Real-Time Prediction of Solar Flares and Coronal Mass Ejections

Prasanna, Rohit (School: Academies of Loudoun)

Solar phenomena, specifically solar flares and coronal mass ejections (CMEs), have plagued the Earth since its creation. In 1859, the Earth was struck with the most devastating CME it's ever experienced, causing most telegrams to explode. If an event of a similar caliber occurred modern day, the impacts to the electrical grid would be catastrophic. Predicting these events before they occur would allow us to prepare our electrical grid and minimize the damage. My project aims to solve this pressing issue by presenting a novel method of predicting solar phenomena 24 hours prior to their occurrence. After compiling a database of solar events from four distinct classes (Flare + CME, Flare, CME, and Neither), I determined the active region of origin and collected 18 of the regions' features 24 hours prior to the events' occurrence. These 18 features were inputted into a deep learning model that was trained to predict the class of the solar event. After the model was trained to high accuracy, it was implemented in real-time to serve as a method of predicting solar events before they reach the Earth. The model reached an accuracy of 95.22% distinguishing between the four classes and reached a 99.20% accuracy in distinguishing between no solar event and solar event. The real-time implementation of my model serves as the first step in preparing for the next life-threatening solar event. By predicting the likelihood of dangerous events 24 hours in advance, we can take preventative measures to help avoid catastrophe.

Awards Won:
Third Award of $1,000
Air Force Research Laboratory on behalf of the United States Air Force: Glass trophy and USAF medal for each recipient
Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category