Detection and energy derivation of nano-flares based on deep learning

*河合 敏輝[1]、今田 晋亮[1]
*Toshiki Kawai[1], Shinsuke Imada[1]

1. 名古屋大学宇宙地球環境研究所
1. Institute for Space-Earth Environmental Research, Nagoya University

Coronal heating is one of the long-standing problems in solar physics. So far, two primary mechanisms have been proposed to explain how the corona is heated, namely small-scale magnetic reconnection and wave dissipation. To estimate the contribution of small-scale magnetic reconnection, so called nano-flares, to heat the corona is crucial to solve the coronal heating problem. The purpose of this study is to develop a method which can accurately detect nano-flares and estimate their energies. Firstly, we carry out one-dimensional hydrodynamic simulations of coronal loops heated by nano-flares which have wide range of energy ($10^{23} < E < 10^{27}$ erg). Secondly, we calculate the temporal variation of EUV and soft X-ray spectra of coronal loops from the simulation results by using CHIANTI atomic database. We perform these procedures more than 1,000 times with randomized flare energy and occurrence time to produce various datasets. Finally, we train a Deep Neural Network (DNN) by using these datasets to estimate the energy distribution and occurrence times of flares from soft X-ray observation. Moreover, we apply trained DNN to actual soft X-ray observations. As a result, we obtain reasonable occurrence times and energies of flares comparing another method which regards flare energy as change amount of thermal energy of the loop.

キーワード：深層学習、ナノフレア
Keywords: deep learning, nano-flare

