

EXSdetect – Extended X-ray Source Detection

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1 Dependency

First please make sure you have Python in your system. Python 2.6 or 2.7 is recommended. Beside Python, the following Python packages are needed:

<code>numpy</code>	numerical python package
<code>scipy</code>	scientific python package
<code>pyfits</code>	provides an interface to FITS formatted files

To perform on Chandra ACIS image, the CIAO package is needed to provide the PSF library. CIAO 4.4 is recommended.

2 How to Run

No installation is needed. Just allow execute permission to the file `EXSdetect_Swift` or `EXSdetect_Chandra` and run it directly.

```
chmod +x EXSdetect_Swift
YOURDIRECTORY/EXSdetect_Swift -h
```

Please see `Demo/` for an example or running this program and use the `-h` option for help information.

For your convenience, you can add the `EXSdetect/` directory to your `$PATH` in `.bashrc`

```
export PATH=$PATH:YOURDIRECTORY/EXSdetect
```

Or add an alias to your `.bashrc`

```
alias EXSdetect_Swift='YOURDIRECTORY/EXSdetect/EXSdetect_Swift'
```

Then you can call the `EXSdetect_Swift` command directly.

```
EXSdetect_Swift -h
```

3 Setting for Chandra

The *CIAO* package provide a Python environment independent of the system Python. However, the system Python is recommended because in all possibility you should already have the associating Python packages set up with the system Python. To let *CIAO* use the system Python, please set the two options in `.ciaorc`

```
PYTHON_PATH postpend
PYTHON /usr/bin
```

Here `/usr/bin/python` is assumed to be the system Python. To perform on a Chandra ACIS image, just start *CIAO* , and then run the `EXSdetect_CIAO` task.

4 Classification Threshold

The classification thresholds are defined in `CurveDef_SWIFT.py` and `CurveDEF_CHANDRA.py` in the format of two 1D arrays `_Xfromsimu, _Yfromsimu`. The `CurveDef` files executable, directly running them can visualize the classification threshold curves. The threshold for SWIFT is optimized according to simulation in SWIFT X-ray cluster survey. However the one for Chandra is not yet optimized.

5 Results

There are three final output files: `exs_src.fits` contains the source region mask in fits format, and `exs_src.reg` contains the source regions in ds9 format, extended sources in red and point sources in green. `exs_src.dat` contains 9 columns:

```
0: Number
1: Net Count
2: Net Count in Core region
3: Source Area
4: SNR in core region
5: SNR of source
6: Image X
7: Image Y
8: Probability of classification
9: Exposure Time
```

6 Files

Document.pdf	Document
Manual.txt	Manual page
exsdetect.py	The main program
sweepline.py	The sweep-line Voronoi construction program
CurveDef_SWIFT.py	Curve Definition for SWIFT XRT
CurveDef_CHANDRA.py	Curve Definition for Chandra ACIS
EXSdetect_Chandra	Entrance for Chandra ACIS, executable
EXSdetect_Swift	Entrance for Swift XRT, executable

7 Caveats

It's invalid to use reprojected images, in which one count from one pixel may be redistributed into a few neighboring pixels during the reprojection, resulting in float pixel values. Integer values of the image should be guaranteed. If you want to use combined image from different observations, please combine the event files rather than the images so as to avoid image reprojection.