
21cmVAE

Release 2.0.0

Christian H. Bye

Nov 13, 2021

CONTENTS:

1	Very Accurate Emulator	3
1.1	Set-up	3
2	Indices and tables	5

VERY ACCURATE EMULATOR

Very Accurate Emulator (21cmVAE) is an emulator of the 21-cm global signal. Given an input of seven astrophysical parameters, it directly computes realizations of the global signal across redshifts 5-50. The emulator is described in detail in [Bye et. al, 2021](#).

21cmVAE emulates global signals with an average error of 0.34% of the signal amplitude (equivalently 0.54 mK) with a run time of 40 ms on average. It is trained on ~30,000 cases, the same training set as the other existing emulators [21cmGEM](#) and [globalemu](#). The accuracy and speed makes 21cmVAE a possible tool for parameter fitting, using sampling techniques like MCMC. Moreover, the variational autoencoder approach creates an interpretable latent space that allows us to determine the relative importance of the model parameters on the global 21-cm signal.

21cmVAE is free to use on the MIT open source license. We provide here our best pretrained model, as well as code to modify and train new models. We also provide the code used for the hyperparameter tuner and code to run and train the direct emulator. We refer to the sample notebooks for an introduction on how to run and test the pretrained model, as well as how to train new models.

Questions and comments are welcome; please e-mail me at chbye@berkeley.edu. If you use this work for academic purposes, please cite [Bye et. al, 2021](#) and link to this repository.

1.1 Set-up

Dependencies: Python 3, Tensorflow 2, h5py, numpy. Recommended: Matplotlib (required for the sample notebooks).

The simplest way to install 21cmVAE with all dependencies is with pip:

```
python -m pip install 21cmVAE
```

Alternatively, you may clone the Git repository:

```
git clone https://github.com/christianhbye/21cmVAE.git
python setup.py --install
```

Finally, download the dataset used from <http://doi.org/10.5281/zenodo.5084114>, and move the file to the 21cmVAE folder. This is necessary for all uses of the emulator, as the dataset is used in the prediction algorithm.

INDICES AND TABLES

- `genindex`
- `modindex`
- `search`