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Accelerating reionization simulations using machine learning

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Semi-numerical simulations are the leading candidates for evolving reionization on cosmological scales. These semi-numerical models are efficient in generating large-scale maps of the 21cm signal, but they are too slow to enable inference at the field level. We present different strategies to train machine learning models to accelerate these simulations. We derive the ionization field directly from the initial density field without using the ionizing sources' location, and hence emulating the radiative transfer process. We find that the Unet model achieves higher accuracy in reconstructing the ionization field if the input includes either white noise or a noisy version of the ionization map beside the density field during training. Our model reconstructs the power spectrum over all scales perfectly well. This work represents a step towards generating large-scale ionization maps with a minimal cost and hence enabling rapid parameter inference at the field level

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