Operational Forecasting of Solar Flares using Deep Neural Network

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Solar flares are the largest explosive phenomena in the Heliosphere. They affect the earth by X-ray and UV emissions, high energy particles, and magnetic storms, causing troubles of satellites and blackout in a large area. To reduce the risk of social impact caused by solar flares and space weather, it is very important to predict solar flares with high accuracy. In our institute NICT, we have predicted solar flares in the daily forecasting meeting by an empirical method. However, the amount of solar observation data is so huge that we cannot deal with all the data by hands.

Here we developed an operational system of solar flare prediction using a deep neural network (DNN), named Deep Flare Net (DeFN; Nishizuka et al. 2018 ApJ), and we started to run it in the operation. The model can predict probabilities of the maximum class of flares occurring in the following 24 hr. The training dataset is maded by 3x10^5 images during 2010-2015 taken by SDO, from which we detected active regions and calculated 79 features for each region attached with the flare occurrence labels (X, M, C). We used features in our previous work (Nishizuka et al. 2017) and added novel features for operational prediction: coronal hot brightening at 131 A (T=10^7 K) and the histories of X-ray and 131 A emissions 1 and 2 hr before an image. The prediction data in the near real-time is downloaded from JSOC server operated by Stanford University and NASA, and all the active regions and features are automatically detected and calculated. The prediction results will be shown in the web site of NICT. In this talk, we will introduce our DeFN model and operational forecasting system and would like to discuss how it works in the daily operations.

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