We introduce a novel method for reconstructing the projected matter distributions of galaxy clusters with weak-lensing (WL) data based on convolutional neural network (CNN). We control the noise level of the galaxy shear catalog such that it mimics the typical properties of the existing Subaru/Suprime-Cam WL observations of galaxy clusters. We find that our mass reconstruction based on multi-layered CNN with architectures of alternating convolution and trans-convolution filters significantly outperforms the traditional mass reconstruction methods.

[구 ML-03] Reconstructing the cosmic density field based on the generative adversarial network.

Feng Shi
Korea Astronomy and Space Science Institute

In this topic, I will introduce a recent work on reconstructing the cosmic density field based on the GAN. I will show the performance of the GAN compared to the traditional Unet architecture. I’d also like to discuss a 3-channels-based 2D datasets for the training to recover the 3D density field. Finally, I will present some performance tests based on the test datasets.

[구 ML-04] From dark matter to baryons in a simulated universe via machine learning

Yongseok Jo
Seoul National University

The dark matter (DM) only simulations have been exploited to study e.g. the large scale structures and properties of a halo. In a baryon side, the high-resolution hydrodynamic simulation such as IllustrisTNG has helped extend the physics of gas along with stars and DM. However, the expansive computational cost of hydrodynamic simulations limits the size of a simulated universe whereas DM-only simulations can generate the universe of the cosmological horizon size approximately.

I will introduce a pipeline to estimate baryonic properties of a galaxy inside a dark matter (DM) halo in DM-only simulations using a machine trained on high-resolution hydrodynamic simulations. An extremely randomized tree (ERT) algorithm is used together with multiple novel improvements such as a refined error function in machine training and two-stage learning. By applying our machine to the DM-only simulation of a large volume, I then validate the pipeline that rapidly generates a galaxy catalog from a DM halo catalog using the correlations the machine found in hydrodynamic simulations. I will discuss the benefits that machine-based approaches like this entail, as well as suggestions to raise the scientific potential of such approaches.