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Predicting CMEs (Coronal Mass Ejections) using Neural Networks

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Abstract

Two of the most powerful events of all solar activity observed are flayers and coronal mass ejections (CMEs). They are often associated with solar flares due to the rapidly growing solar activity field (AR) with strong magnetic fields. Major CMEs and associated flayers can have a significant impact on the global environment and can be life threatening.
Therefore, great efforts are being made to develop new technologies for early detection and prediction of flames and CME. Both flame and CME are considered to be magnetically active events. Evidence suggests that they may be multiple manifestations of the same physiological process(Berkebile-Stoiser et al. 2012; Gosling 2013; Harrison 1995)

However, solar observations over the last few decades have clearly shown that there is no one-to-one correspondence between flayers and CMEs, and their relationship is still being actively investigated(see, e.g., Kawabata et al. 2018;Yashiro & Gopalswamy 2008).
Much effort has been expended in analyzing the structural properties of the coronary magnetic field and plays an important role in determining whether an explosion has evolved into a CME or a constricted flayer.

In this paper, we attempt by proposing new machine learning algorithms and applying the algorithms to SDO/HMI vector magnetic field data to predict whether an AR that produces an M- or X-class flare will also produce a CME. The machine learning algorithms. A desktop application is developed where the user can input data and check any AR patches occurred due that day if yes can measure the features of both flayers to predict the probability of being a CME.

The system is developed using Python programming language. Implemented system was tested thoroughly under different conditions, and domain experts evaluated the system. Eventually, the test results proved that the analysis, design, implementation, and documentation had been carried out effectively and efficiently.

Key words: **Machine Learning , LSTM , RNN , CME , Solar flayer , Active Regions**