**Application of deep learning methods to solar and geophysical data**

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**Abstract**

Multi-wavelength observations become very popular in astronomy and geophysics. Even though there are some correlations among different sensor images, it is not easy to translate from one to the other one. In this paper, we apply a deep learning method for image-to-image translation, based on conditional generative adversarial networks (cGANs), to solar and geophysical images. To examine the validity of the method for scientific data, we use several different types of pairs: (1) AI-generated magnetograms from solar SDO/AIA images, (2) AI-generated EUV images from SDO/HMI solar magnetograms, (3) AI-generated magnetograms from historical sunspot drawings such as Carrington events, and (4) AI-generated IR images from visual weather images. It is very impressive that AI-generated ones are quite consistent with actual ones. We will discuss several applications of this methodology for scientific research. In addition, we apply convolution neural networks(CNNs) to solar flare forecast using many solar images such as SDO/HMI magnetograms and find that our method is more successful than the previous methods.