Jorge
Padial
Vanderbilt University
Dr. Kelly Holley-Bockelmann, Vanderbilt University Physics and Astronomy
Dr. Eric Jonas, University of Chicago Computer Science
Poster
Large solar flares and events associated with them, like Coronal Mass Ejections, are rare but highly destructive phenomena that can impact social, economic, and digital infrastructure on Earth. Attempts have been made to use different machine learning (ML) algorithms tasked with predicting which Active Regions (AR) will erupt within a predetermined time frame. Regardless of model complexity or the amount of data being fed into these classifiers, >10 years of ML applied to flare prediction yield similar evaluation metrics (TSS ~ 0.7). We hypothesize that this stagnation is a result of incorrect labeling of AR's as flare producing or non-flare producing, which is being fed into these models. Evidence stems from the incomplete localization of historical solar flares compiled from canonical databases. In order to test this hypothesis, we have developed the Automatically Labeled EUV and X-Ray Incident SolarFlare (ALEXIS) catalog.
Solar flare locations, peaks, magnitudes, and associated AR are learned by ALEXIS by recreating the full-disk X-Ray flux from XRS as a weighted linear combination of discrete regions as observed by multi-pixel images. This is possible by applying contemporary computer vision techniques coupled with clustering, differential time-series analysis, and convex optimization to the full resolution and cadence of the XRS, AIA and SXI data. A proof of concept run of ALEXIS was run locally parsing through 14 TB of data in search of 1057 solar flares of C-class magnitudes and above, randomly selected between March 2010 - May 2020. Comparison of ALEXIS's catalog with the catalogs produced by SWPC and SolarSoft show that these databases incorrectly localize 56% and 18% of the flares, respectively. Additionally, ALEXIS increased the amount of flares in this subsample by 34%, has provided the first observational evidence for synchronous flares, and has proved that the flare durations (start, peak, end) and X-Ray labels as compiled by SWPC are misleading. ALEXIS has been granted 200 TB of storage and 20,000 node hours at the Argonne Leadership Computing Facility to run this pipeline on ~ 8,300 flare entries compiled by SWPC from March 2010 to May 2020. The ALEXIS catalog will compete with canonical databases and can also be modified to return near-real time flare detection.

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