot std vs. time]

issue any warnings to log
issue update to report
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Meta-analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        estimate delta-charge_0 and decay tau from time-series

report:
    persistence level (delta-charge_0) and time constant
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
```

set_inpdefaults(***kwargs*)

set_perfdefaults(***kwargs*)

class Pipe.**PTC0X**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds PTC0X script structure dictionary.

#:param exptimes: list of ints [ms], exposure times. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 800 nm. :param diffvalues: dict, opt, differential values.

extract_PTC()

Performs basic analysis of images:

- builds PTC curves: both on non-binned and binned images

METACODE

```
create list of OBSID pairs

```

```
create segmentation map given grid parameters

f.e. OBSID pair:
    CCD:
        Q:
            subtract CCD images
            f.e. segment:
                measure central value
                measure variance
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

Analyzes the variance and fluence: gain, and gain(fluence)

METACODE

```
f.e. CCD:
    Q:
        (using stats across segments:)
        fit PTC to quadratic model
        solve for gain
        solve for alpha (pixel-correls, Guyonnet+15)
        solve for blooming limit (ADU)
            convert bloom limit to electrons, using gain

plot PTC curves with best-fit f.e. CCD, Q
report on gain estimates f. e. CCD, Q (table)
report on blooming limits (table)
```

set_inpdefaults (***kwargs*)

class Pipe.**STRAY00** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds STRAY00 script structure dictionary. :param diffvalues: dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**TP00** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

check_data ()

TP01: Checks quality of ingested data.

METACODE

```
check common HK values are within safe / nominal margins
check voltages in HK match commanded voltages, within margins

f.e.ObsID:
    f.e.CCD:
        f.e.Q.:
            measure offsets in pre-, over-
            measure std in pre-, over-
            measure mean in img-
```

```
assess std in pre- (~RON) is within allocated margins
assess offsets in pre-, and over- are equal, within allocated margins
assess offsets are within allocated margins
assess injection level is within expected margins

plot histogram of injected levels for each Q
[plot std vs. time]

issue any warnings to log
issue update to report
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**TP01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load "map of relative pumping"
            find_dipoles:
                x, y, rel-amplitude, orientation

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for N and S)
    Counts of dipoles (and N vs. S)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,I-phase, Amp
    from Amp(TOI) -> tau, Pc

Report on :
    Histogram of Taus
    Histogram of Pc (capture probability)
    Histogram of I-phases (larger phases should have more traps,
                      statistically) -> check

    Total Count of Traps
```

prep_data ()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            save "map of relative pumping"
```

set_inpdefaults(***kwargs*)

class Pipe.**TP02**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load raw 1D map of relative pumping (from extract_data)
            identify dipoles:
                x, rel-amplitude, orientation (E or W)

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for E and W)
    Counts of dipoles (and E vs. W)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,R-phase, amp(dwell)
    from Amp(dwell) -> tau, Pc

Report on :
   Histogram of Taus
   Histogram of Pc (capture probability)
   Histogram of R-phases

   Total Count of Traps
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
```

```
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            average across readout lines (iterations)
            save raw 1D map of relative pumping
```

set_inpdefaults(***kwargs*)

Pipe.**catchtraceback**()

Pipe.**dotask**(*taskname*, *inputs*, *drill=False*, *debug=False*)
Generic test master function.

Pipe.**launchtask**(*taskname*)

Pipe.**run**(*explogf=None*, *elvis=None*)

Pipe.**wait_and_run**(*dayfolder*, *elvis='6.5.X'*)

class vison.pipe.master.**Pipe**(*inputdict*, *dolog=True*, *drill=False*, *debug=False*, *startobsid=0*, *processes=1*)
Master Class of FM-analysis

class BIAS01(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()
BIAS01: Basic analysis of data.

METACODE

```
f. e. ObsID:
   f.e.CCD:

       load ccdobj of ObsID, CCD

       with ccdobj, f.e.Q:
           produce a 2D poly model of bias, save coefficients
           produce average profile along rows
           produce average profile along cols
           save 2D model and profiles in a pick file for each OBSID-CCD
           measure and save RON after subtracting large scale structure

plot RON vs. time f. each CCD and Q
plot average profiles f. each CCD and Q (color coded by time)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)
Builds BIAS01 script structure dictionary.

###:param N: integer, number of frames to acquire. :param diffvalues: dict, opt, differential values. :param elvis: char, ELVIS version.

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()
METACODE

```
f. each CCD:
   f. e. Q:
       stack all ObsIDs to produce Master Bias
       measure average profile along rows
       measure average profile along cols
```

```
plot average profiles of Master Bias f. each Q
produce table(s) with summary of results, include in report
show Master Bias (image), include in report
save name of MasterBias to DataDict, report
```

prep_data()
BIAS01: Preparation of data for further analysis. Calls task.prepare_images().
Applies: offset subtraction cosmetics masking

class Pipe.**CHINJ00**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)
Builds CHINJ00 script structure dictionary.
Parameters diffvalues – dict, opt, differential values.

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults(***kwargs*)

class Pipe.**CHINJ01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()
Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
            measure charge-inj. non-uniformity
            produce average profile across lines
            measure charge spillover into non-injection
            measure stats of injection (mean, med, std, min/max,␣
↪percentiles)

plot average inj. profiles along lines f. each CCD, Q and IG1
    save as a rationalized set of curves
plot average inj. profiles across lines f. each CCD, Q and IG1
    save as a rationalized set of  curves

plot charge injection vs. IG1
report injection stats as a table
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)
Builds CHINJ01 script structure dictionary.

#:param IDL: int, [mV], value of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param IG1s: list of 2 ints, [mV], [min,max] values of IG1. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data()
NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**CHINJ02** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

Basic analysis of data. AS IT IS, REPEATS WHAT'S DONE IN THE CHECK_DATA. CONSIDER MERGING/SKIPPING

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
            [measure charge-inj. non-uniformity]
            [produce average profile across lines]
            [measure charge spillover into non-injection]
            measure stats of injection (mean, med, std, min/max,
↪percentiles)

[plot average inj. profiles along lines f. each CCD, Q and IG1]
[    save as a rationalized set of curves]
[plot average inj. profiles across lines f. each CCD, Q and IG1]
[    save as a rationalized set of  curves]

save&plot charge injection vs. IDL
report injection stats as a table
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds CHINJ02 script structure dictionary.

#:param IDLs: list of 2 ints, [mV], [min,max] values of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data ()

NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Finds the Injection Threshold for each CCD half.

METACODE

```
f.e.CCD:
    f.e.Q:
        load injection vs. IDL cuve
        find&save injection threshold on curve

report injection threshold as a table
```

set_inpdefaults(***kwargs*)

class Pipe.**DARK01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

DARK01: Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            produce mask of hot pixels
            count hot pixels / columns
            produce a 2D poly model of masked-image, save coefficients
            produce average profile along rows
            produce average profile along cols
            measure and save RON after subtracting large scale structure
        save 2D model and profiles in a pick file for each OBSID-CCD

plot average profiles f. each CCD and Q (color coded by time)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds DARK01 script structure dictionary.

Parameters diffvalues – dict, opt, differential values.

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

METACODE

```
f. each CCD:
    f. e. Q:
        stack all ObsIDs to produce Master Dark
        produce mask of hot pixels / columns
        count hot pixels / columns
        measure average profile along rows
        measure average profile along cols

plot average profiles of Master Bias f. each CCD,Q
show Master Dark (images), include in report
report stats of defects, include in report
save name of MasterDark to DataDict, report
save name of Defects in Darkness Mask to DD, report
```

prep_data()

DARK01: Preparation of data for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset: save to pick, update filename
```

class Pipe.**FLAT0X**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds FLAT0X script structure dictionary.

Parameters diffvalues – dict, opt, differential values.

do_indiv_flats()

METACODE

```
Preparation of data for further analysis and
produce flat-field for each OBSID.

f.e. ObsID:
    f.e.CCD:

        load ccdobj

        f.e.Q:

            model 2D fluence distro in image area
            produce average profile along rows
            produce average profile along cols

        save 2D model and profiles in a pick file for each OBSID-CCD
        divide by 2D model to produce indiv-flat
        save indiv-Flat to FITS(?), update add filename

plot average profiles f. each CCD and Q (color coded by time)
```

do_master_flat()

METACODE

```
Produces Master Flat-Field

f.e.CCD:
    f.e.Q:
        stack individual flat-fields by chosen estimator
save Master FF to FITS
measure PRNU and
report PRNU figures
```

do_prdef_mask()

METACODE

```
Produces mask of defects in Photo-Response
Could use master FF, or a stack of a subset of images (in order
to produce mask, needed by other tasks, quicker).
```

```
f.e.CCD:
    f.e.Q:
        produce mask of PR defects
        save mask of PR defects
        count dead pixels / columns

report PR-defects stats
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

prepare_images ()
FLAT0X: Preparation of data for further analysis. Calls task.prepare_images().
Applies: offset subtraction [bias structure subtraction, if available] cosmetics masking

set_inpdefaults (***kwargs*)

class Pipe.**FOCUS00** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds FOCUS00 script structure dictionary.

#:param wavelength: int, [nm], wavelength. #:param exptime: int, [ms], exposure time. :param diffvalues: dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

prep_data ()

class Pipe.**NL01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds NL01 script structure dictionary.

#:param expts: list of ints [ms], exposure times. #:param exptinter: int, ms, exposure time of interleaved source-stability exposures. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 0 (Neutral Density Filter) :param diffvalues: dict, opt, differential values.

do_satCTE ()
METACODE

```
select ObsIDs with fluence(exptime) >~ 0.5 FWC

f.e. ObsID:
    CCD:
        Q:
            measure CTE from amount of charge in over-scan relative to␣
↪fluence

f.e. CCD:
    Q:
        get curve of CTE vs. fluence
        measure FWC from curve in ADU

report FWCs in electrons [via gain in inputs] f.e. CCD, Q (table)
```

extract_stats()
Performs basic analysis: extracts statistics from image regions to later build NLC.

METACODE

```
create segmentation map given grid parameters

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            f.e. "img-segment": (done elsewhere)
                measure central value
                measure variance
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)
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.

prep_data()
Takes Raw Data and prepares it for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
        opt: [sub bias frame]
        opt: [divide by FF]
        opt: [mask-out defects]
```

produce_NLCs()
METACODE

```
Obtains Best-Fit Non-Linearity Curve

f.e. CCD:
    f.e. Q:

        [opt] apply correction for source variability (interspersed␣
↪exposure
          with constant exptime)
        Build NL Curve (NLC) - use stats and exptimes
        fit poly. shape to NL curve

plot NL curves for each CCD, Q
report max. values of NL (table)
```

class Pipe.**PERSIST01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()
Basic analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        use SATURATED frame to generate pixel saturation MASK
        measure stats in pix satur MASK across OBSIDs
         (pre-satur, satur, post-satur)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds PERSISTENCE01 script structure dictionary.

Parameters
- **exptSATUR** – int, saturation exposure time.
- **exptLATEN** – int, latency exposure time.
- **diffvalues** – dict, opt, differential values.

check_data ()
PERSIST01: Checks quality of ingested data.

METACODE

```
check common HK values are within safe / nominal margins
check voltages in HK match commanded voltages, within margins

f.e.ObsID:
    f.e.CCD:
        f.e.Q.:
            measure offsets in pre-, over-
            measure std in pre-, over-
            measure fluence in apertures around Point Sources

assess std in pre- (~RON) is within allocated margins
assess offsets in pre-, and over- are equal, within allocated  margins
assess fluence is ~expected within apertures (PS) for each frame (pre-
↪satur, satur, post-satur)


plot point source fluence vs. OBSID, all sources
[plot std vs. time]

issue any warnings to log
issue update to report
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()
Meta-analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        estimate delta-charge_0 and decay tau from time-series

report:
    persistence level (delta-charge_0) and time constant
```

prep_data ()
METACODE

```
Preparation of data for further analysis:
```

```
f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
```

set_inpdefaults(***kwargs*)

set_perfdefaults(***kwargs*)

class Pipe.**PTC0X**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds PTC0X script structure dictionary.

#:param exptimes: list of ints [ms], exposure times. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 800 nm. :param diffvalues: dict, opt, differential values.

extract_PTC()

Performs basic analysis of images:

- builds PTC curves: both on non-binned and binned images

METACODE

```
create list of OBSID pairs

create segmentation map given grid parameters

f.e. OBSID pair:
    CCD:
        Q:
            subtract CCD images
            f.e. segment:
                measure central value
                measure variance
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Analyzes the variance and fluence: gain, and gain(fluence)

METACODE

```
f.e. CCD:
    Q:
        (using stats across segments:)
        fit PTC to quadratic model
        solve for gain
        solve for alpha (pixel-correls, Guyonnet+15)
        solve for blooming limit (ADU)
            convert bloom limit to electrons, using gain

plot PTC curves with best-fit f.e. CCD, Q
report on gain estimates f. e. CCD, Q (table)
report on blooming limits (table)
```

set_inpdefaults(***kwargs*)

class Pipe.**STRAY00**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)
Builds STRAY00 script structure dictionary. :param diffvalues: dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**TP00** (*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

check_data ()
TP01: Checks quality of ingested data.

METACODE

```
check common HK values are within safe / nominal margins
check voltages in HK match commanded voltages, within margins

f.e.ObsID:
    f.e.CCD:
        f.e.Q.:
            measure offsets in pre-, over-
            measure std in pre-, over-
            measure mean in img-

assess std in pre- (~RON) is within allocated margins
assess offsets in pre-, and over- are equal, within allocated margins
assess offsets are within allocated margins
assess injection level is within expected margins

plot histogram of injected levels for each Q
[plot std vs. time]

issue any warnings to log
issue update to report
```

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults (***kwargs*)

class Pipe.**TP01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()
Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load "map of relative pumping"
            find_dipoles:
                x, y, rel-amplitude, orientation

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for N and S)
    Counts of dipoles (and N vs. S)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,I-phase, Amp
    from Amp(TOI) -> tau, Pc

Report on :
    Histogram of Taus
    Histogram of Pc (capture probability)
    Histogram of I-phases (larger phases should have more traps,
                    statistically) -> check

    Total Count of Traps
```

prep_data ()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            save "map of relative pumping"
```

set_inpdefaults (***kwargs*)

class Pipe.**TP02** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load raw 1D map of relative pumping (from extract_data)
            identify dipoles:
                x, rel-amplitude, orientation (E or W)

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for E and W)
    Counts of dipoles (and E vs. W)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,R-phase, amp(dwell)
    from Amp(dwell) -> tau, Pc

Report on :
   Histogram of Taus
   Histogram of Pc (capture probability)
   Histogram of R-phases

   Total Count of Traps
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            average across readout lines (iterations)
            save raw 1D map of relative pumping
```

set_inpdefaults(***kwargs*)

Pipe.**catchtraceback**()

Pipe.**dotask**(*taskname, inputs, drill=False, debug=False*)

Generic test master function.

Pipe.**launchtask**(*taskname*)

Pipe.**run**(*explogf=None, elvis=None*)

Pipe.**wait_and_run**(*dayfolder, elvis='6.5.X'*)

CHAPTER

FOUR

DATA MODEL

Modules with classes to hold data model for inputs and outputs: exposure log, HK files, FITS files, etc.

4.1 Data Model

4.1.1 ccd.py

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

Created on Fri Nov 13 17:42:36 2015

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

class `vison.datamodel.ccd.`**`CCD`**(*infits=None, extensions=[-1], getallextensions=False, withpover=True*)

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*)

`add_to_hist`(*action, extension=-1, vison=u'0.4+119.g8cde5f6', params={}*)

`del_extension`(*extension*)

`divide_by_flatfield`(*FF, extension=-1*)

Divides by a Flat-field

`do_Vscan_Mask`(*VSTART, VEND*)

`extract_region`(*ccdobj, Q, area='img', vstart=0, vend=2086, Full=False, canonical=True, extension=-1*)

`get_1Dprofile`(*ccdobj, Q, orient='hor', area='img', stacker='mean', vstart=0, vend=2086, extension=-1*)

`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_region2Dmodel (*ccdobj*, *Q*, *area='img'*, *kind='spline'*, *splinemethod='cubic'*, *pdegree=2*, *doFilter=False*, *filtsize=1*, *filtertype='mean'*, *vstart=0*, *vend=2086*, *canonical=True*, *extension=-1*)

get_stats (*Quadrant, sector='img', statkeys=['mean'], trimscan=[0, 0], ignore_pover=True, extension=-1, VSTART=0, VEND=2086*)

get_tile_coos (*Quadrant*, *wpx*, *hpx*)

get_tiles (*Quadrant*, *tile_coos*, *extension=-1*)

get_tiles_stats (*Quad*, *tile_coos*, *statkey*, *extension=-1*)

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

getsectionrowlims (*QUAD*)
Returns limits of [VERTICAL] sections: image [and overscan]

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

sim_window (*vstart*, *vend*, *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], ignore_pover=True, extension=-1*)

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

class vison.datamodel.ccd.**CCDPile** (*infitsList=[]*, *ccdobjList=[]*, *extension=-1*, *withpover=True*)
Class to hold and operate (e.g. stack) on a bunch of CCD images. Each image (a single extension picked from each) becomes an extension in the pile.

stack (*method='median'*, *dostd=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** ()

4.1.2 EXPLOGtools.py

class vison.datamodel.EXPLOGtools.**ExpLogClass** (*elvis='6.5.X'*)

addRow (*row*)

iniExplog ()

summary ()

writeto (*outfile*)

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

vison.datamodel.EXPLOGtools.**loadExpLog** (*expfile*, *elvis='6.5.X'*)
Loads an Exposure Log from file.

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

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

4.1.3 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.**check_HK_abs** (*HKKeys*, *dd*, *limits='S'*, *elvis='6.5.X'*)
Returns report on HK parameters, in DataDict (dd), compared to absolute limits.

HK Keys which have "relative" limits, always return False.

Parameters

- **HKKeys** – list of HK parameters, as named in HK files (without **HK_** suffix)
- **dd** – DataDict object
- **limits** – type of limits to use, either "P" (Performance) or "S" (Safe)
- **elvis** – ELVIS version to find correspondence between HK key and Exposure Log input (commanded voltage).

Returns report dictionary with pairs of HK-key : Bool. True = All values for given key are within limits. False = At least one value for given key is outside limits.

`vison.datamodel.HKtools.`**`check_HK_vs_command`**(*HKKeys*, *dd*, *limits='P'*, *elvis='6.5.X'*)

Returns report on HK parameters, in DataDict (dd), comparing inputs (commanded) vs. output (HK data).

HK Keys which do not correspond to commanded voltages always return 'True'.

Parameters

- **`HKKeys`** – list of HK parameters, as named in HK files (without HK_ suffix)
- **`dd`** – DataDict object
- **`limits`** – type of limits to use, either "P" (Performance) or "S" (Safe)
- **`elvis`** – ELVIS version to find correspondence between HK key and Exposure Log input (commanded voltage).

Returns report dictionary with pairs of HK-key : Bool. True = All values are within limits, referred to commanded value. False = At least one value is outside limits, referred to commanded value.

`vison.datamodel.HKtools.`**`doHKSinglePlot`**(*dtobjs*, *HK*, *HKkey*, *ylabel='V'*, *HKlims=[]*, *filename=''*)

Plots the values of a HK parameter as a function of time.

Parameters

- **`dtobjs`** – datetime objects time axis.
- **`HK`** – HK values (array)
- **`HKkey`** –
- **`ylabel`** –
- **`HKlims`** –
- **`filename`** – file-name to store plot [empty string not to save].

Returns None!!

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

`vison.datamodel.HKtools.`**`iniHK_QFM`**(*elvis='6.5.X'*, *length=0*)

`vison.datamodel.HKtools.`**`loadHK_QFM`**(*filename*, *elvis='6.5.X'*)

Loads a HK file, or list of HK files.

Structure: astropy table. 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, or list of paths to HK files.
- **`elvis`** – "ELVIS" version

Returns astropy table with pairs parameter:[values]

`vison.datamodel.HKtools.`**`loadHK_QFMsingle`**(*filename*, *elvis='6.5.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
- **`elvis`** – "ELVIS" version

Returns astropy table 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

Returns dictionary with pairs parameter:[values]

`vison.datamodel.HKtools.`**`mergeHK`**(*HKList*)

`vison.datamodel.HKtools.`**`parseDTstr`**(*DTstr*)

`vison.datamodel.HKtools.`**`parseHKfiles`**(*HKlist*, *elvis='6.5.X'*)

Parameters

- **`HKlist`** – list of HK files (path+name).
- **`elvis`** – "ELVIS" version.

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]

4.1.4 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)

5.1 Analysis (Shared)

5.1.1 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

5.1.2 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_cross_shape_rough`**(*cross*, *pitch=12.0*)

`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*)
'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

CHARGE INJECTION TOOLS

6.1 Charge Injection Tools

6.1.1 lib.py

NEEDSREVISION

Module to provide common tools for analysis of Charge Injection acquisitions.

Created on Thu Sep 14 15:32:10 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

6.1.2 plot.py

NEEDSREVISION

Charge Injection Plotting Tools.

Created on Thu Sep 14 15:39:34 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

CHAPTER

SEVEN

"FLAT" ACQ. ANALYSIS TOOLS

7.1 "Flat" Acq. Analysis Tools

7.1.1 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*)

7.1.2 ptc.py

NEEDSREVISION

Module with tools used in PTC analysis.

Created on Thu Sep 14 16:29:36 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

`vison.flat.ptc.`**`fitPTC`**(*means, var*)

vison.flat.ptc.**foo_bloom**(*means*, *var*)
DUMMY function (PLACE-HOLDER)

7.1.3 nl.py

NEEDSREVISION

Module with tools used in NL analysis.

Created on Mon Feb 5 15:51:00 2018

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

vison.flat.nl.**fitNL**(*fluences*, *exptimes*)

vison.flat.nl.**get_exptime_atmiddynrange**(*flu1D*, *exp1D*)

vison.flat.nl.**test_wrap_fitNL**()

vison.flat.nl.**wrap_fitNL**(*raw_data*, *exptimes*, *col_labels*, *times=array([]*, *dtype=float64)*, *TrackFlux=True*, *subBgd=True*)

CHAPTER

EIGHT

IMAGE

8.1 Image Analysis

8.1.1 bits.py

NEEDSREVISION

Image bits analysis tools.

Created on Thu Sep 14 15:54:14 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

8.1.2 pixbounce.py

Euclid-VIS Ground Calibration Campaign

Pixel Bounce Analysis methods.

Created on Fri Mar 9 09:50:16 2018

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

`vison.image.pixbounce.`**`get_pixbounce_from_overscan`**(*ccdobj, thresholds=[0, 65536.0]*)

Retrieves Hard Edge Respose for all Quadrants of a CCD. Uses the transition from image to overscan (along rows). Averages across rows. Input image should have high image-area fluence but not saturating. Rows can be filtered by average fluence in them via "thresholds" keyword. Do not use on images acquired with irradiated CCDs.

CHAPTER NINE

MONITORING ("EYEGORE")

Tools to monitor data acquisition on real time: plots of HK, auto-updating of visual display of Exposure Log with some interactive capabilities, and display of latest images.

9.1 Monitoring ("Eyegore")

Fig. 9.1: You must be Igor...

9.1.1 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.`**`Eyegore`**(*path, broadcast, intervals=[20000, 20000, 1000, 20000, 20000, 20000], elvis='6.5.X', dolite=False, altpath=''*)

`setup_MasterWG`()

`vison.eyegore.eyegore.`**`rsync_to_altlocalpath`**(*path, altpath*)

`vison.eyegore.eyegore.`**`rsync_to_remote`**(*path, broadcast*)

9.1.2 eyeCCDs.py

Created on Fri Oct 13 16:16:08 2017

author raf

contact r.azzollini_at_ucl.ac.uk

class `vison.eyegore.eyeCCDs.`**`ImageDisplay`**(*parent, path, elvis='6.5.X'*)

`gen_render`()

`setup_fig`()

9.1.3 eyeHK.py

Created on Fri Oct 13 14:11:41 2017

author raf

contact r.azzollini_at_ucl.ac.uk

class `vison.eyegore.eyeHK.`**`HKDisplay`**(*root, path, interval, elvis='6.5.X'*)

`get_bitsize`(*filelist*)

`get_data`()

`search_HKfiles`()

`select_HKkeys`()

`sort_HKfiles`(*HKfiles*)

class `vison.eyegore.eyeHK.`**`HKFlags`**(*root, parent, interval=5000, elvis='6.5.X'*)

`ResetFlag`(*event*)

class `vison.eyegore.eyeHK.`**`SingleHKplot`**(*root*)

9.1.4 eyeObs.py

Created on Fri Oct 13 16:22:36 2017

author raf

contact r.azzollini_at_ucl.ac.uk

class `vison.eyegore.eyeObs.`**`ExpLogDisplay`**(*parent, path, interval, elvis='6.5.X'*)

build_elementList()

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

get_bitsize(*filelist*)

get_data()

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

loadExplogs()

search_EXPLOGs()

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

CHAPTER

TEN

OGSE

OGSE stands for Optical Ground Support Equipment.

10.1 OGSE Tools

10.1.1 ogse.py

EUCLID-VIS Ground Calibration Campaign

Model of the calibration OGSE

Created on Fri Sep 8 12:11:55 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

`vison.ogse.ogse.`**`get_FW_ID`**`(`*wavelength*`)`

returns FW key corresponding to input wavelength. :param wavelength: integer, wavelength.

CHAPTER

ELEVEN

PLOTTING

General use plotting facilities.

11.1 Plotting

11.1.1 classes.py

vison pipeline: Classes to do plots.

Created on Mon Nov 13 17:54:08 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

class `vison.plot.classes.`**`BlueScreen`**

`build_data`(*parent*)

`configure`(***kwargs*)

`plot`(***kwargs*)

class `vison.plot.classes.`**`BasicPlot`**(***kwargs*)

class `vison.plot.classes.`**`CCD2DPlot`**(*data*, ***kwargs*)

CHAPTER

TWELVE

POINT-SOURCE ANALYSIS

12.1 Point-Source Analysis

12.1.1 basis.py

author Ruyman Azzollini

contact r.azzollini _at_ ucl.ac.uk

Created on Thu Apr 20 18:56:40 2017

class `vison.point.basis.`**`SpotBase`**(*data*, *log=None*, *verbose=False*)

12.1.2 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*)

12.1.3 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*, *verbose=False*, ***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()

12.1.4 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

12.1.5 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*, *verbose=False*, ***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*)

12.1.6 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*, *verbose=False*, ***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

12.1.7 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*, *verbose=False*, ***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.

get_photom ()
measurements:'apflu','eapflu','bgd','ebgd'

get_shape_Gauss ()

Returns res = dict(i0,ei0,x,ex,y,ey, sigma_x,esigma_x,sigmay,esigma_y, fwhm_x,efwhm_x, fwhm_y,efwhm_y, fluence,efluence)

get_shape_Moments ()

Returns res = dict(x,y,ellip,e1,e2,a,b)

get_shape_easy (*method='G'*, *debug=False*)

measure_basic(*rap=10*, *rin=10*, *rout=-1*, *gain=3.1*, *debug=False*)

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

Parameters

- **rap** – source extraction aperture radius.
- **rin** – inner radius of background annulus.
- **rout** – outer radius of background annulus (-1 to set bound by image area).
- **gain** – image gain (e-/ADU).

12.1.8 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 (except where indicated)

contact r.azzollini_at_ucl.ac.uk

vison.point.lib.**extract_spot**(*ccdobj*, *coo*, *Quad*, *log=None*, *stampw=25*)

vison.point.lib.**gen_point_mask**(*CCD*, *Quad*, *width=75*, *sources='all'*)

CHAPTER

THIRTEEN

SCRIPTS

These are pipeline scripts, not the Test Scripts (for those keep scrolling down).

13.1 Scripts

13.1.1 HKmonitor.py

13.1.2 quickds9.py

Wrap-up of ds9 to quickly load a number of images, for inspection.

History

Created on Thu Mar 17 13:18:10 2016

@author: Ruyman Azzollini

13.1.3 vis_genDataSet.py

EUCLID-VIS Ground Calibration Campaign

Development: Creating Calibration Campaign Fake Data-set

Created on Tue Sep 05 16:07:00 2017

autor Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

`vison.scripts.vis_genDataSet.`**`datasetGenerator`**(*TestsSelector*, *doGenExplog*, *doGenHK*, *doGenFITS*, *outpath*, *elvis*, *Nrows=0*)

`vison.scripts.vis_genDataSet.`**`genExpLog`**(*toGen*, *explogf*, *equipment*, *elvis='6.5.X'*)

13.1.4 vis_mkscripts.py

VIS Ground Calibration Campaign

Automatically Generating Calibration Campaign Scripts.

Created on Fri Sep 08 12:03:00 2017

autor Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

CHAPTER

FOURTEEN

SUPPORT CODE

14.1 Support Code

NEEDSREVISION TODO: UPDATE

Module with functions related to the handling of ds9 from python through XPA.

History

Created on Thu Mar 17 13:18:10 2016

@author: Ruyman Azzollini

class `vison.support.ds9.`**`ds9class`**

A very simple class to handle ds9 through xpa.

`isOpen``()`

Return True if this ds9 window is open and available for communication, False otherwise.

`launch``()`

Launches ds9

`xpaget``(`*cmd*`)`

Executes xpaget and retrieves the stdout. If an error happens, an exception is raised.

`xpaset``(`*cmd*`)`

Executes xpaset.

`zoomhere``(`*x*, *y*, *zoom*`)`

Zooms in on given coordinates of display (ds9).

Module to issue WARNING / ALERT phone calls to designated phone numbers.

'... E.T. phone home...'

Created on Thu Sep 14 10:13:12 2017

@author: raf

class `vison.support.ET.`**`ET`**

Class to do phone calls.

`dial_numbers``(`*url*`)`

Dials one or more phone numbers from a Twilio phone number.

Parameters **`url`** – char, URL with the TwiML code that Twilio uses as instructions on call. Basically, it provides a message to be voiced, as intended.

`vison.support.ET.`**`grab_numbers_and_codes`**`()`

Retrieves phone numbers and access codes necessary to make the phone calls.

IO related functions.

requires PyFITS

requires NumPy

author Sami-Matias Niemi

contact r.azzollini_at_ucl.ac.uk

`vison.support.files.`**`cPickleDump`**(*data*, *output*, *protocol=2*)
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*, *protocol=2*)
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.

`vison.support.files.`**`convert_fig_to_eps`**(*figname*)
Converts a figure to .eps. Returns new file name.

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.`**`Container`**

`add_to_Contents`(*item*)

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

class `vison.support.report.`**`FigsTable`**(*FigsList*, *Ncols*, *figswidth*, *caption=None*)
Class to generate table of figures

`generate_Latex`()
Generates LaTeX as list of strings

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`**(*keyword*, *Title=''*, *level=0*)

`generate_Latex`()

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

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.`**`f_text_wrapper`**(*msg*)

`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

Euclid VIS Ground Calibration Campaign Classes and functions to do Real-Time Monitoring of the Data Acquisition

Created on Wed Feb 1 17:37:32 2017

author Ruyman Azzollini

contact r.azzollini_at_ucl.ac.uk

`vison.support.monitor.test()`
Tests Module Basic Functionality

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.Container`

`add_to_Contents(`*item*`)`

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

class `vison.support.report.FigsTable(`*FigsList, Ncols, figswidth, caption=None*`)`
Class to generate table of figures

`generate_Latex()`
Generates LaTeX as list of strings

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(`*keyword, Title='', level=0*`)`

`generate_Latex()`

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

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()`

CHAPTER

FIFTEEN

TEST SCRIPTS

These are the scripts that hold the description, execution, data validation and analysis of the tests that make the campaign. They are served by the infrasctructure and tools provided by the pipeline.

WARNING: Currently most of the test scripts are largely meta-code, with the exception of very basic functionality used to generate acqusition scripts and validate the acquisitions, as listed in the Exposure Log, against the description of the test. The metacode has been included in the doc-strings for ease of browsing.

15.1 Charge Injection Scripts

15.1.1 Charge Injection Scripts

CHINJ01

VIS Ground Calibration TEST: CHINJ01

Charge injection calibration (part 1) Injection vs. IG1-IG2

Created on Tue Aug 29 17:36:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class `vison.inject.CHINJ01.`**`CHINJ01`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

`basic_analysis`()

Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
            measure charge-inj. non-uniformity
            produce average profile across lines
            measure charge spillover into non-injection
            measure stats of injection (mean, med, std, min/max, percentiles)

plot average inj. profiles along lines f. each CCD, Q and IG1
    save as a rationalized set of curves
plot average inj. profiles across lines f. each CCD, Q and IG1
```

```
    save as a rationalized set of  curves

plot charge injection vs. IG1
report injection stats as a table
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)
Builds CHINJ01 script structure dictionary.

#:param IDL: int, [mV], value of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param IG1s: list of 2 ints, [mV], [min,max] values of IG1. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data()
NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

set_inpdefaults(***kwargs*)

CHINJ02

VIS Ground Calibration TEST: CHINJ02

Charge injection calibration (part 2) Injection vs. IDL (injection threshold)

Created on Tue Aug 29 17:36:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class vison.inject.CHINJ02.**CHINJ02**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()
Basic analysis of data. AS IT IS, REPEATS WHAT'S DONE IN THE CHECK_DATA. CONSIDER MERGING/SKIPPING

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            load average 2D injection pattern
            produce average profile along lines
            [measure charge-inj. non-uniformity]
            [produce average profile across lines]
            [measure charge spillover into non-injection]
            measure stats of injection (mean, med, std, min/max, percentiles)
```

```
[plot average inj. profiles along lines f. each CCD, Q and IG1]
[    save as a rationalized set of curves]
[plot average inj. profiles across lines f. each CCD, Q and IG1]
[    save as a rationalized set of  curves]

save&plot charge injection vs. IDL
report injection stats as a table
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds CHINJ02 script structure dictionary.

#:param IDLs: list of 2 ints, [mV], [min,max] values of IDL (Inject. Drain Low). #:param IDH: int, [mV], Injection Drain High. #:param id_delays: list of 2 ints, [mV], injection drain delays (2). #:param toi_chinj: int, [us], TOI-charge injection. :param diffvalues: dict, opt, differential values.

extract_data()

NEEDED? Could be merged with basic_analysis

METACODE

```
Preparation of data for further analysis:

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
            extract average 2D injection pattern and save
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Finds the Injection Threshold for each CCD half.

METACODE

```
f.e.CCD:
    f.e.Q:
        load injection vs. IDL cuve
        find&save injection threshold on curve

report injection threshold as a table
```

set_inpdefaults(***kwargs*)

15.2 Dark Scripts

15.2.1 "Dark Acquisitions" Scripts

BIAS01

VIS Ground Calibration TEST: BIAS01

Bias-structure/RON analysis script

Created on Tue Aug 29 16:53:40 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class `vison.dark.BIAS01.`**`BIAS01`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

`basic_analysis`()

BIAS01: Basic analysis of data.

METACODE

```
f. e. ObsID:
   f.e.CCD:

       load ccdobj of ObsID, CCD

       with ccdobj, f.e.Q:
           produce a 2D poly model of bias, save coefficients
           produce average profile along rows
           produce average profile along cols
           save 2D model and profiles in a pick file for each OBSID-CCD
           measure and save RON after subtracting large scale structure

plot RON vs. time f. each CCD and Q
plot average profiles f. each CCD and Q (color coded by time)
```

`build_scriptdict`(*diffvalues={}*, *elvis='6.5.X'*)

Builds BIAS01 script structure dictionary.

###:param N: integer, number of frames to acquire. :param diffvalues: dict, opt, differential values. :param elvis: char, ELVIS version.

`filterexposures`(*structure*, *explogf*, *datapath*, *OBSID_lims*)

`meta_analysis`()

METACODE

```
f. each CCD:
   f. e. Q:
       stack all ObsIDs to produce Master Bias
       measure average profile along rows
       measure average profile along cols
plot average profiles of Master Bias f. each Q
produce table(s) with summary of results, include in report
show Master Bias (image), include in report
save name of MasterBias to DataDict, report
```

`prep_data`()

BIAS01: Preparation of data for further analysis. Calls task.prepare_images().

Applies: offset subtraction cosmetics masking

DARK01

VIS Ground Calibration TEST: DARK01

"Dark Current" analysis script

Created on Tue Aug 29 17:21:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class vison.dark.DARK01.**DARK01** (*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis ()

DARK01: Basic analysis of data.

METACODE

```
f. e. ObsID:
    f.e.CCD:
        f.e.Q:
            produce mask of hot pixels
            count hot pixels / columns
            produce a 2D poly model of masked-image, save coefficients
            produce average profile along rows
            produce average profile along cols
            measure and save RON after subtracting large scale structure
        save 2D model and profiles in a pick file for each OBSID-CCD

plot average profiles f. each CCD and Q (color coded by time)
```

build_scriptdict (*diffvalues={}*, *elvis='6.5.X'*)

Builds DARK01 script structure dictionary.

Parameters **diffvalues** – dict, opt, differential values.

filterexposures (*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis ()

METACODE

```
f. each CCD:
    f. e. Q:
        stack all ObsIDs to produce Master Dark
        produce mask of hot pixels / columns
        count hot pixels / columns
        measure average profile along rows
        measure average profile along cols

plot average profiles of Master Bias f. each CCD,Q
show Master Dark (images), include in report
report stats of defects, include in report
save name of MasterDark to DataDict, report
save name of Defects in Darkness Mask to DD, report
```

prep_data ()

DARK01: Preparation of data for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset: save to pick, update filename
```

15.3 Flat-Illumination Scripts

15.3.1 Flat-Illumination Scripts

FLAT0X

VIS Ground Calibration TEST: FLAT0X

Flat-fields acquisition / analysis script

Created on Tue Aug 29 17:32:52 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class `vison.flat.FLAT0X.`**`FLAT0X`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

`build_scriptdict`(*diffvalues={}*, *elvis='6.5.X'*)
Builds FLAT0X script structure dictionary.

Parameters **`diffvalues`** – dict, opt, differential values.

`do_indiv_flats`()
METACODE

```
Preparation of data for further analysis and
produce flat-field for each OBSID.

f.e. ObsID:
    f.e.CCD:

        load ccdobj

        f.e.Q:

            model 2D fluence distro in image area
            produce average profile along rows
            produce average profile along cols

        save 2D model and profiles in a pick file for each OBSID-CCD
        divide by 2D model to produce indiv-flat
        save indiv-Flat to FITS(?), update add filename

plot average profiles f. each CCD and Q (color coded by time)
```

`do_master_flat`()
METACODE

```
Produces Master Flat-Field

f.e.CCD:
    f.e.Q:
        stack individual flat-fields by chosen estimator
save Master FF to FITS
measure PRNU and
report PRNU figures
```

do_prdef_mask()
METACODE

```
Produces mask of defects in Photo-Response
Could use master FF, or a stack of a subset of images (in order
to produce mask, needed by other tasks, quicker).

f.e.CCD:
    f.e.Q:
        produce mask of PR defects
        save mask of PR defects
        count dead pixels / columns

report PR-defects stats
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

prepare_images()
FLAT0X: Preparation of data for further analysis. Calls task.prepare_images().

Applies: offset subtraction [bias structure subtraction, if available] cosmetics masking

set_inpdefaults(***kwargs*)

NL01

VIS Ground Calibration TEST: NL01

End-To-End Non-Linearity Curve

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.
- **Synoptic analysis:** fluence ratios vs. extime ratios >> non-linearity curve
- extract: Non-Linearity curve for each CCD and quadrant
- produce synoptic figures
- Save results.

Created on Mon Apr 3 17:38:00 2017

author raf

contact r.azzollini_at_ucl.ac.uk

class vison.flat.NL01.**NL01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)
Builds NL01 script structure dictionary.

#:param expts: list of ints [ms], exposure times. #:param exptinter: int, ms, exposure time of interleaved source-stability exposures. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 0 (Neutral Density Filter) :param diffvalues: dict, opt, differential values.

do_satCTE()

METACODE

```
select ObsIDs with fluence(exptime) >~ 0.5 FWC

f.e. ObsID:
    CCD:
        Q:
            measure CTE from amount of charge in over-scan relative to fluence

f.e. CCD:
    Q:
        get curve of CTE vs. fluence
        measure FWC from curve in ADU

report FWCs in electrons [via gain in inputs] f.e. CCD, Q (table)
```

extract_stats()

Performs basic analysis: extracts statistics from image regions to later build NLC.

METACODE

```
create segmentation map given grid parameters

f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            f.e. "img-segment": (done elsewhere)
                measure central value
                measure variance
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

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.

prep_data()

Takes Raw Data and prepares it for further analysis.

METACODE

```
f.e. ObsID:
    f.e.CCD:
        f.e.Q:
            subtract offset
        opt: [sub bias frame]
        opt: [divide by FF]
        opt: [mask-out defects]
```

produce_NLCs()

METACODE

```
Obtains Best-Fit Non-Linearity Curve
```

```
f.e. CCD:
    f.e. Q:

        [opt] apply correction for source variability (interspersed exposure
          with constant exptime)
        Build NL Curve (NLC) - use stats and exptimes
        fit poly. shape to NL curve

plot NL curves for each CCD, Q
report max. values of NL (table)
```

PTC0X

VIS Ground Calibration TEST: PTC_0X

Photon-Transfer-Curve Analysis PTC01 - nominal temperature and wavelength PTC02 - alternative temperatures / wavelengths

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 pairs of exposures with equal fluence
- **Synoptic analysis:** variance vs. fluence variance(binned difference-frames) vs. fluence
- extract: RON, gain, gain(fluence)
- produce synoptic figures
- Save results.

Created on Mon Apr 3 17:00:24 2017

author raf

contact r.azzollini_at_ucl.ac.uk

class `vison.flat.PTC0X.PTC0X`(*inputs*, *log=None*, *drill=False*, *debug=False*)

`build_scriptdict`(*diffvalues={}*, *elvis='6.5.X'*)
Builds PTC0X script structure dictionary.

#:param exptimes: list of ints [ms], exposure times. #:param frames: list of ints, number of frames for each exposure time. #:param wavelength: int, wavelength. Default: 800 nm. :param diffvalues: dict, opt, differential values.

`extract_PTC`()

Performs basic analysis of images:

- builds PTC curves: both on non-binned and binned images

METACODE

```
create list of OBSID pairs

create segmentation map given grid parameters
```

```
f.e. OBSID pair:
    CCD:
        Q:
            subtract CCD images
            f.e. segment:
                measure central value
                measure variance
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Analyzes the variance and fluence: gain, and gain(fluence)

METACODE

```
f.e. CCD:
    Q:
        (using stats across segments:)
        fit PTC to quadratic model
        solve for gain
        solve for alpha (pixel-correls, Guyonnet+15)
        solve for blooming limit (ADU)
            convert bloom limit to electrons, using gain

plot PTC curves with best-fit f.e. CCD, Q
report on gain estimates f. e. CCD, Q (table)
report on blooming limits (table)
```

set_inpdefaults(***kwargs*)

15.4 Point-Source Scripts

15.4.1 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

class `vison.point.FOCUS00.`**`FOCUS00`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

`basic_analysis`()

`build_scriptdict`(*diffvalues={}*, *elvis='6.5.X'*)
Builds FOCUS00 script structure dictionary.

#:param wavelength: int, [nm], wavelength. #:param exptime: int, [ms], exposure time. :param diffvalues: dict, opt, differential values.

`filterexposures`(*structure*, *explogf*, *datapath*, *OBSID_lims*)

`meta_analysis`()

`prep_data`()

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

15.5 Trap-Pumping Scripts

15.5.1 Trap-Pumping Scripts

TP01

VIS Ground Calibration TEST: TP01

Trap-Pumping calibration (vertical)

Created on Tue Aug 29 17:37:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class `vison.pump.TP01.`**`TP01`**(*inputs*, *log=None*, *drill=False*, *debug=False*)

`basic_analysis`()

Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load "map of relative pumping"
            find_dipoles:
                x, y, rel-amplitude, orientation

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for N and S)
    Counts of dipoles (and N vs. S)
```

`build_scriptdict`(*diffvalues={}*, *elvis='6.5.X'*)

`filterexposures`(*structure*, *explogf*, *datapath*, *OBSID_lims*)

`meta_analysis`()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,I-phase, Amp
    from Amp(TOI) -> tau, Pc

Report on :
    Histogram of Taus
    Histogram of Pc (capture probability)
    Histogram of I-phases (larger phases should have more traps,
                      statistically) -> check

    Total Count of Traps
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            save "map of relative pumping"
```

set_inpdefaults(***kwargs*)

TP02

VIS Ground Calibration TEST: TP01

Trap-Pumping calibration (serial)

Created on Tue Aug 29 17:38:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class vison.pump.TP02.**TP02**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

Basic analysis of data.

METACODE

```
f. e. ObsID [there are different TOI_TP and TP-patterns]:
    f.e.CCD:
        f.e.Q:
            load raw 1D map of relative pumping (from extract_data)
            identify dipoles:
                x, rel-amplitude, orientation (E or W)

produce & report:
    map location of dipoles
    PDF of dipole amplitudes (for E and W)
    Counts of dipoles (and E vs. W)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Meta-analysis of data:

Try to identify tau and pixel-phase location for each trap. Need to associate dipoles across TOI_TPs and TP-patterns

METACODE

```
across TOI_TP, patterns:
    build catalog of traps: x,y,R-phase, amp(dwell)
    from Amp(dwell) -> tau, Pc
```

```
Report on :
   Histogram of Taus
   Histogram of Pc (capture probability)
   Histogram of R-phases

   Total Count of Traps
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
            divide by reference image wo TPing
            average across readout lines (iterations)
            save raw 1D map of relative pumping
```

set_inpdefaults(***kwargs*)

15.6 Other Test Scripts

15.6.1 Other Scripts

PERSIST01

VIS Ground Calibration TEST: PERSIST01

CCD Persistence test

Created on Tue Aug 29 17:39:00 2017

author Ruyman Azzollini

contact r.azzollini__at__ucl.ac.uk

class vison.other.PERSIST01.**PERSIST01**(*inputs*, *log=None*, *drill=False*, *debug=False*)

basic_analysis()

Basic analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        use SATURATED frame to generate pixel saturation MASK
        measure stats in pix satur MASK across OBSIDs
         (pre-satur, satur, post-satur)
```

build_scriptdict(*diffvalues={}*, *elvis='6.5.X'*)

Builds PERSISTENCE01 script structure dictionary.

Parameters

- **exptSATUR** – int, saturation exposure time.
- **exptLATEN** – int, latency exposure time.
- **diffvalues** – dict, opt, differential values.

check_data()

PERSIST01: Checks quality of ingested data.

METACODE

```
check common HK values are within safe / nominal margins
check voltages in HK match commanded voltages, within margins

f.e.ObsID:
    f.e.CCD:
        f.e.Q.:
            measure offsets in pre-, over-
            measure std in pre-, over-
            measure fluence in apertures around Point Sources

assess std in pre- (~RON) is within allocated margins
assess offsets in pre-, and over- are equal, within allocated  margins
assess fluence is ~expected within apertures (PS) for each frame (pre-satur,
↪satur, post-satur)


plot point source fluence vs. OBSID, all sources
[plot std vs. time]

issue any warnings to log
issue update to report
```

filterexposures(*structure*, *explogf*, *datapath*, *OBSID_lims*)

meta_analysis()

Meta-analysis of data.

METACODE

```
f.e.CCD:
    f.e.Q:
        estimate delta-charge_0 and decay tau from time-series

report:
    persistence level (delta-charge_0) and time constant
```

prep_data()

METACODE

```
Preparation of data for further analysis:

f.e. ObsID [images with TPing only]:
    f.e.CCD:
        f.e.Q:
            subtract offset
```

set_inpdefaults(***kwargs*)

set_perfdefaults(***kwargs*)

CHAPTER

SIXTEEN

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PYTHON MODULE INDEX

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