태양 / 태양계

[포 SS-01] Sausage Waves in a Plasma Cylinder with a Surface Current

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Linear sausage oscillations of a cylinder embedded in a plasma with an azimuthal magnetic field, created by a current on the surface of the cylinder, are studied. Such a plasma configuration could be applied to modelling demonstrate that the lowest radial harmonic of the sausage mode is in the trapped regime for all values of the parallel wave number. In the long-wavelength limit, phase and group speeds of this mode are equal to the Alfven speed in the external medium. It makes the oscillation period to be determined by the ratio of the parallel wavelength, e.g., double the length of an oscillating loop, to the external Alfven speed, allowing for its seismological estimations. The application of the results obtained to the interpretation of long-period (longer than 20-30 s) oscillations of emission intensity detected in solar coronal structure, gives reasonable estimations of the external Alfven speed. Cutoff values of the parallel wavenumber for higher radial harmonics are determined analytically. Implications of this finding to the observational signatures of fast magnetoacoustic wave trains guided by the plasma non-uniformity are discussed.

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[포 SS-02] Application of Deep Learning to Solar Data: 3. Generation of Solar images from Galileo sunspot drawings

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We develop an image-to-image translation model, which is a popular deep learning method based on conditional Generative Adversarial Networks (cGANs), to generate solar magnetograms and EUV images from sunspot drawings. For this, we train the model using pairs of sunspot drawings from Mount Wilson Observatory (MWO) and their corresponding SDO/HMI magnetograms and SDO/AIA EUV images (512 by 512) from January 2012 to September 2014. We test the model by comparing pairs of actual SDO images (magnetogram and EUV images) and the corresponding AI-generated ones from October to December in 2014. Our results show that bipolar structures and coronal loop structures of AI-generated images are consistent with those of the original ones. We find that their unsigned magnetic fluxes well correlate with those of the original ones with a good correlation coefficient of 0.86. We also obtain pixel-to-pixel correlations EUV images and AI-generated ones. The average correlations of 92 test samples for several SDO lines are very good: 0.88 for AIA 211, 0.87 for AIA 1600 and 0.93 for AIA 1700. These facts imply that AI-generated EUV images quite similar to AIA ones. Applying this model to the Galileo sunspot drawings in 1612, we generate HMI-like magnetograms and AIA-like EUV images of the sunspots. This application will be used to generate solar images using historical sunspot drawings.

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[포 SS-03] Application of Deep Learning to Solar Data: 2. Generation of Solar UV & EUV images from magnetograms

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In this study, we apply conditional Generative Adversarial Network, which is one of the deep learning method, to the image-to-image translation from solar magentograms to solar UV and EUV images. For this, we train a model using pairs of SDO/AIA 9 wavelength UV and EUV images and their corresponding SDO/HMI line-of-sight magnetograms from 2011 to 2017 except August and September each year. We evaluate the model by comparing pairs of SDO/AIA images and corresponding generated ones in August and September. Our results from this study are as follows. First, we successfully generate SDO/AIA like solar UV and EUV images from SDO/HMI magnetograms. Second, our model has pixel-to-pixel correlation coefficients (CC) higher than 0.8 except 171. Third, our model slightly underestimates the pixel values in the view of