Web Based Front-End For Astronomical Image Processing Pipeline Implementation

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Abstract:- The image data collected by the scientists from the telescope needs to be reduced and analysed with IRAF(Image Reduction and Analysis Facility) either with the spectroscopic or direct Imaging in the Inter-University Center for Astronomy and Astrophysics(IUCAA).Reduction is done so as to remove the additive effects as well as the dark current from the images. The swift analysis of the image data should take place and currently IRAF (Image Reduction and Analysis Facility)is used for this purpose which requires intense computing and human involvement.
Therefore, a pipeline for Image reduction is required which is implemented in python and platform independent. The main intention is to make a user friendly front-end using the Python modules for easier and better access.The front-end also allows the user to select the name of the instrument amongst ifosc,hfosc and aries.The user can select only the required parameters on which the operation has to be performed.The graphical user interface also allows to select the multiple fits files so as to perform the flat combine operation.The fits files which are processed can be downloaded from the link which is mentioned in the graphical user interface after the processing is done.

Keywords:- aries,flat-combine,hfosc,ifosc,IRAF

I. INTRODUCTION

The overall complexity and the time required for Image reduction using IRAF makes it a complicated task for the newly joined researchers and the scientists working under IUCAA.A web based interface is an easy to interact way to perform Image Reduction and Analysis.

The main aim of this project is to study the Image reduction in Astronomy and Astrophysics and to make an abstract model of IRAF in form of a front-end which works on the Python modules and which will make an easy to interact interface.The interface also allows the users to select the required instrument for processing.Users can provide single or multiple fits files according to the operation which the user has to perform on.The parameters can also be passed from the user side from bias subtraction,trim,overscan,prescan,cosmicray,flatcombine,flat correction.

The entire paper is organized into six sections.The first section consists of the introduction of the entire project.The second section describes the methodology.The next section consists of the proposed work.The fifth section depicts the results obtained after the implementation.The further sections consist of the discussions, conclusion and the references.

II. METHODOLOGY

The CCD image reduction is carried out using the spectroscopic or direct imaging
Most of the calibration data is intended to remove "additive" effects: the electronic pedestal level (measured from the overscan region on each of your frames), the pre-flash level and/or underlying bias structure, and, if necessary, the dark current. The flatfield data (dome or projector flats and twilight sky exposures) will remove the multiplicative gain and illumination variations across the chip. Fringes are an additive effect that must be removed last.

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When the frames of the signal are obtained, the output signal is "biased" by adding a pedestal level of several hundred ADU's. We need to determine this bias level for each frame individually, as it is not stabilized, and will vary slightly (a few ADU's) with telescope position, temperature.

The average of the data over all columns in the overscan region is taken, and fit these values as a function of line-number.This fit will be subtracted from each column in your frame; this "fit" may be a simple constant. At this point we will chop off the overscan region, and keep only the part of the image containing useful data. This latter step usually trims off not only the overscan region but the first and last few rows and columns of the data.

The next step in removing the instrumental signature is to flatfield the data. The variations in sensitivity are multiplicative, and there is need to divide the data by the flatfield to remove the pixel-to-pixel gain variations, and, in the case of long-slit spectroscopy and direct imaging, the larger-scale spatial variations. The final step in the flatfielding process is to see if the twilight sky exposures have been well flattened by this procedure.

The last step is remove the fringes.The fringe pattern is an additive effect, and must be subtracted from each program frame that is affected. This means that you will first have to construct master "fringe frames" for each filter you are planning to defringe. If the fringe pattern on your frames simply scaled with exposure time, you would now be able to process your data; but in fact, fringes are caused by night-sky lines that may change quite drastically in intensity through out the night. Thus for each and every affected program frames, you will have to "manually" determine what additional scaling factor is needed to adequately remove the fringes[1]s

III. IMPLEMENTATION

With reference to the reduction of images,IRAF performs image reduction and also the analysis regarding the same is obtained.But.it is very time consuming and a lengthy procedure.The implemented work is construction of a code-based interacting GUI(Graphical user Interface) which will be helpful in a friendly interaction.A Graphical user interface which will have proper check boxes in order to select the name of the instrument the user wants to work upon.Atpresent,it will select the IFOSC instrument.The future scope of this project will allow the user to work on instruments such as hfosc or aries

The code allows the provision of browsing the science frame,the bias frame and the flat frame which are required to be given as the input for the purpose of image reduction.If the user selects the parameter flat combine as true,then there is a provision for selection of multiple flat frames.Whereas,if the value of flat correction is given as true,then there is requirement of only one flat frame.If the value of flat combine is true,then the value of flat correction should always be false because flat combine and flat correction can not be true at a same time. The output after execution of the code will be the reduced images which are obtained after the removal of the dark current and the noisy data is in form of the fits files of the reduced images which can be downloaded from the interface as there is a specified link to download the images

To identify the difference between the actual captured data from the telescope and the reduced data which is obtained after the execution of the code in the back-end,It is viewed under the ds9 software which is used for the purpose of viewing the astronomical images.The reduced images which we get in

our directory after the execution of the reduction code,are given as the file inputs in the ds9 software in order to view them.
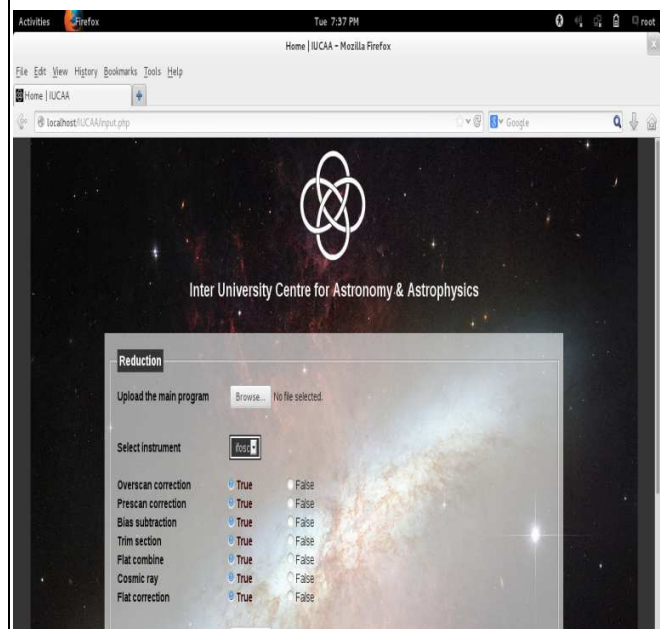

Figure 1: Snapshot of GUI

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IV. RESULTS AND DISCUSSION

The web based front-end which is created provides a easier access to the user to select the reduction code as well as by providing the name of the instrument .Ifoscintrument gives results in consideration with this project.The user gets the reduced images from the link mentioned in the GUI(GraphicalUser Interface)to download the reduced fits files and view them with the help of ds9 software.The advantage of this GUI is that user can specify the parameters which he has to actually work upon.by specifying the boolean values by selecting them in the GUI,the values are stored in the variables and hence passed to the code in the backend and the processing is done.The reduction code needs some time to run as the image reduction takes time
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Sr. no	Parameters	Significance
1	Bias	The bias is measured by taking zero second exposures with the shutter closed.
2	Overscan	The average value of the overscan region should be subtracted from each image as the first processing step
3	Prescan	The amplifier current is read and stored on several columns of the CCD prior to the transfer of the CCD counts (prescan) and/or the amplifier current is read and stored on several column of the CCD after the CCD data have been transferred (overscan)
4	Trim	For the 'partial' and 'trim' modes, a partial overlap of the cutout array and the input data array is sufficient.
5	Cosmic ray	Cosmic rays are energetic charged subatomic particles, originating in outer space
6	Flat combine	Before combining, the images will be multiplied by a factor (close to one) which will make the mode of each image the same
7	Flat correction	Flat-field correction is a technique used to improve quality in digital imaging.

Figure 2: significance of parameter [1]

Web based front-end gives a provision of easy interaction with the reduction code and allows user to select the parameters which are required for the
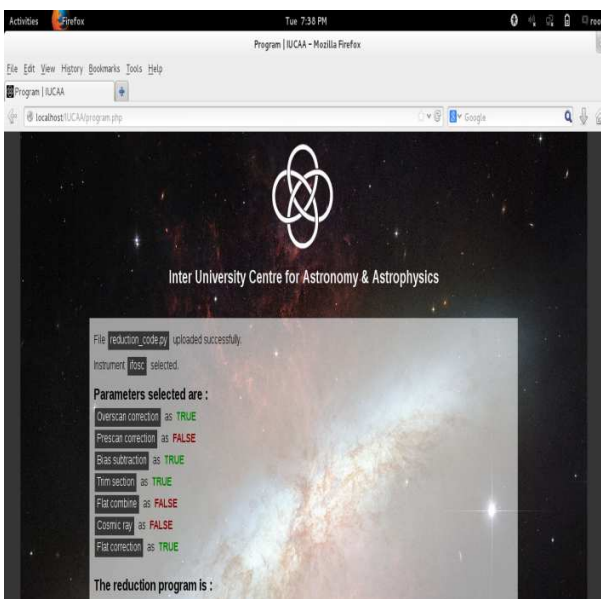
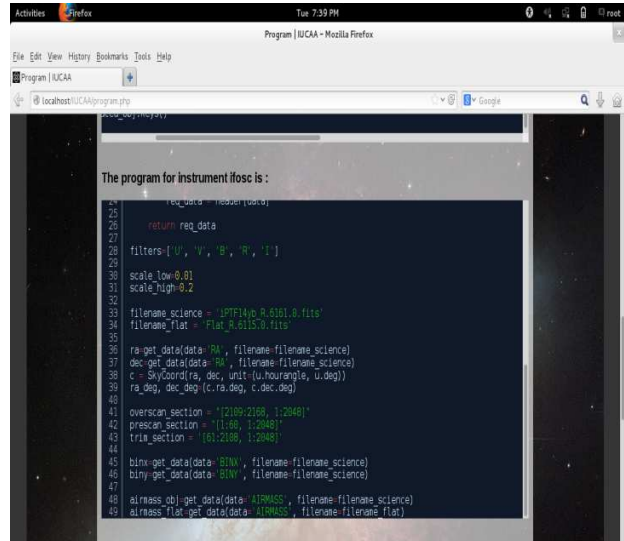reduction purpose

Figure 2:Snapshot of GUI

figure 3:snapshot of the instrument code

V. CONCLUSION

A web based interface which was proposed in the research paper gets implementation which allows flexible access to the users toselect the instrument and select the bias,flat,as well as the science frames from the directory and selecting multiple fits files if required if flat combine has to take place.The reduced fits files can be downloaded from the server so as to perform the analysis.

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