Progress Update 1

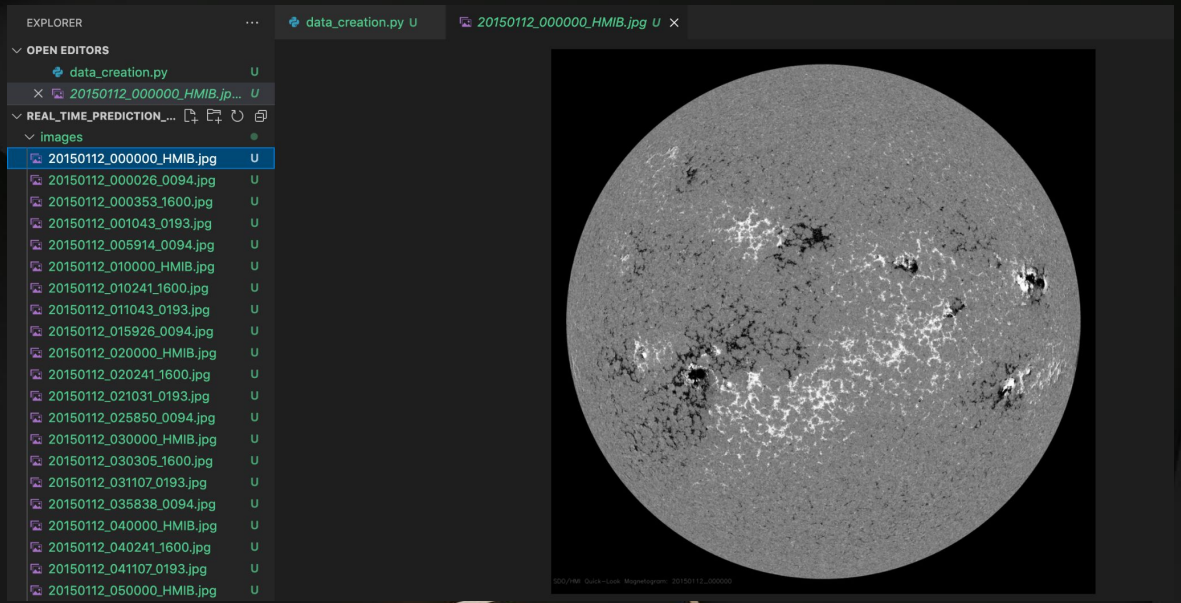
Rohit Prasanna

Real-Time Prediction and Classification of Flare Events

Short Overview

- Goal of Project
  - Create a real-time predictor of flare events (solar flares, CMEs) based on sun images taken by SDO
    - Predicts time and type of flare (intensity and/or CME likelihood)
  - Potential secondary path of light curve extension
    - Extract relevant features from light curves for prediction

Research Updates



- Begun data collection from SDO website
  - Web scraping from 2010-2017
  - 4 filtergrams with 1 hour cadence
    - HMIB Magnetogram
    - AIA 1600
    - AIA 94
    - AIA 193
- Code shown on next slide.

Research Updates

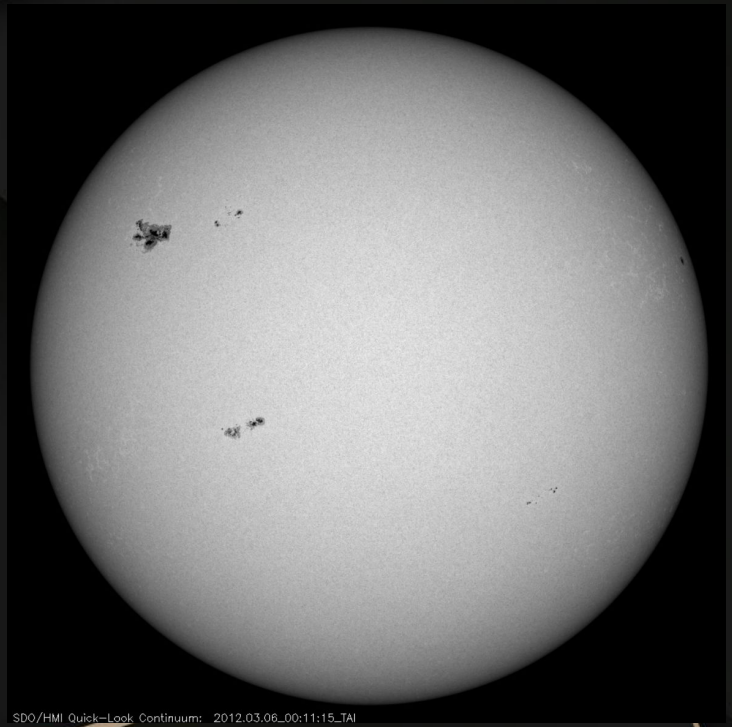
```
'''
SDO Available From: 2010/05/21
#GOES Flare Available From: 17/06/28
Overlap of about 7 years.
'''

# TODO: Add data of Solar Flare times and intensities --> pair 24 hours images before with flare events
# TODO: Find CME dataset and research into CME intensities
# TODO: Next Step: Feature Extraction on Magnetogram

from bs4 import BeautifulSoup
import requests
import os
import shutil

def add_image(image):
    # print(os.path.exists(parent_dir + 'images/'))
    filename = year + month + day + "_" + image[9:15] + "_" + image[21:]
    if not os.path.exists(parent_dir + 'images/'):
        os.mkdir(os.path.join(parent_dir, 'images/'))
    folderpath = "images/" + filename
    r = requests.get(url + image, stream = True)
    r.raw.decode_content = True
    with open(folderpath,'wb') as f:
        shutil.copyfileobj(r.raw, f)
    # print(image)
    pass
```

Updated Filters and Google Drive

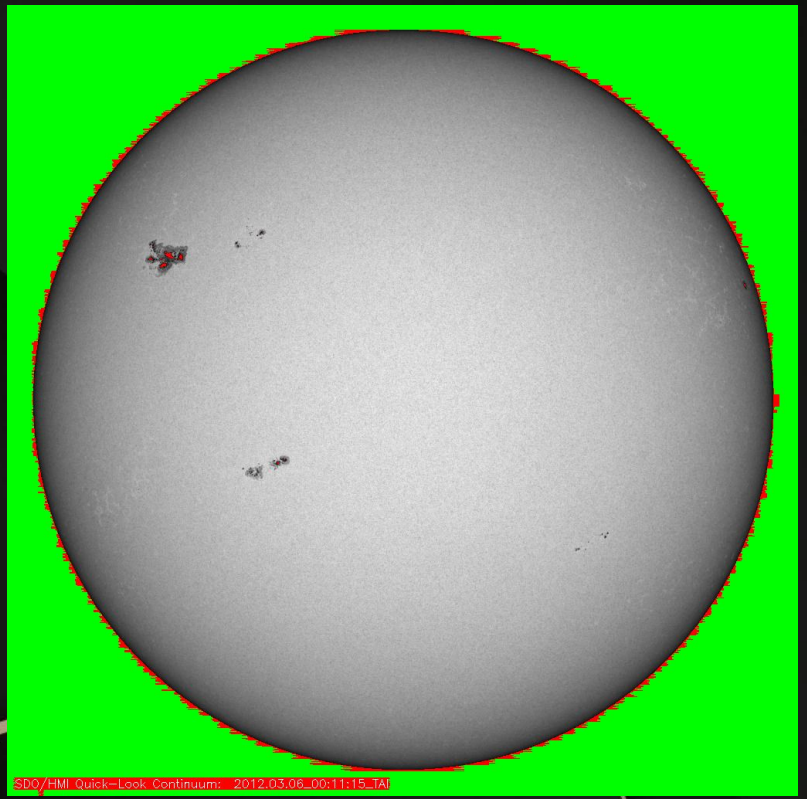


HMII Contiuum Filtergram Added

20130701_235455_HMII.jpg	me	Nov 28, 2021	150 KB
20130701_234500_HMIB.jpg	me	Nov 28, 2021	374 KB
20130701_231407_0193.jpg	me	Nov 28, 2021	139 KB
20130701_230153_1600.jpg	me	Nov 28, 2021	212 KB
20130701_230126_0094.jpg	me	Nov 28, 2021	376 KB
20130701_225455_HMII.jpg	me	Nov 28, 2021	150 KB
20130701_224500_HMIB.jpg	me	Nov 28, 2021	375 KB
20130701_221407_0193.jpg	me	Nov 28, 2021	139 KB
20130701_220217_1600.jpg	me	Nov 28, 2021	215 KB
20130701_220102_0094.jpg	me	Nov 28, 2021	377 KB
20130701_215455_HMII.jpg	me	Nov 28, 2021	149 KB
20130701_214500_HMIB.jpg	me	Nov 28, 2021	375 KB
20130701_211355_0193.jpg	me	Nov 28, 2021	139 KB

05/21/2010 - 07/01/2013
so far

Preprocessing



Current Preprocessing:

- Made background transparent (made green here to visualize)
- Collected Active Regions
  - regions of high magnetic activity, leading to solar activity

To Implement:

- Region Bounding
- Reduce Limb Importance
- Research Active Region Implementation (boxed)

Data Compilation

THE ASTROPHYSICAL JOURNAL
SUPPLEMENT SERIES

OPEN ACCESS

A Machine-learning Data Set Prepared from the NASA *Solar Dynamics Observatory* Mission

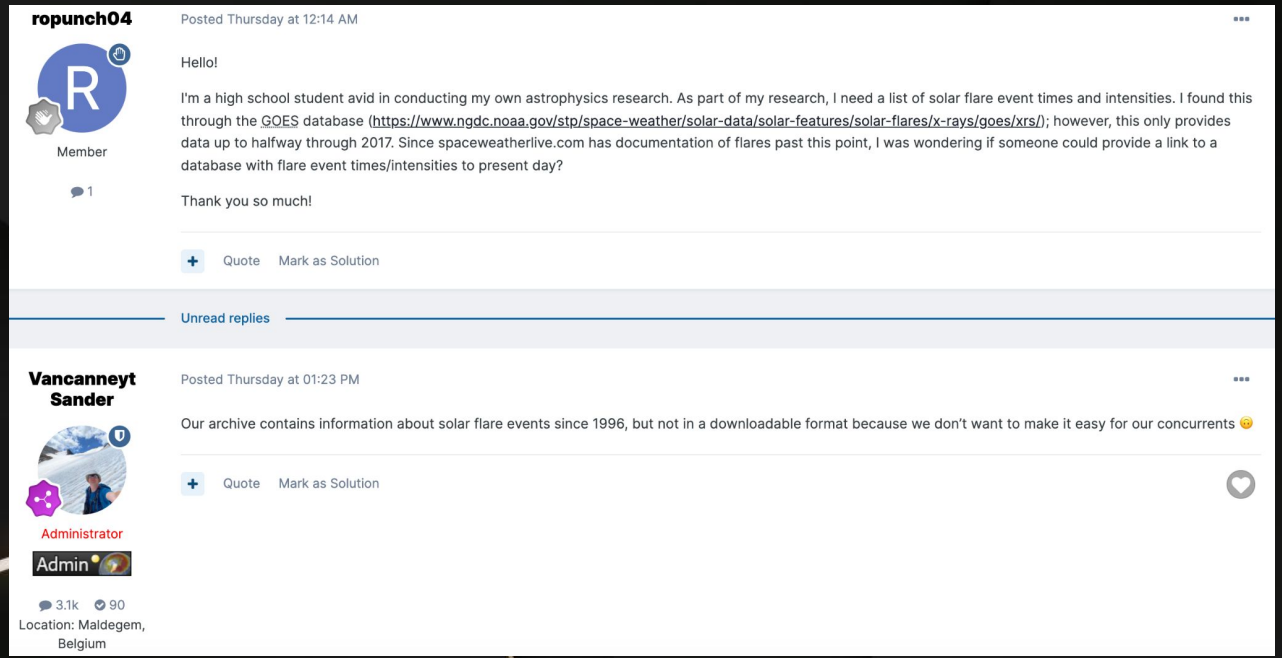
Richard Galvez[1], David F. Fouhey[2], Meng Jin[3,4], Alexandre Szenicer[5], Andrés Muñoz-Jaramillo[6], Mark C. M. Cheung[3,7], Paul J. Wright[8], Monica G. Bobra[7], Yang Liu[7], James Mason[9] + Show full author list

Published 2019 May 8 • © 2019. The American Astronomical Society.
The Astrophysical Journal Supplement Series, Volume 242, Number 1
Citation Richard Galvez *et al* 2019 *ApJS* **242** 7

Article PDF Article ePub

Collaborations

Attempt at finding Solar Flare Occurrence data past 2017



ropunch04

Posted Thursday at 12:14 AM

Member

1

Hello!

I'm a high school student avid in conducting my own astrophysics research. As part of my research, I need a list of solar flare event times and intensities. I found this through the GOES database (https://www.ngdc.noaa.gov/stp/space-weather/solar-data/solar-features/solar-flares/x-rays/goes/xrs/); however, this only provides data up to halfway through 2017. Since spaceweatherlive.com has documentation of flares past this point, I was wondering if someone could provide a link to a database with flare event times/intensities to present day?

Thank you so much!

Quote Mark as Solution

Unread replies

Vancanneyt Sander

Posted Thursday at 01:23 PM

Administrator

Admin

3.1k 90

Location: Maldegem, Belgium

Our archive contains information about solar flare events since 1996, but not in a downloadable format because we don't want to make it easy for our concurrents

Quote Mark as Solution

Collaborations

- Dr. Naoto Nishizuka (Kyoto University)
  - Feature Extraction and Flare Event Expert
  - Provided general advice on project and gave many helpful links/resources
    - Explained her relevant feature extraction process
    - Insight into how I may go about my light curve portion of project later on once I'm able to replicate findings
  - HMII Filter

Collaborations

- Dr. Komei Sugiura (Keio University)
  - Machine Learning Expert
  - Provided advice regarding my machine learning model (specifically relevant feature extraction portion)
    - CNN-LSTM Gradcam
    - CNN-LSTM Attention
- To get a larger move on my project:
  - Work on relevant feature extraction **in parallel** after reading a few papers regarding SHARP parameters and emailing more researchers
  - Use traditional feature extraction of images and get a **very basic machine learning model** in place

Collaborations

- Dr. William Pesnell (SDO Project Manager)
  - Awaiting secondary response
  - Has emailed me back

Further Collaborations

First Name	Last Name	Email	Article Name
Rohit	Prasanna	837329@lcps.org	Test Email Sending
Monica	Bobra	mbobra@stanford.edu	Solar Flare Prediction Using SDO/HMI Vector Magnetic Field Data with a Ma
Sebastien	Coudvidat	couvidat@stanford.edu	Solar Flare Prediction Using SDO/HMI Vector Magnetic Field Data with a Ma
Stathis	Ilonidis	ilonidis@stanford.edu	Predicting Coronal Mass Ejections Using Machine Learning Methods
Robert	Erdélyi	robertus@sheffield.ac.uk	CME Arrival Time Prediction Using Convolutional Neural Network
Yimin	Wang	yimin.wang@shef.ac.uk	CME Arrival Time Prediction Using Convolutional Neural Network
Ye	Jiang	ye.jiang@sheffield.ac.uk	CME Arrival Time Prediction Using Convolutional Neural Network
Jiajia	Liu	jj.liu@shef.ac.uk	CME Arrival Time Prediction Using Convolutional Neural Network
Xiantong	Wang	xtwang@umich.edu	Predicting Solar Flares with Machine Learning: Investigating Solar Cycle Dep
Yang	Chen	ychenang@umich.edu	Identifying Solar Flare Precursors Using Time Series of SDO/HMI Images an
Ward	Manchester	chipm@umich.edu	Predicting Solar Flares with Machine Learning: Investigating Solar Cycle Dep

Near Future Work

- Research more into relevant feature extraction and successfully extract features from one magnetogram
  - compare to SHARP database
- Research into the scientific theory behind CMEs and their characteristics
  - Edit filter grams based on results
  - Locate dataset
- Compile full data and attach flare event labels (almost complete)