

The Third National Workshop on the SKA Project - The Italian Route to the SKAO Revolution



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Optimal compression of the cosmological 21cm signal

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With the Square Kilometre Array (SKA), through the cosmic 21cm signal, we will soon have images of the first billion years of our Universe. Inferring the (unknown) UV and X-ray properties of the first galaxies from the highly non-Gaussian patterns of such images is a challenging problem where there is no obvious choice of a summary statistic (image compression). For this purpose, neural networks (NN) have proven as a viable and important tool, as they adaptively select a summary that maximizes their ability to recover astrophysical and cosmological parameters. Here, besides convolutional NNs, we introduce the recursive NN architectures, which can optimally take advantage of the correlation in the cosmic signal between neighboring frequency bins. Using realistic 3D mock data, including SKA noise as well as foreground dominated wedge excision, we demonstrate that constructed networks outperform other commonly used architectures, enabling precise parameter recovery even in the presence of strong foregrounds. Moreover, we use NNs to optimally compress the cosmological 21cm signal and find a summary which maximizes extracted information. Using likelihood free inference, we are able to recover Bayesian posterior of the astrophysical properties encoded in the signal.

Research area

Epoch of Reionization

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