DeepClean: Software Injection Tests on KAGRA Data

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Introduction

- Generate the white Gaussian noise background.
- Inject the single-frequency sine wave to the background for software injection tests.

We will test the performance of:

- The performance of noise subtraction via DeepClean
Injection Dataset - White Gaussian Background

We prepare the white Gaussian noise background data for strain and PEM.

Do not apply the band-pass filter on the background data.

White Gaussian Strain Amplitude: $2e^{-21}$

White Gaussian PEM Amplitude: $8e^{-8}$
Injection Dataset - Sine Wave Injection

Inject sine wave with frequency: 125 Hz.

Injection lasts for 300 seconds.

Strain Amplitude: 2e-20

PEM Amplitude: 4.9e-3 Pa

No phase shift between Strain and PEM injection.
125 Hz
Background: Strain and PEM
Sine Wave Injection: Strain and PEM
Injected Background: Strain and PEM
Strain ASD: Background and Injection
PEM ASD: Background and Injection

![Graph showing PEM ASD: Background and Injection (125 Hz)]
DeepClean Results
Dataset Properties

- GPS time to train: 1275891680 (duration: 320 seconds)
- GPS time to clean: 1275892000 (duration: 160 seconds)
- Strain channel: K1:Strain_White_Gaussian_INJ
- PEM channel: K1:PEM_White_Gaussian_INJ
- Sampling rate: 4096 Hz
- Bandpass filter:
  - filt_fl = 120
  - filt_fh = 130
- Epochs: 20
Loss function

Epoch

Loss

Iteration

Train

Test
ASD: Predicted Strain (125 Hz)
Dataset Properties

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ASD: Predicted Strain (125 Hz)
Summary

- Prepare the white Gaussian noise background channels and do not apply the band-pass filter on background data.
- Inject the 300 seconds long single-frequency sine wave to the strain and PEM channels.
- We use the training and cleaning on the different segments of the 125 Hz injection.
- We have the better results on noise subtraction via DeepClean.

Next step:

- Estimate the transfer function.
- Other types of environmental noise injection tests.