DEVELOPING ASTROPHYSICAL DATA MANAGEMENT & PROCESSING TOOLS

- STUDENTS / UNIVERSITIES
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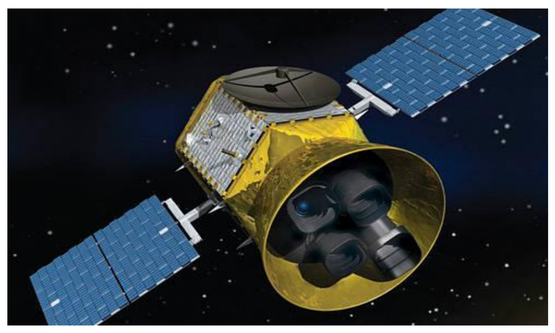
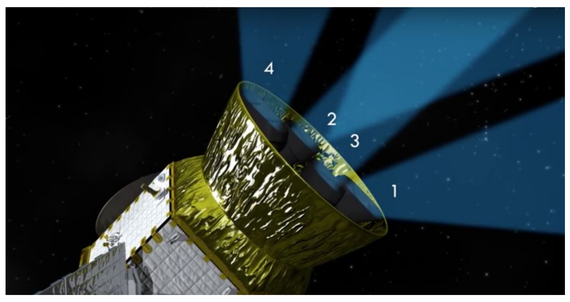
PURE PROGRAM FOR UNDERGRADUATE RESEARCH

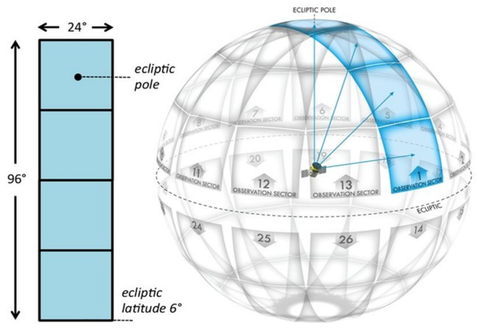
ABSTRACT



TESS is a space telescope which is operated by NASA and MIT.TESS was launched on April 18, 2018 via a Falcon 9 rocket and began regular science operations on July 25, 2018.

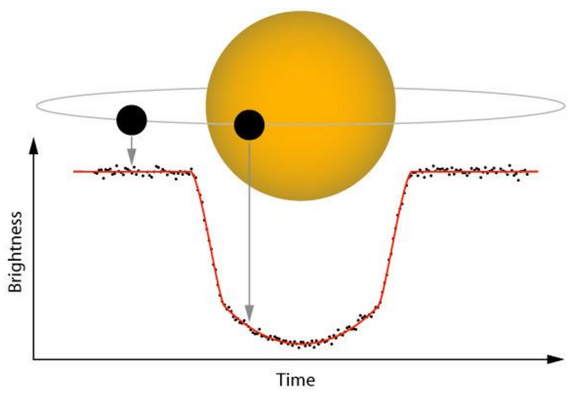
Main goal of TESS is discovering thousands of exoplanets in orbit around the brightest dwarf stars outside our solar system.





- TESS has 4 wide-field optical CCD cameras.
- Divides the sky into 26 different sectors.
- Two year prime mission; 1 year on South hemisphere, 1 year on North hemisphere.

The Transit Method



TESS uses Transit Method to detect planets.
When a planet passes in front of its star, it blocks some of the light, causing a slight drop in brightness. With the drops in brightness, exoplanets are detected by this method.

OBJECTIVES

In this Project, we are trying to find periodic behaviors in TESS data with python programming and FFT method. These periodic behaviors may assert that there is a planet in that sector of sky.

PROJECT DETAILS

`.fits, .fit, .fts`

- TESS data is accessible online
- TESS Archive is in fits format
- Python programming for filter and plot the data
- Fits data format:
  - 'Flexible Image Transport System'
  - Endorsed by NASA and the International Astronomical Union
  - Header keywords provide descriptive information about the data
- Astropy and NumPy libraries in Python
  - Astropy for reaching the data in fits format
  - NumPy for doing calculations
- MobaXterm to reach university's server which stores the data.

PROJECT DETAILS

We firstly plot out flux vs. time data and write an algorithm to filter our data from errors.

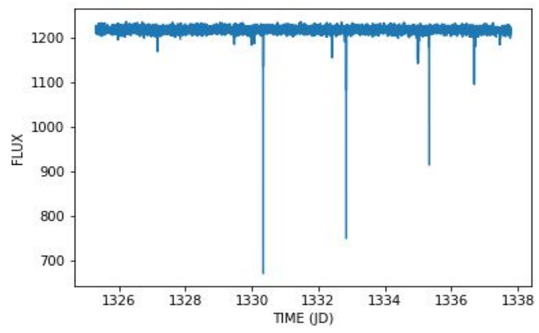


FIG. 1

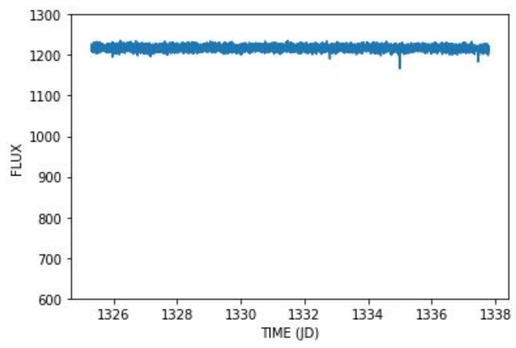
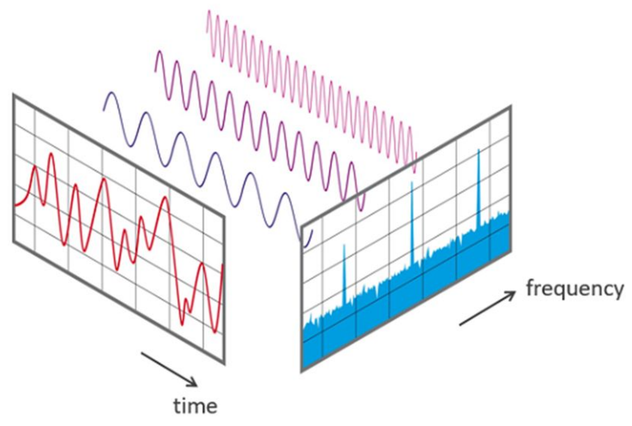


FIG. 2

FIG. 1 shows the plot of raw, unprocessed data of TESS. It is plotted by using time vs. flux. This plot contains errors that is caused by the malfunction of TESS. Therefore, we have to remove the errors and clean the plot. FIG. 2 is the clarified version of FIG. 1. After removing the errors, the plot is ready to apply FFT (Fast Fourier Transform)

Fast Fourier Transform



FFT is an algorithm that computes the discrete Fourier transform of a sequence. Fourier analysis converts a signal from its original domain (often time or space) to frequency domain. We use FFT to remove noise from our data and highlight the motions in same frequency.

Before we implement FFT to our data, we firstly create a pure sinus wave (with 0.3 frequency) and add random numbers to create noise like in our data (FIG 3). Then we implement FFT and see the periodic motion in the frequency which we decided before.(FIG 4)

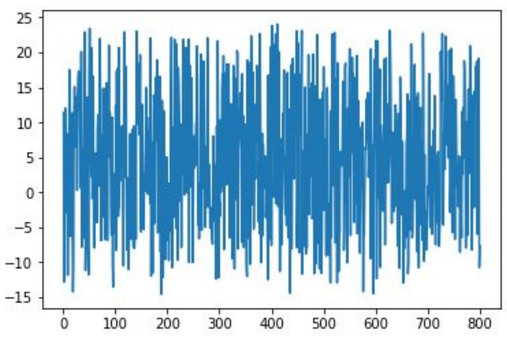


FIG. 3

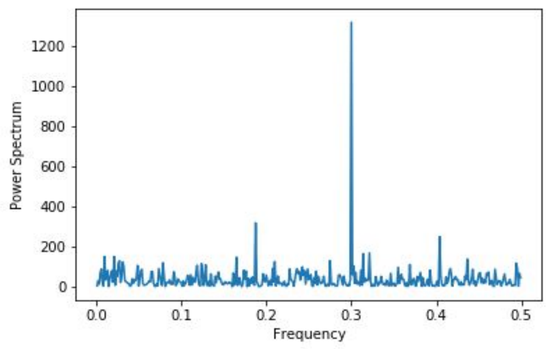


FIG. 4

RESULTS

Then we develop another algorithm for using FFT (Fast Fourier Transform) in order to transform our data into power spectrum and frequency. With the new plot we are expecting to see the periodic behaviors in the flux and detect a planet.

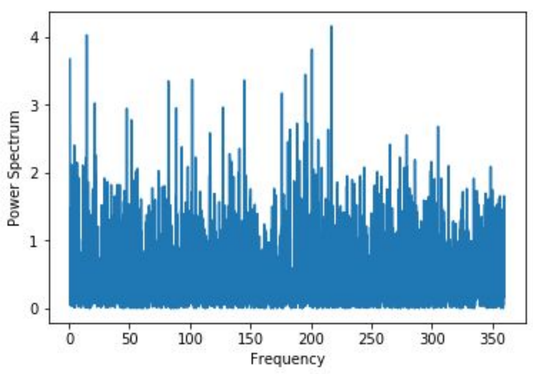


FIG. 5

FIG. 5 is the plot that is plotted after applying FFT (Fast Fourier Transform) .

REFERENCES

TESS Science Support Center. (n.d.). Retrieved August 1, 2019, from https://heasarc.gsfc.nasa.gov/docs/tess/