

# Development of coronal hole detection method from LOS magnetograms with deep learning

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We challenged the development of coronal hole detection method only from LOS magnetograms with deep learning.

Coronal holes are the source of the solar wind that can cause geomagnetic storms that affect the Earth's magnetosphere, and it is possible to predict the geomagnetic storms from the area of the coronal hole. Coronal holes appear as dark areas in extreme ultraviolet(EUV) images, and in addition to automatic detection methods with image processing technology, a detection method with deep learning also has been developed by Jarolim et al. (2021). On the other hand, these detection methods from EUV images are aimed at the detection of coronal holes that have already appeared, but it is desirable to predict them before they appear in the space weather forecast. For example, if it becomes possible to detect the coronal hole magnetic field area which has unipolarity, it may be possible to discover signatures of its appearance. In this study, we challenged the development of a coronal hole detection method only from LOS magnetograms with deep learning.

For the detection methods, we used U-Net for semantic segmentation and a model based on SCAN(Jarolim et al. 2021). For the data set, we used LOS magnetograms taken by Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamics Observatory (SDO). The data set contains a total of 2,167 LOS magnetograms between 2011-01-01 and 2016-12-31. For the coronal hole labels, we used segmentation images created from EUV images with the automatic detection method proposed by Garton et al. (2017).

As a result of our study, U-Net archives 0.388 as Precision and 0.316 as Recall using only LOS magnetograms. On the other hand, there is a problem that the detected area was divided into smaller regions as the training epoch increases. The detection model based on SCAN provided Precision of 0.389 and Recall of 0.308. As reported by Jarolim et al. (2021), there is a tendency to detect a larger area than the ground truth. In the presentation, we will further discuss how to solve these problems.

Keywords: Sun, Coronal Holes