AstroImage

Pre-processing software for deep sky pictures

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POLYTECH

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Context presentation

This project (AstroImage) was realized by three engineer school for the year-end projects and it's registered to the AIR program (Ambient Intelligent Room) of Polytech' Grenoble. He was given with a precise aim and various technical constraints. This kind of project allows student to learn new skills and improve those existing. It's also form in project and team management with schedule & milestones.

Needs Analyse and Specification

Aim

AstroImage is a pre-processing software for deep sky pictures. It's allow to treat pictures taken by telescope and pre-process them. This treatment include computing of Master Dark[1], Master Flat[2] and Master Bias[3]. When this work it's done, the software can now start Registration[4] and Calibration process[5].

With picture obtain by pre-processing state, we as able to do standard process, like Median Filter, Log Correction, Gamma Correction, or Luminosity correction.

Requirement specification

Pre-processing of deep sky pictures needs lot of complex calculations. It's necessary for these calculations as fastest as possible. So we must choose the best algorithms.

Furthermore, it's very important for astronomer to not lose any data on the initial pictures. So it's was necessary to implement reliable algorithms.

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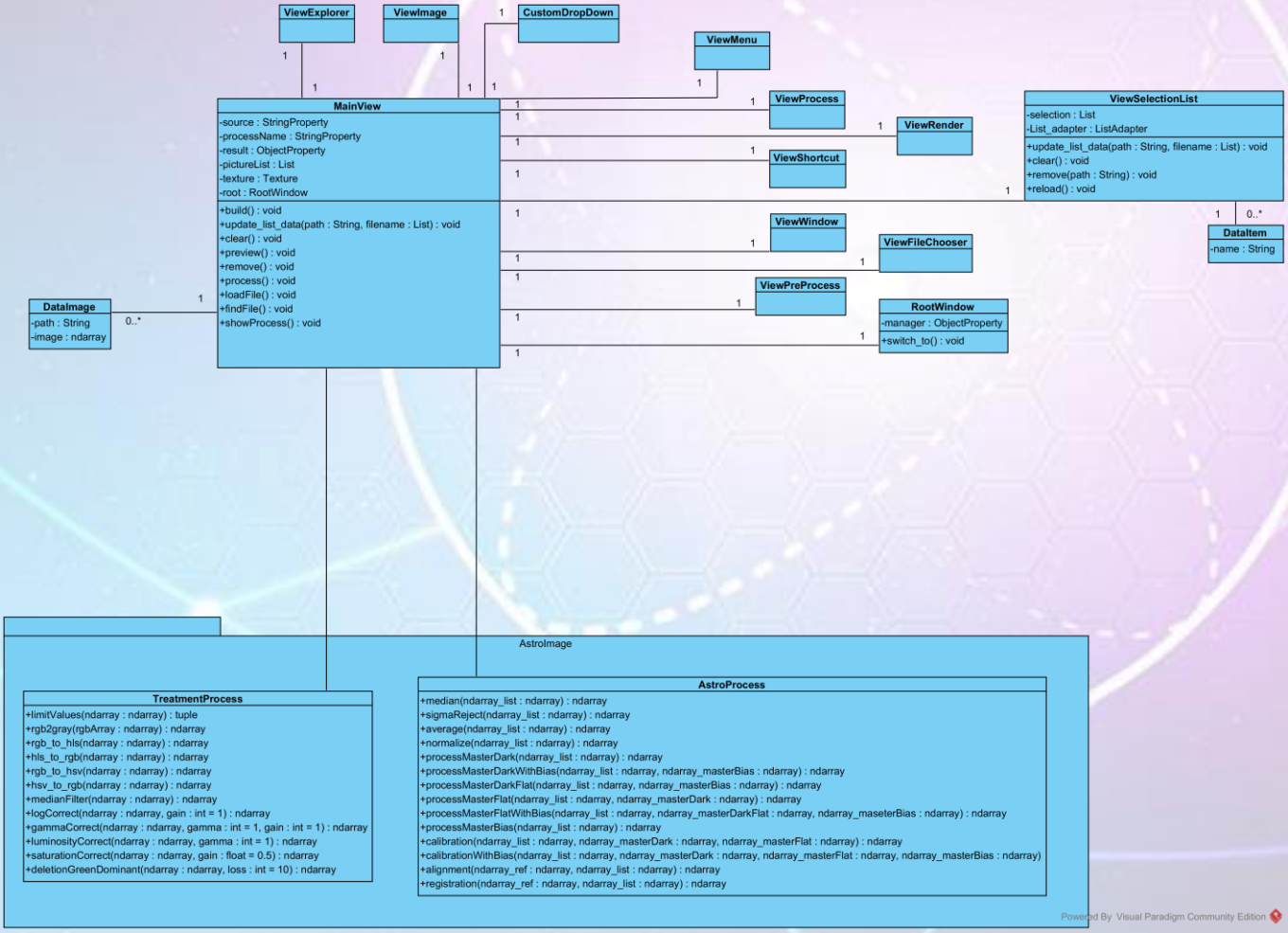
[1] Process will create a picture used to remove the thermal noise and random noise on our light picture
[2] Process will create a picture used to remove all track of dusts, gradient, vignetting on our light picture
[3] Process will create a picture used to remove the initial exposure level of pixels in our light
[4] Process will shift and combine all light picture
[5] Process will use the master Dark & Flat to clean up each light picture

Constraint

AstroImage contain various technical constraints. First of all the nature of the project require us to use the Python language and kivy for user interface. Secondly, libraries scikit-image and numpy was necessary for all the treatment function.

Design

Diagram



Class description

Like you can see on the previous paragraph, class diagram was inspired by MVC Pattern (Model-View-Controller). Because kivy is very specific with kv langage, MainView matching with the controller and the View has not represented in the diagram and correspond to .kv file descriptor. DataImage is the Model and the controller can access of all functions in the 2 libraries :

- **TreatmentProcess** : For basic process like Median Filter or Gamma Correction
- **AstroProcess** : For pre-process of deep sky picture.

Data representation

For load and process any algorithm on picture, we use the numpy data ndarray.

It's contain various attributes :

T	Same as self.transpose(), except that self is returned if self.ndim < 2.
data	Python buffer object pointing to the start of the array's data.
dtype	Data-type of the array's elements.
flags	Information about the memory layout of the array.
flat	A 1-D iterator over the array.
imag	The imaginary part of the array.
real	The real part of the array.
size	Number of elements in the array.
itemsize	Length of one array element in bytes.
nbytes	Total bytes consumed by the elements of the array.
ndim	Number of array dimensions.
shape	Tuple of array dimensions.
strides	Tuple of bytes to step in each dimension when traversing an array.
ctypes	An object to simplify the interaction of the array with the ctypes module.
base	Base object if memory is from some other object.

Production

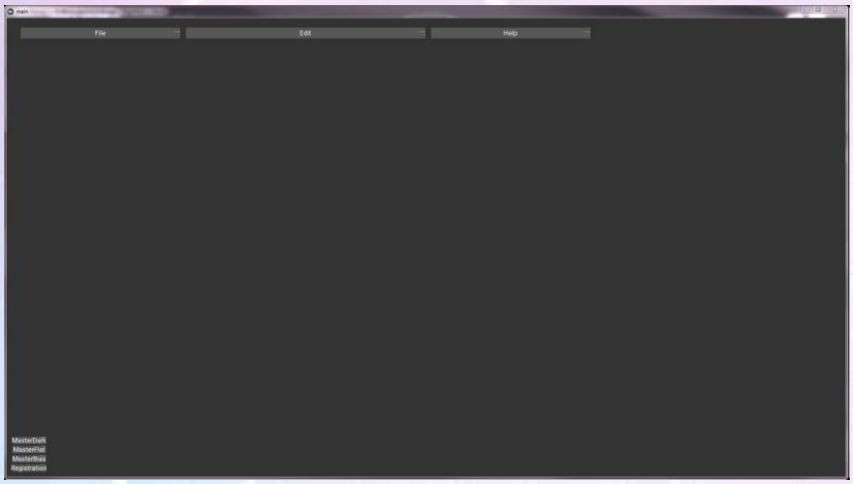
Technical choice

Because language and used libraries was decided by the project, we had make only little technical choice.

For open RAW picture, we use the rawpy librarie.

For open FITS picture, we use the pyfits librarie

Graphic interface



Main view :

File : Allow to open a picture

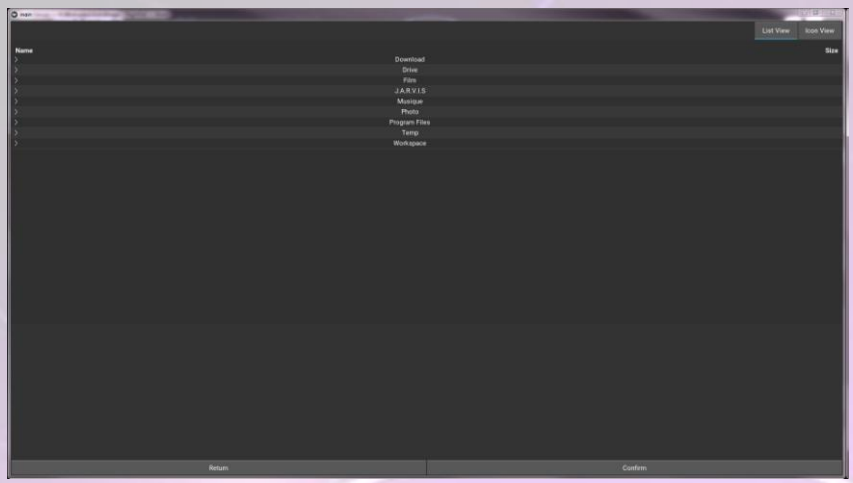
Edit : Allow to choose a process and execute on loaded picture

MasterDark : Switch to the Master Dark Selection View

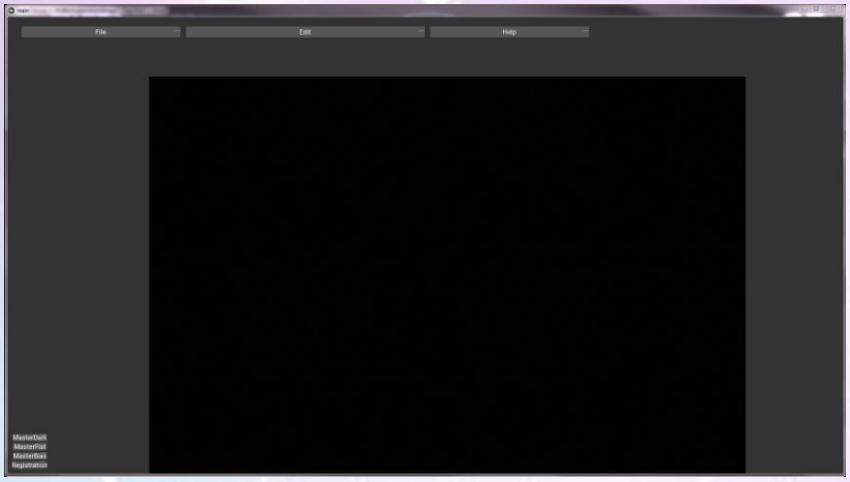
MasterFlat : Switch to the Master Flat Selection View

MasterBias : Switch to the Master Bias Selection View

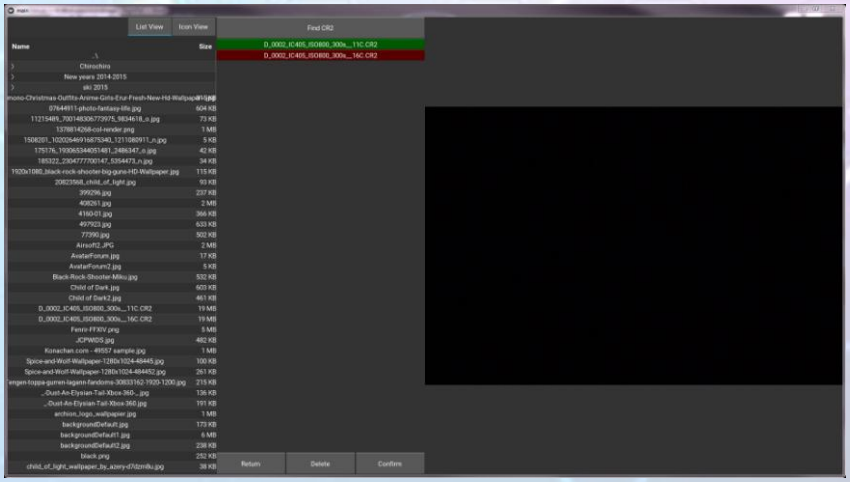
Registration : Switch to the Registration Selection View



File load view : Simply choose a picture and click to confirm.



Main View : Deep sky picture was loaded



Pre-process View :

You can find any deep sky picture on the explorer located on the left of the view. In the middle, the loaded deep sky pictures list allow to preview selected file, delete but also find automatically any .CR2 in the current folder

References & Webographie

Kivy : https://kivy.org/#home (05/04/2016)

Numpy : http://www.numpy.org/ (05/04/2016)

Scikit-image : http://scikit-image.org/ (05/04/2016)

RawPy : https://pypi.python.org/pypi/rawpy (05/04/2016)

PyFits : http://www.stsci.edu/portal/ (05/04/2016)

Stackoverflow : http://stackoverflow.com/ (05/04/2016)

Dialou : http://astro.dialou.fr/ (05/04/2016)

Astrosurf : http://www.astrosurf.com/ (05/04/2016)