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Domain adaption between SKA radio mocks and cosmological simulations

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In this work, we investigate state-of-the-art deep-learning techniques for domain transfer applied to astrophysical images of simulated galaxies. Our main objective is to infer astrophysical properties, including galactic dark matter distribution, from observational data, such as radio interferometry from the upcoming Square-Kilometer Array (SKA) Observatory.

To achieve this, we leverage large-scale cosmological hydrodynamics simulations, like the IllustrisTNG suite which generates thousands of galaxy models comprising gas, stars, and dark matter based on first principles. We compile and project these simulations into a multi-class image dataset, which serves as training data for various machine learning models.

Generative models, such as conditional GANs, denoising diffusion, and flow-based models, have demonstrated successful learning of high-level features in natural images. However, their effectiveness when trained on astrophysical data with a significantly larger dynamic range remains largely untested.

Here, we report on our ongoing efforts to train and evaluate these deep learning models. Our findings will contribute to a better understanding of their performance in the context of domain transfer, the inference of astrophysical galaxy properties, and, ultimately, of the formation and evolution of galaxies.

Brainstorming idea [title]

Generative models for various types types of astronomical observations

Brainstorming idea [abstract]

We are testing conditional GANs and denoising diffusion models for domain transfer of astronomical images and 2D projections from hydrodynamical simulations. However, since we synthesize our training data from hydrodynamical simulations, which essentially are point-cloud data snapshots, there might be an opportunity to draw information from additional dimension(s).

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