Solar X-ray Monitor and Data Analysis System

User Manual

Contents

1. Introduction

Solar X-ray Monitor (XSM) is a scientific instrument on-board the orbiter of India's Chandrayaan-2 mission. It provides the measurement of soft X-ray spectrum from the Sun in the band 1-15 keV.
Apart from using it to obtain an estimate of the elemental composition of the Lunar surface, the high cadence X-ray spectral measurements during a wide range of Solar flare classes helps us in improving our understanding of the Solar corona.

For gaining a visual insight into the data provided by XSM and to extract useful parameters out of it, this software has been designed. This user manual will guide you through all the steps, right from installation to actually taking a sample example and running it on the application.

XSM's public data archived at ISRO Science Data Archive(ISDA) can be downloaded from here:
https://pradan.issdc.gov.in/pradan/

2. Installation

XSM visualizer is an easy to use data analysis application which helps in analysing Chandrayaan-2's data. The frontend part of the project is made with ReactJS and backend is supported by Flask.

Downloading:

Download the repository. Structure of the repository is shown below:

```
MP-ISRO-T9
   |-- backend
   |-- frontend
```

Backend:

1. Go to backend directory and install dependencies

```
cd backend
pip install -r requirements.txt
```

2. Run the server

```
python app.py
```

Frontend:

1. Go to frontend directory and install dependencies

```
cd frontend
npm install
```

2. Run the server

```
npm start
```

NOTE:

The XSM data archive includes ‘raw’ (or level-1) data

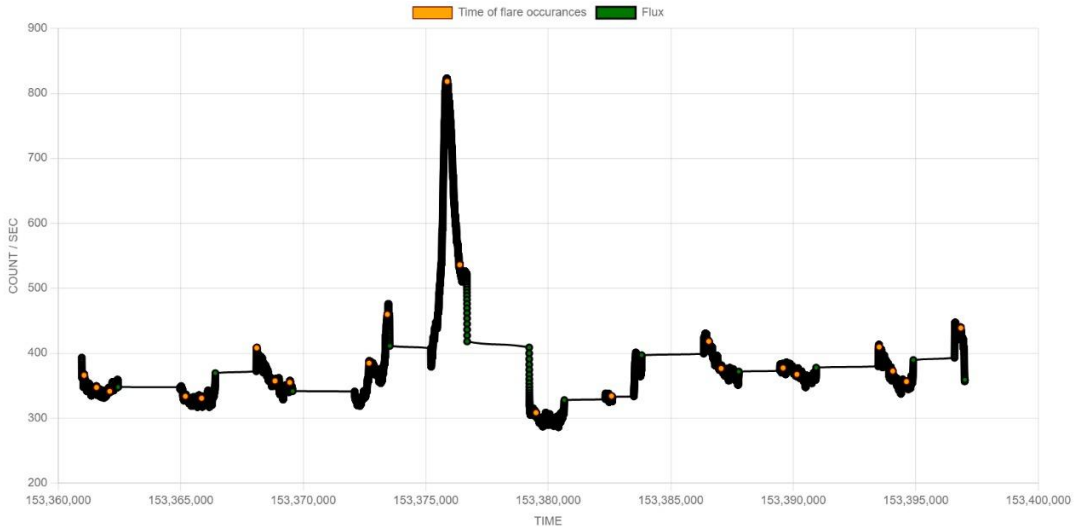
and ‘calibrated’ (or level-2) data created by the XSMDAS. Currently we are using the lightcurve (ch2_xsm_yyyymmdd_vn_level2.lc) files from the 'calibrated' data.

All data has been taken from https://pradan.issdc.gov.in/pradan/ .

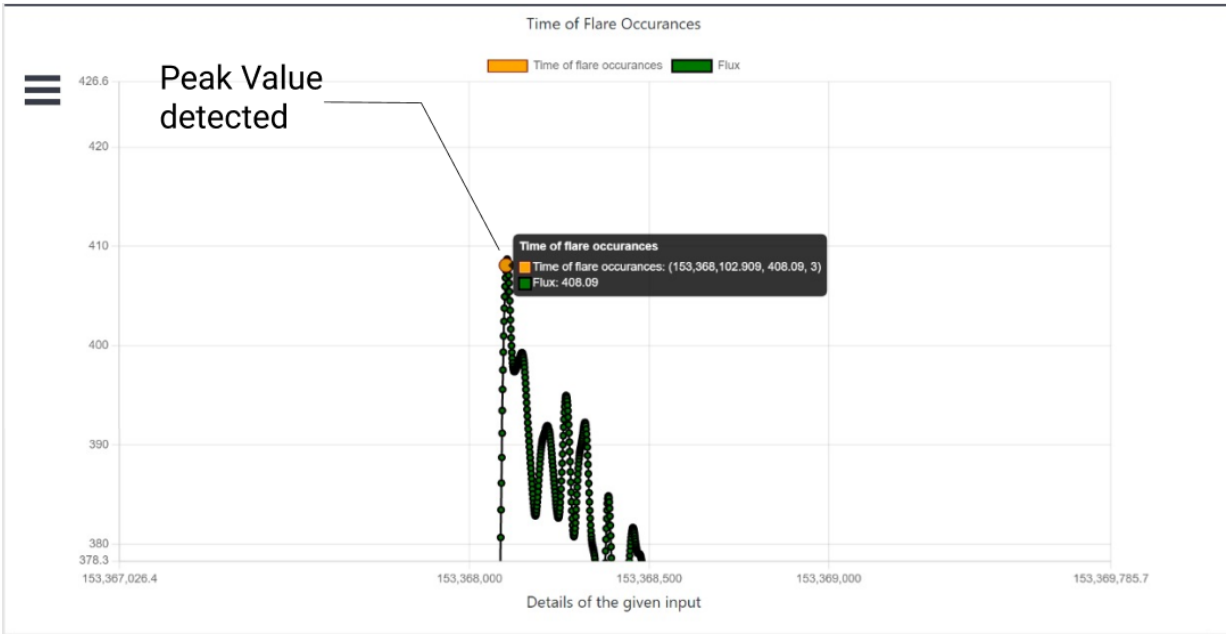
3. Software interaction and features

1) App in function

Rate count vs time graph:



On zooming in:



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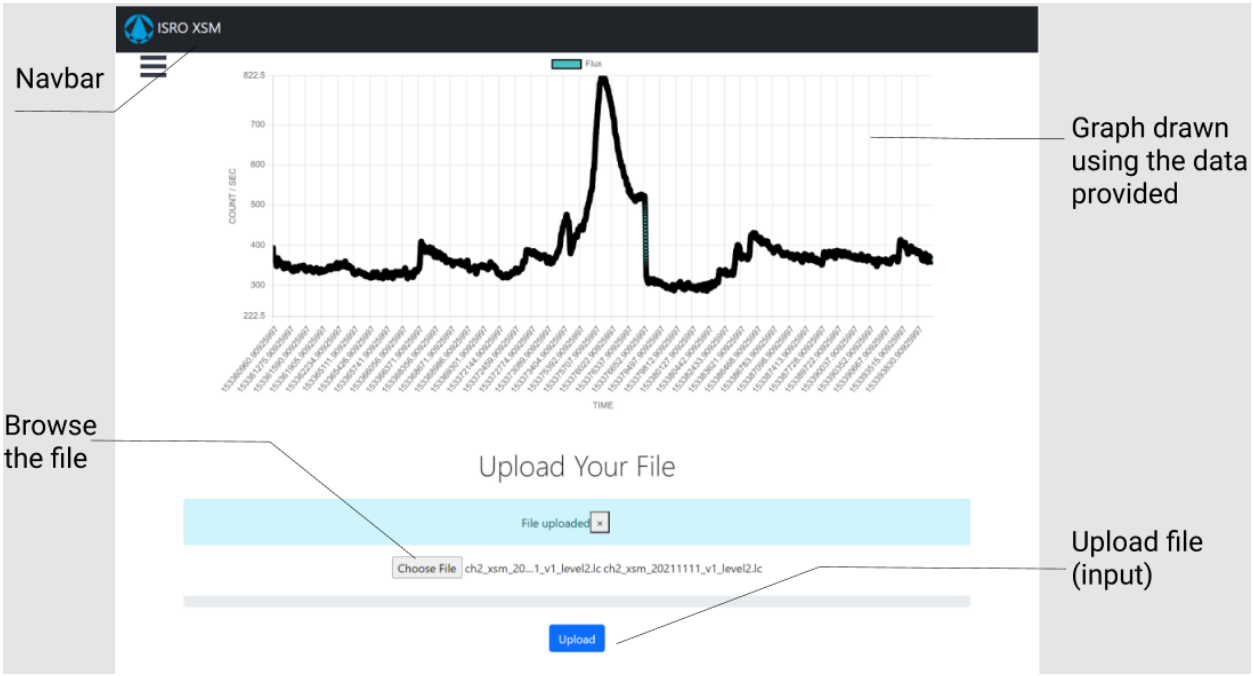
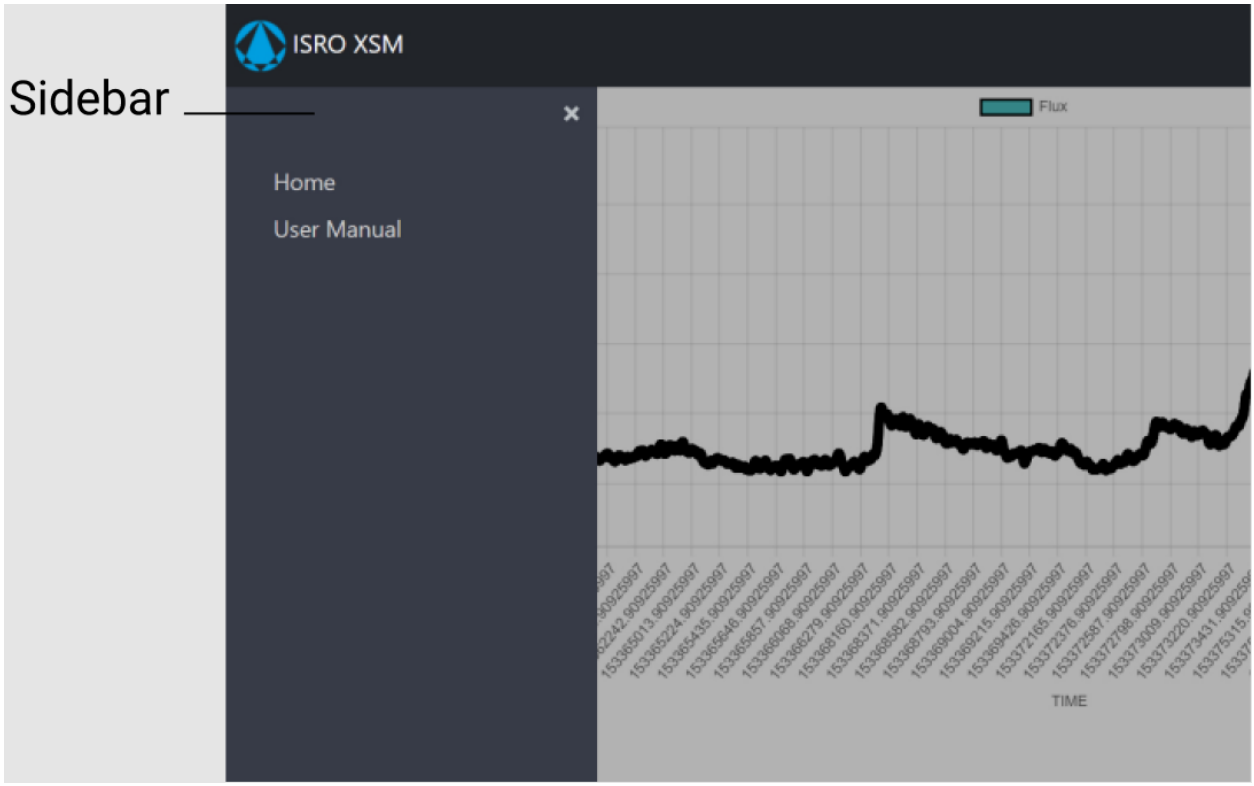
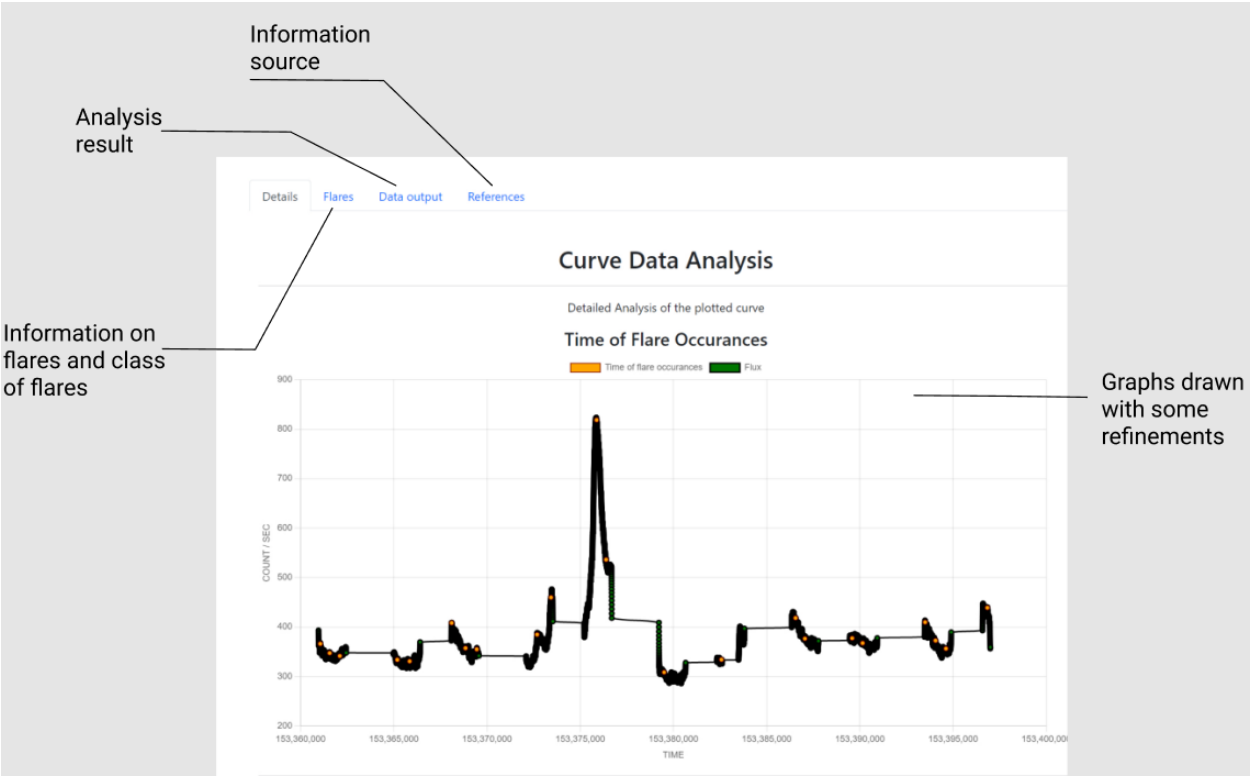

ISRO XSM
Navbar
Flux
COUNT / SEC
TIME
Graph drawn using the data provided
Browse the file
Upload Your File
File uploaded
Choose File
ch2_xsm_20...1_v1_level2.lc ch2_xsm_20211111_v1_level2.lc
Upload
Upload file (input)


Sidebar
ISRO XSM
Home
User Manual
Flux
TIME



Analysis output:

Sl No.	Peak Flare occurrence time	Count/s	Starting Time	Ending time	Rise Time	Decay Time	Total Time
1	153273738.125209	1404.1964111328125	153273658.125209	153273742.125209	38	46	84
2	153275998.125209	1310.8897705078125	153275828.125209	153275904.125209	21	55	76
3	153276898.125209	1308.7845458984375	153276362.125209	153276446.125209	38	46	84
4	153280240.125209	1079.70458984375	153276876.125209	153279661.125209	35	2750	2785
5	153280854.125209	1037.595703125	153279973.125209	153280059.125209	53	33	86
6	153283107.125209	914.4382934570312	153280546.125209	153280643.125209	24	73	97
7	153284014.125209	889.2860717773438	153282859.125209	153282951.125209	39	53	92
8	153287135.125209	815.5271606445312	153283387.125209	153283479.125209	32	60	92
9	153287966.125209	926.7033081054688	153283998.125209	153286650.125209	25	2627	2652
10	153290447.125209	814.9633178710938	153287112.125209	153287284.125209	42	130	172
11	153291000.125209	753.9853515625	153287684.125209	153287942.125209	226	32	258
12	153294188.125209	703.3400268554688	153290376.125209	153290536.125209	103	57	160
13	153294709.125209	698.4268188476562	153291013.125209	153293905.125209	128	2764	2892
14	153297136.125209	826.31787109375	153294214.125209	153294347.125209	82	51	133
15	153301086.125209	593.3838500976562	153294869.125209	153294949.125209	20	60	80
16	153302047.125209	580.7892456054688	153296863.125209	153298030.125209	265	902	1167
17	153304206.125209	540.4833374023438	153301015.125209	153301230.125209	72	143	215
18	153304748.125209	527.739013671875	153301573.125209	153301630.125209	35	22	57
19	153305430.125209	547.1223754882812	153302060.125209	153302240.125209	54	126	180

34	153333671.125209	588.9306030273438	153329841.125209	153329994.125209	91	62	153
35	153336698.125209	432.6024169921875	153330443.125209	153330728.125209	72	213	285
36	153337199.125209	413.108642578125	153332768.125209	153333078.125209	293	17	310
37	153339722.125209	503.5873107910156	153333641.125209	153336608.125209	29	2938	2967
38	153340331.125209	484.9466247558594	153336661.125209	153336974.125209	36	277	313
39	153341071.125209	527.080078125	153337122.125209	153337511.125209	174	215	389
40	153344293.125209	417.662841796875	153337893.125209	153339794.125209	1706	195	1901
41	153344996.125209	420.3677673339844	153340109.125209	153340243.125209	53	81	134
42	153347177.125209	389.8597412109375	153340756.125209	153343624.125209	305	2563	2868
43	153347860.125209	545.396484375	153344131.125209	153344252.125209	43	78	121
44	153351061.125209	404.3872985839844	153344439.125209	153344738.125209	246	53	299
45	153351605.125209	390.9026794433594	153347277.125209	153347394.125209	89	28	117
46	153352112.125209	409.0198059082031	153347795.125209	153347951.125209	115	41	156
47	153354735.125209	368.5508117675781	153350860.125209	153351323.125209	182	281	463
48	153355239.125209	381.8951110839844	153351921.125209	153352101.125209	142	38	180
49	153358677.125209	397.0017395019531	153354453.125209	153354615.125209	72	90	162
50	153359277.125209	357.3711242675781	153355103.125209	153357935.125209	103	2729	2832

Download as CSV file

More about UI

- The web app's main page displays the counts per second vs time graph.
- The user can easily zoom in and out, and also pan on the interactive graph. Moreover, on hovering the cursor over a particular point on the curve, it displays the corresponding coordinates.
- User uploaded `.lc file` is sent to the backend for processing and the result is displayed on the frontend using react-chartjs-2.

- Essential information like start time, end time and other parameters are listed under ‘Data output’ section.

4. Code Explanation

Function Description

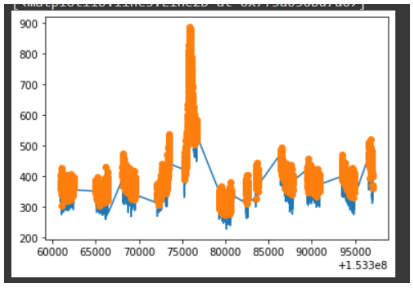
returnable: Opens the data file and preprocess(cleans the data) the data.This function calls all corresponding functions to find values for different parameters.

findpeaks: Finds all the points at which there is a peak in graph

It has the following variables

- **all_peaks** it contains every little peak It is not really helpful too

Example

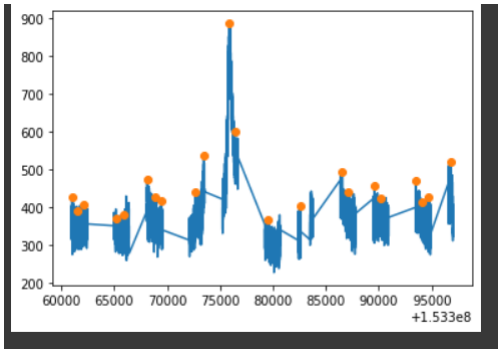


Orange dots are peaks

As the above diagram shows it is too much to consider every tiny bump in graph as many may have occurred due to errors.

- **peaks_dist_unprocces** contains all peaks which are atleast above the average background flux (which is around 350) and are atleast 150 apart on unprocessed data.

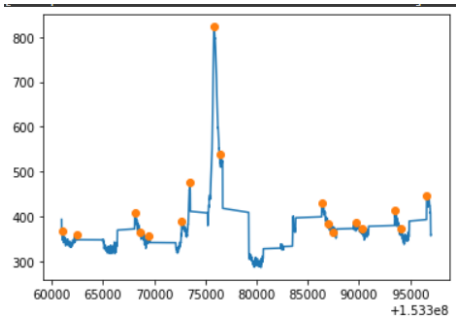
Example



This is more useful than above but finding rise time, decay time etc is not very feasible.

- **peaks_dist** contains all peaks which are atleast above the average background flux(which is around 350) and are atleast 150apart on processed data.

Example



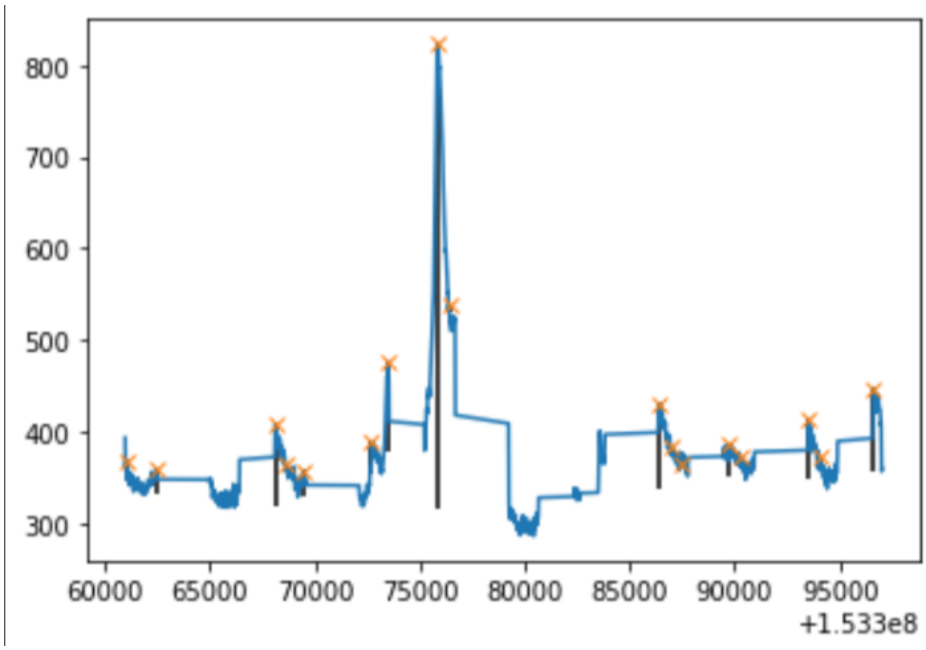
As we can see it is more useful

timesofpeaks: Contains all information about peaks, like peak's height,time of occurrence,max peak value,average height of peaks and calculates rise and decay time.

riseTime: Calculates the left most part of every peak and finds difference between leftmost corner and time of occurrence of peak.It tolerates a flux difference of about 0.5

decayTime: Calculates the right most part of every peak and finds difference between rightmost corner and time of occurrence of peak.It tolerates a flux difference of about 0.5

contourInfo: It contains information about prominence and counter heights



Note: Here the black lines are representing the prominence of the peaks

For more info see the colab file Here

5. References

https://pradan.issdc.gov.in/pradan/index.xhtml

Chandrayaan-2 Solar X-ray Monitor (XSM) Data Analysis Guide