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Automatic Prediction of Solar Flares Using a Neural Network

Statistical Methods have been marginally successful in predicting Solar Flares within a 24-hour period. However, better methods may be available for more efficiently predicting flares that could pose a threat to human activity. Specifically, M and X class flares are the primary categories of flares that need to be filtered for detection due to their highly energetic nature. A Neural Network may be an ideal solution to process large amounts of data and analyze whether flares in these classes will occur or not in a much shorter timespan. Within a Neural Network are an input layer that receives the data, a hidden layer that trains the network to process and categorize the data, and an output layer that predicts whether or not an event will occur. In order to test this new routine on the Network, data was used from the GOES satellites and SDO (Solar Dynamics Observatory). From the SDO, the EVE (Extreme Ultraviolet Explorer) instrument was used to process data into the Neural Network. In particular, the 0-7nm, 18nm, and 30nm channels were used as sources of solar data. The GOES data provided valuable data pertaining to the X-ray background, radio flux, M, and X forecasts. Several programs were constructed within IDL in order to create irradiance, forecast, and X-Ray background plots in relation to time. The plots made it easier to visualize the parameters that needed to be set within the Neural Network to better classify a flare and predict if one potentially harmful to human communication and electrical supply will actually occur. Through Multilayered perceptron and dynamic back propagation the network could be trained within a max error of .005. The network is still in its testing phase though and may require additional parameters (such as solar magnetic fields, field geometry, and coronal temperature), some of these data sets are available, but have not been processed yet. The training methods also still need to be optimized. Some potential future endeavors may be to utilize image processing to characterize active regions, which can reveal concentration of magnetic activity. As a result, the network may be able to perform 'local' forecasting about the possibilities of an individual or group of regions producing large flares.