Characteristics of plasma motions in the surge are determined with the normalizing radial gradient filter and the Fourier motion filter. The shape of the surge is found to change from a `C' shape to an inverse `C' shape after a formation of a cusp, a signature of reconnection. There are apparent upflows seen above the cusp top and downflows below it. The upflows show rising and rotational motions in the right-hand direction, with the rotational speed decreasing with height.

Near the cusp top, we find a transverse oscillation of the surge, with the period of ~2 min. There is no change of the oscillation phase below the cusp top, but above the top a phase change is identified, giving a vertical phase speed about 86kms-1. As the height increases, the initial amplitude of the oscillation increases, and the oscillation damping time decreases from 5.13 to 1.18min. We conclude that the oscillation is a propagating kink wave that is possibly excited by an x-point oscillation.

[구 SS-14] A Comprehensive Study of Interaction of Magnetic Flux Ropes Leading to Solar Eruption

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Solar observations often show that interaction of more than one flux rope is involved in solar eruptions. In this regard, Lau and Finn (1996) intensively studied the interaction of two flux ropes, which reside in between two parallel planes each mimicking one polarity region of the solar photosphere. However, this geometry is quite far from the real solar situation, in which all feet of flux tubes are rooted in one surface only. In this paper, we study the interaction of two flux ropes in a semi-infinite region above a plane representing the solar photosphere. Four cases of the flux rope interaction are investigated in our MHD simulation study: (1) parallel axial fields and parallel axial currents (co-helicity), (2) antiparallel axial fields and parallel axial currents (counter-helicity), (3) parallel axial fields and antiparallel axial currents (counter-helicity), and (4) antiparallel axial fields and antiparallel axial currents (co-helicity). Each case consists of four or six subcases according to the background field direction relative to the flux ropes and the relative positions of the flux rope footpoints. In our simulations, all the cases eventually show eruptive behaviors, but their degree of explosiveness and field topological evolutions are quite different. We construct artificial emission measure maps based on the simulations and compare them with images of CME observations, which provides us with information on what field configurations may generate certain eruption features.

[구 SS-15] Denoise of Astronomical Images with Deep Learning

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Removing noise which occurs inevitably when taking image data has been a big concern. There is a way to raise signal-to-noise ratio and it is regarded as the only way, image stacking. Image stacking is averaging or just adding all pixel values of multiple pictures taken of a specific area. Its performance and reliability are unquestioned, but its weaknesses are also evident. Object with fast proper motion can be vanished, and most of all, it takes too long time. So if we can handle single shot image well and achieve similar performance, we can overcome those weaknesses.

Recent developments in deep learning have enabled things that were not possible with former algorithm-based programming. One of the things is generating data with more information from data with less information. As a part of that, we reproduced stacked image from single shot image using a kind of deep learning, conditional generative adversarial network (cGAN). r-band camcol2 south data were used from SDSS Stripe 82 data. From all fields, image data which is stacked with only 22 individual images and, as a pair of stacked image, single pass data which were included in all stacked image were used. All used fields are cut in 128x128 pixel size, so total number of image is 17930. 14234 pairs of all images were used for training cGAN and 3696 pairs were used for verify the result.

As a result, RMS error of pixel values between generated data from the best condition and target data were 7.67×10^{-4} compared to original input data, 1.24×10^{-3}. We also applied to a few test galaxy images and generated images were similar to stacked images qualitatively compared to other de-noising methods. In addition, with photometry, The number count of stacked-cGAN matched sources is larger than that of single pass-stacked one, especially for fainter objects. Also, magnitude completeness became better in fainter objects. With this work, it is possible to observe reliably 1