Science and Technology, Korea

We detect a new population of chromospheric jets in a polar coronal hole observed by Hinode/SOT. The propagating speed of the jets ranges in 30 – 490 km/s whose duration time is 3 – 52 s. The recurrent rate is approximately 3/min for a give segment of 1 arc-second horizontal interval. These jets are seemed to be more transient and faster than type II spicules at chromosphere, while the properties are compatible with the network jets seen in emission lines of transition region. We will discuss the implication of these jets for a coronal heating.

[구 SS-06] Development of a diagnostic coronagraph on the ISS: progress report

Yeon-Han Kim[1,2], Seonghwan Choi[1], Su-Chan Bong[1,2], Kyungsuk Cho[1,2], Young-Deuk Park[1], Jeffrey Newmark[3], Nat. Gopalswamy[3], Seiji Yashiro[3], Nelson Reginald[3]
[1]*Korea Astronomy and Space Science Institute, Korea*
[2]*University of Science and Technology, Korea*
[3]*NASA Goddard Space Flight Center, USA*

The Korea Astronomy and Space Science Institute (KASI) has been developing a coronagraph in collaboration with the National Aeronautics and Space Administration (NASA), to install it on the International Space Station (ISS). The coronagraph will utilize spectral information to simultaneously measure electron density, temperature, and velocity. For this, we develop the coronagraph as a two-step process. First, we will perform a stratospheric balloon-borne experiment, so called BITSE, in 2019 with a new type of coronagraph. Second, the coronagraph will be installed and operate on the ISS (CODEX) in 2021 to address a number of questions (e.g., source and acceleration of solar wind, and coronal heating) that are both fundamental and practically important in the physics of the solar corona and of the heliosphere. In this presentation, we will introduce recent progresses.

[구 SS-07] Application of Deep Learning to Solar Data: 1. Overview

Yong-Jae Moon, Eunsu Park, Taeyoung Kim, Harim Lee, Gyungin Shin, Kimoon Kim, Seulki Shin, and Kangwoo Yi
[1]*School of Space Research, Kyung Hee University,* [2]*Department of Research and Development, InSpace Co.*

Multi-wavelength observations become very popular in astronomy. Even though there are some correlations among different sensor images, it is not easy to translate from one to the other one. In this study, we apply a deep learning method for image-to-image translation, based on conditional generative adversarial networks (cGANs), to solar images. To examine the validity of the method for scientific data, we consider several different types of pairs: (1) Generation of SDO/EUV images from SDO/HMI magnetograms, (2) Generation of backside magnetograms from STEREO/EUVI images, (3) Generation of EUV & X-ray images from Carrington sunspot drawing, and (4) Generation of solar magnetograms from Ca II images. It is very impressive that AI-generated ones are quite consistent with actual ones. In addition, we apply the convolution neural network to the forecast of solar flares and find that our method is better than the conventional method. Our study also shows that the forecast of solar proton flux profiles using Long and Short Term Memory method is better than the autoregressive method. We will discuss several applications of these methodologies for scientific research.

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (2018-0-01422, Study on analysis and prediction technique of solar flares).

[구 SS-08] Solar farside magnetograms from deep learning analysis of STEREO/EUVI data

Taeyoung Kim[1,5,7], Eunsu Park[1,7], Harim Lee[1,7], Yong-Jae Moon[1,2⋆], Sung-Ho Bae[3], Daye Lim[1], Soojeong Jang[4], Lokwon Kim[3], Il-Hyun Cho[2], Myungjin Choi[5] and Kyung-Suk Cho[4,6]
[1]*School of Space Research, Kyung Hee University, Yongin, South Korea.* [2]*Department of Astronomy and Space Science, College of Applied Science, Kyung Hee University, Yongin, South Korea.* [3]*Department of Computer Science and Engineering, College of Electronics and Information, Kyung Hee University, Yongin, South Korea.* [4]*Space Science Division, Korea Astronomy and Space Science Institute, Daejeon, South Korea.* [5]*InSpace Co., Ltd., Daejeon, South Korea.* [6]*Department of Astronomy and Space Science, University of Science and Technology, Daejeon, South Korea.* [7]*These authors contributed equally: Taeyoung Kim, Eunsu Park, Harim Lee.*

Solar magnetograms are important for studying solar activity and predicting space weather disturbances1. Farside magnetograms can be constructed from local helioseismology without any farside data2-4, but their quality is lower than that

of typical frontside magnetograms. Here we generate farside solar magnetograms from STEREO/Extreme UltraViolet Imager (EUVI) 304-Å images using a deep learning model based on conditional generative adversarial networks (cGANs). We train the model using pairs of Solar Dynamics Observatory (SDO)/Atmospheric Imaging Assembly (AIA) 304-Å images and SDO/Helioseismic and Magnetic Imager (HMI) magnetograms taken from 2011 to 2017 except for September and October each year. We evaluate the model by comparing pairs of SDO/HMI magnetograms and cGAN-generated magnetograms in September and October. Our method successfully generates frontside solar magnetograms from SDO/AIA 304-Å images and these are similar to those of the SDO/HMI, with Hale-patterned active regions being well replicated. Thus we can monitor the temporal evolution of magnetic fields from the farside to the frontside of the Sun using SDO/HMI and farside magnetograms generated by our model when farside extreme-ultraviolet data are available. This study presents an application of image-to-image translation based on cGANs to scientific data.

이 논문은 2019년도 정부(과학기술정보통신부)의 재원으로 정보통신기술 진흥센터의 지원을 받아 수행된 연구임 (2018-0-01422,태양흑점폭발 분석 및 예측기술연구)

[구 SS-09] Application of Deep Learning to Solar Data: 6. Super Resolution of SDO/HMI magnetograms

Sumiaya Rahman, Yong-Jae Moon, Eunsu Park, Hyewon Jeong, Gyungin Shin, Daye Lim
School of Space Research, Kyung Hee University

The Helioseismic and Magnetic Imager (HMI) is the instrument of Solar Dynamics Observatory (SDO) to study the magnetic field and oscillation at the solar surface. The HMI image is not enough to analyze very small magnetic features on solar surface since it has a spatial resolution of one arcsec. Super resolution is a technique that enhances the resolution of a low resolution image. In this study, we use a method for enhancing the solar image resolution using a Deep-learning model which generates a high resolution HMI image from a low resolution HMI image (4 by 4 binning). Deep learning networks try to find the hidden equation between low resolution image and high resolution image from given input and the corresponding output image. In this study, we trained a model based on a very deep residual channel attention networks (RCAN) with HMI images in 2014 and test it with HMI images in 2015. We find that the model achieves high quality results in view of both visual and measures: 31.40 peak signal-to-noise ratio(PSNR), Correlation Coefficient (0.96), Root mean square error (RMSE) is 0.004. This result is much better than the conventional bi-cubic interpolation. We will apply this model to full-resolution SDO/HMI and GST magnetograms.

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (2018-0-01422, Study on analysis and prediction technique of solar flares).

[구 SS-10] Generation of global coronal field extrapolation from frontside and AI-generated farside magnetograms

Hyunjin Jeong[1], Yong-Jae Moon[1], Eunsu Park[1], Harim Lee[1] and Taeyoung Kim[1,2]
[1]School of Space Research, Kyung Hee University, [2]Department of Research and Development, InSpace Co.

Global map of solar surface magnetic field, such as the synoptic map or daily synchronic frame, does not tell us real-time information about the far side of the Sun. A deep-learning technique based on Conditional Generative Adversarial Network (cGAN) is used to generate farside magnetograms from EUVI 304Å of STEREO spacecrafts by training SDO spacecraft's data pairs of HMI and AIA 304Å. Farside(or backside) data of daily synchronic frames are replaced by the Ai-generated magnetograms. The new type of data is used to calculate the Potential Field Source Surface (PFSS) model. We compare the results of the global field with observations as well as those of the conventional method. We will discuss advantage and disadvantage of the new method and future works.

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (2018-0-01422, Study on analysis and prediction technique of solar flares).

[구 SS-11] Relative Contribution from Short-term to Long-term Flaring rate to Predicting Major Flares

Daye Lim[1], Yong-Jae Moon[1,2], Eunsu Park[1], Jongyeob Park[3], Kangjin Lee[1,4], Jin-Yi Lee[2], Soojeong Jang[3]
[1]School of Space Research, Kyung Hee University, [2]Department of Astronomy & Space Science, Kyung Hee University, [3]Korea Astronomy and Space Science Institute, [4]Electronics and