Applications of ML Technique on GW Detection

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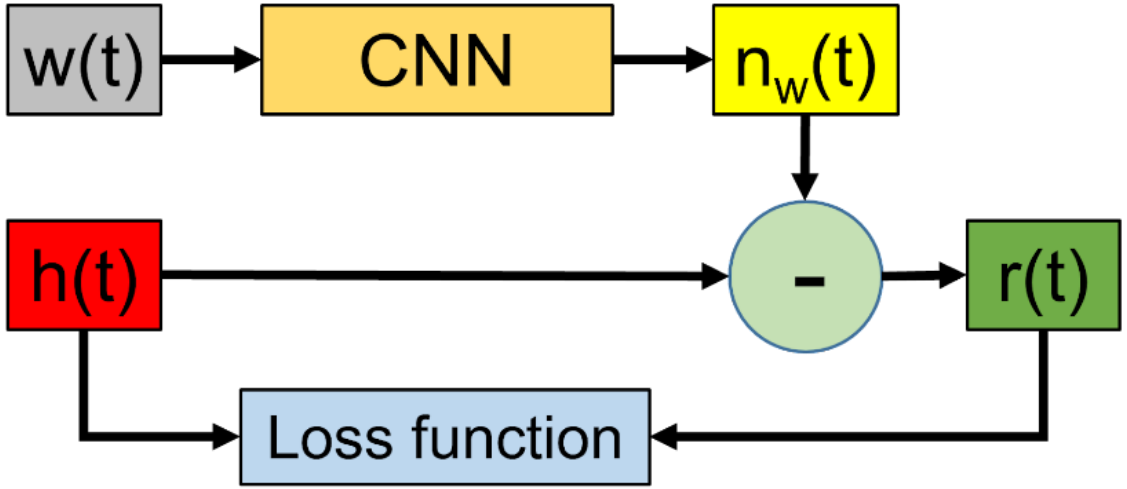
DeepClean: Noise Subtraction Using ML

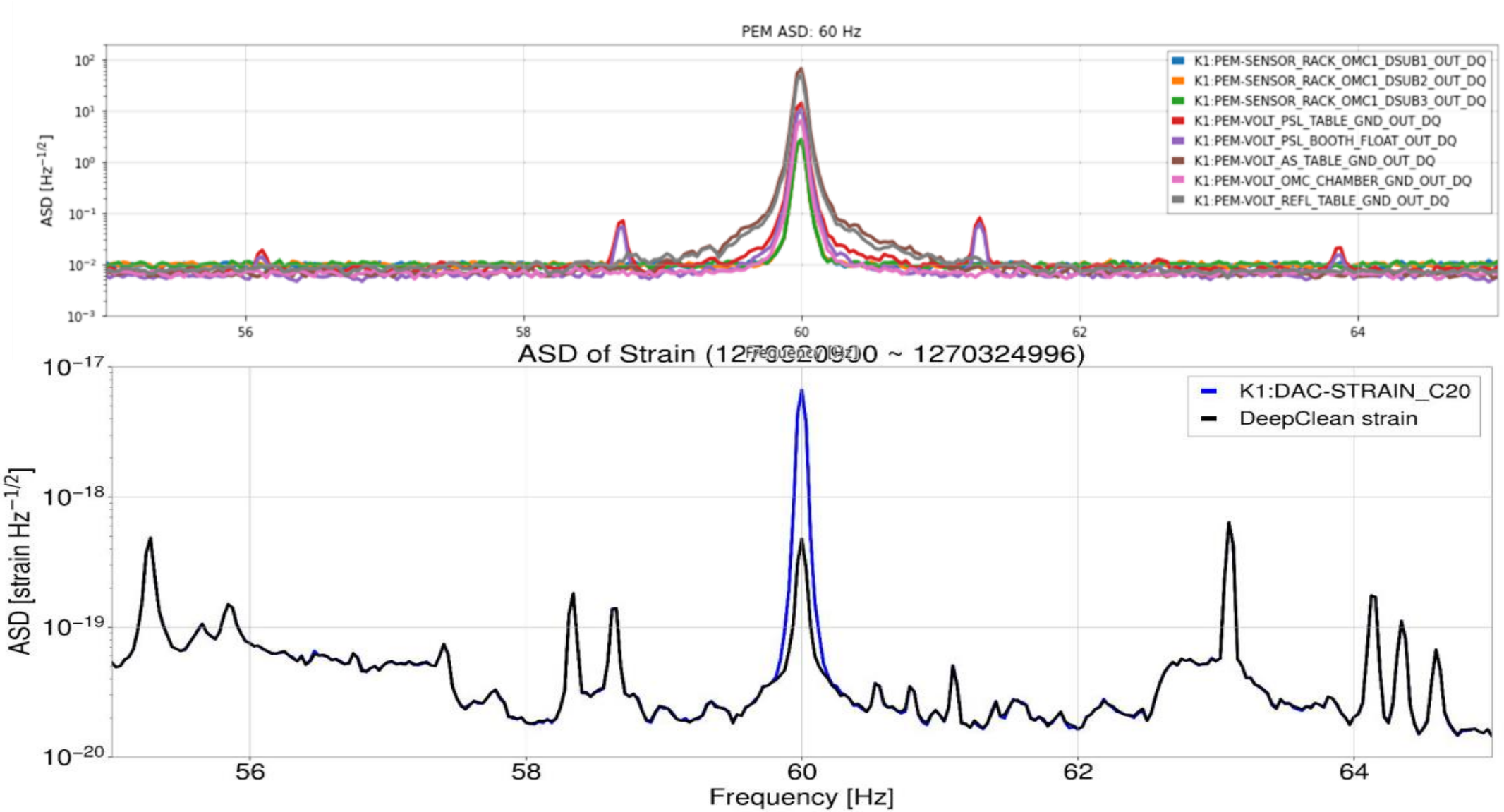
- Convolutional Neural Network (CNN) model
- Raw strain data: $h(t)$
- Witness channels: $w(t)$
- Predicted noise: $n_w(t)$
- Cleaned data:

$$r(t) = h(t) - n_w(t)$$

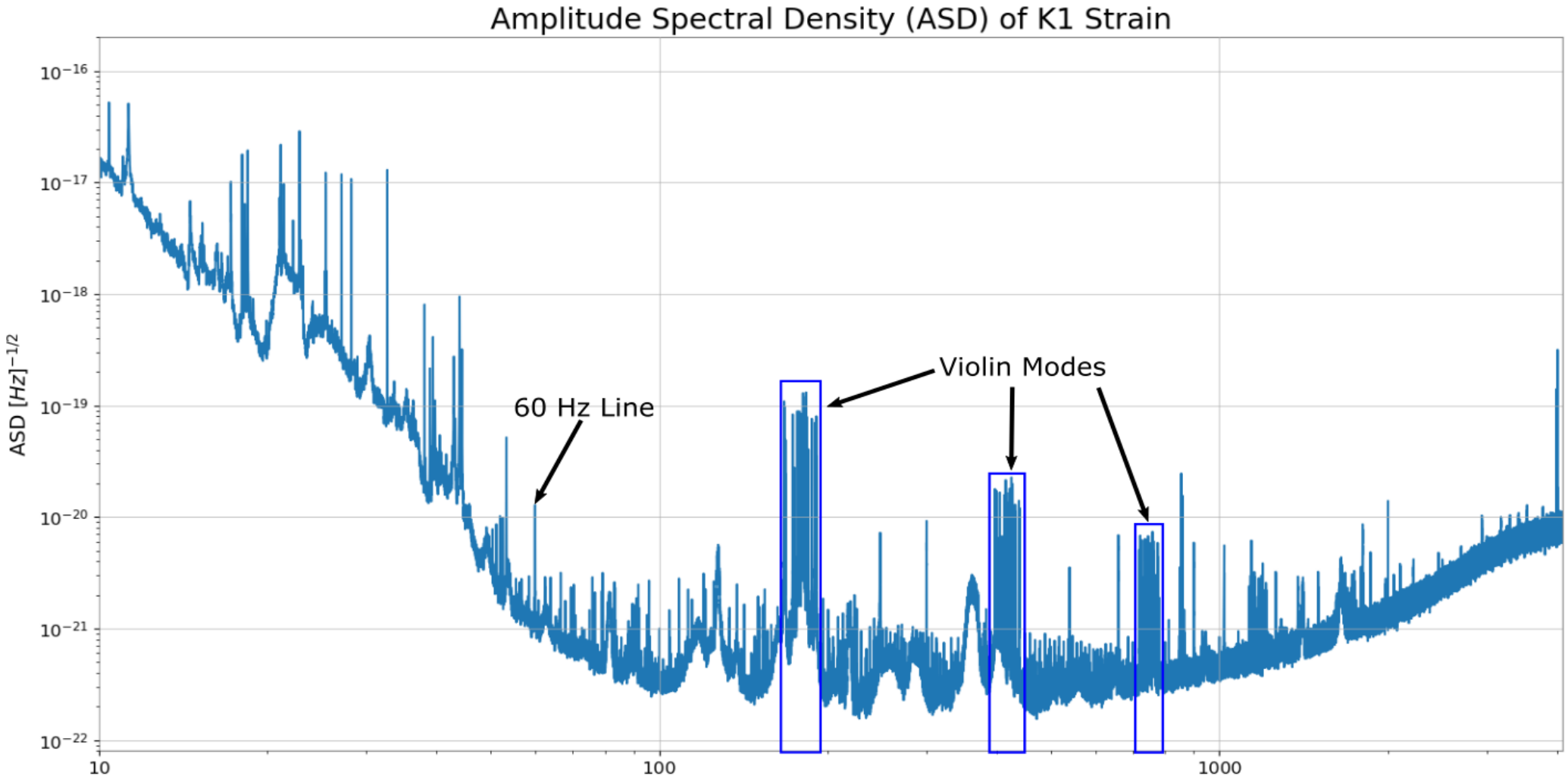


- Minimizing a loss function to reduce Signal-Noise-Ratio (SNR)

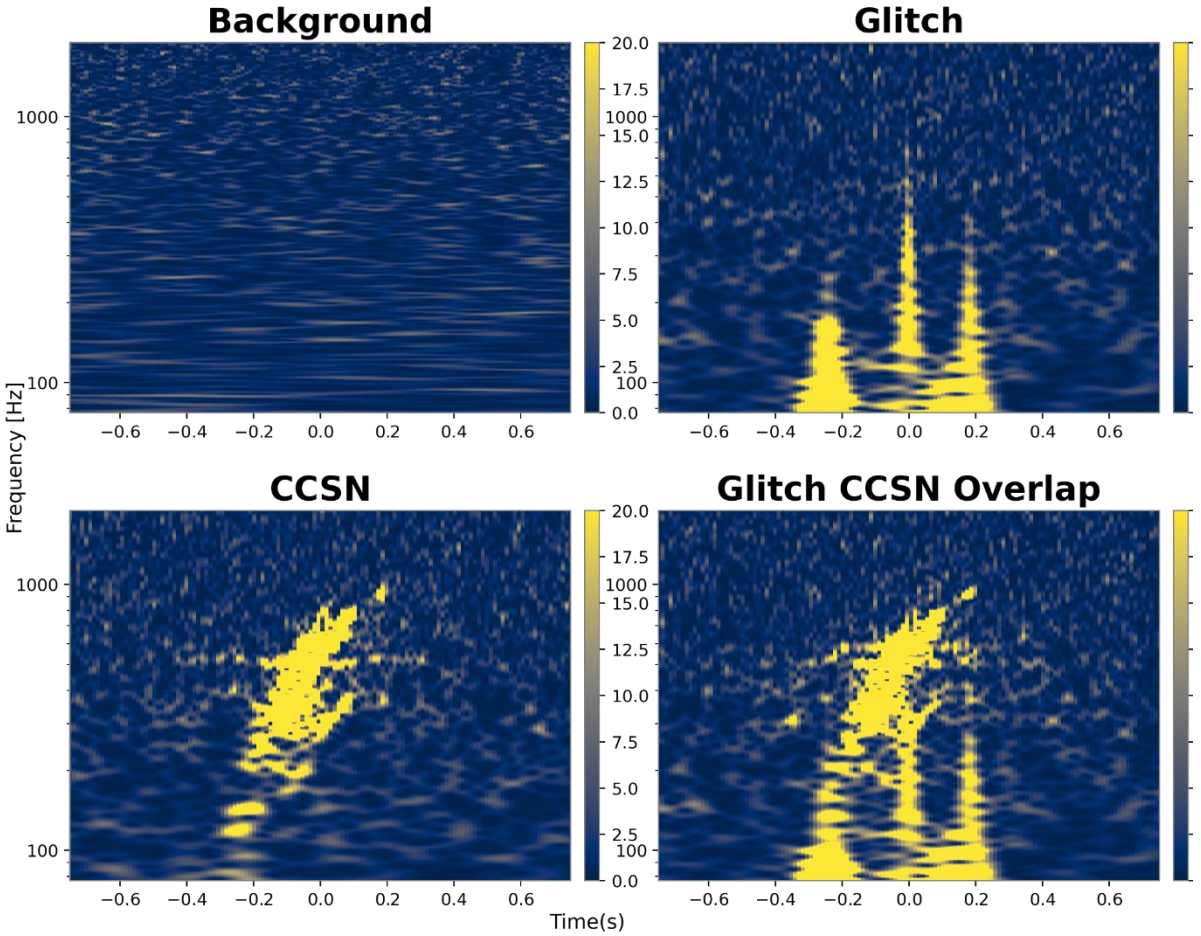
60Hz Noise Reduction by DeepClean

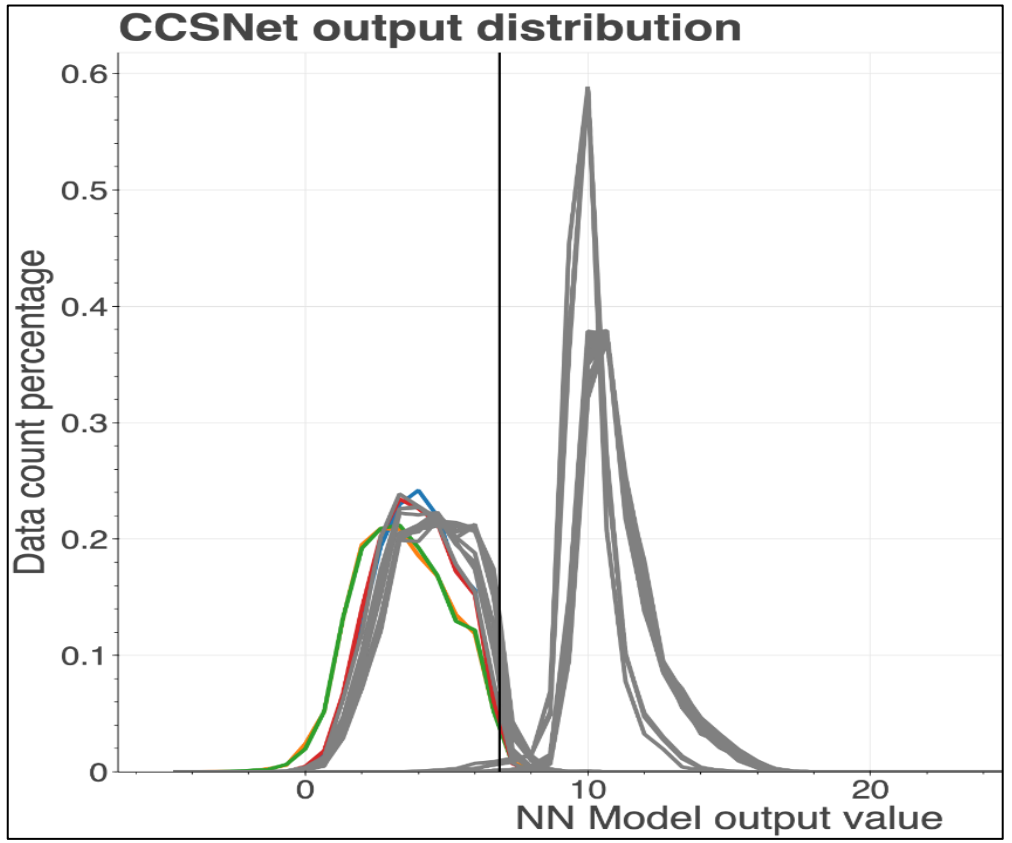


Background Noise in KAGRA



Glitches and CCSN Signals in GW Data





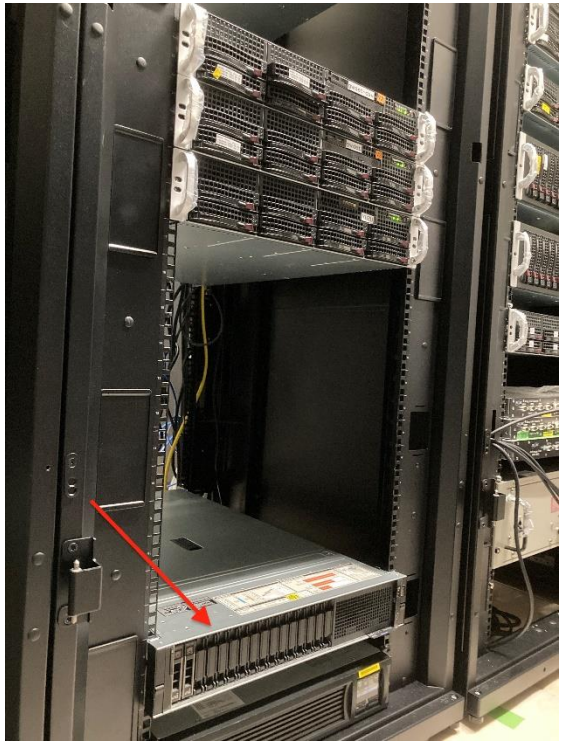
Install GPU Server in KAGRA

Date: 2023/9/28

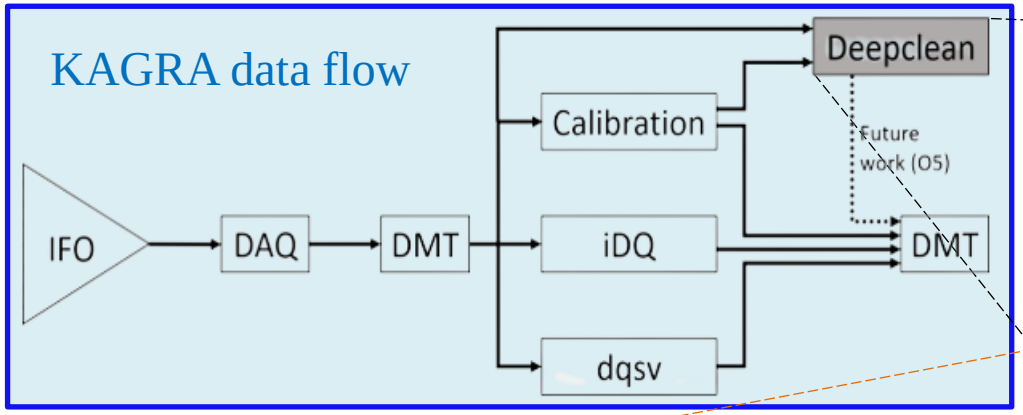
KAGRA Logbook:
https://klog.icrr.u-tokyo.ac.jp/osl/?r=26962

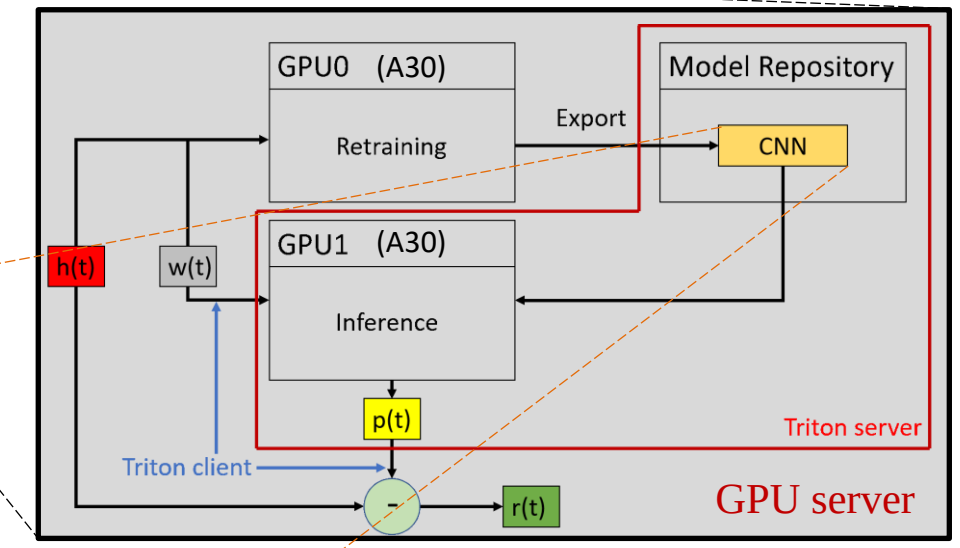
Chia-Jui Chou, Takahiro Yamamoto, Shingo Fujii

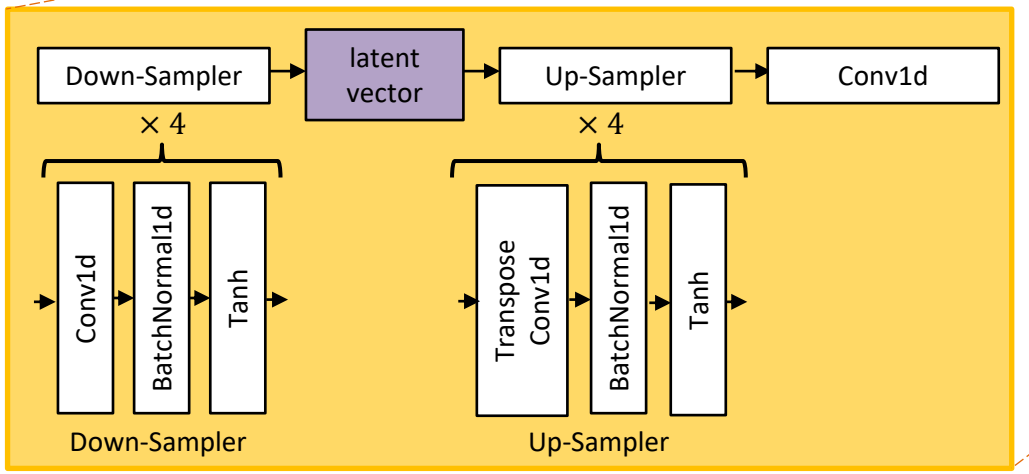
We installed a server machine from NYCU at Mozumi server room.
Server rack slots we used: DMG1 - slots 4 and 5.
It is connected to the KAGRA network via DHCP, but not yet to Kashiwa.
The cardboard box for the server is placed in the ceiling room of the analysis building.
This machine will be used for *Deep-Clean*.



GPU Server for Online DeepClean







- CPUs: Xeon Gold 6326 * 2 (16 cores 2.9 GHz)
- GPUs: Nvidia A30, 165W, 14GB * 2
- Storage: (1.2 TB HDD 2.5”) * 2 + (480GB NVME SSD) * 1
- RAM: DDR4-3200 ECC REG 32GB * 8

Purpose of the GPU Server in KAGRA

- Online DeepClean of 60Hz AC power noise for low latency GW detection
- Offline DeepClean removal of violin modes for O4a data
- Other researches using ML in the future:
  - Classification of glitches in O3GK and O4 data
  - CCSN detection
  - Low-latency sky localization

Summary

- We developed a ML model, DeepClean, to reduce certain noises in GW strain both offline and online
- Glitches classification and CCSN detection using ML
- We installed a GPU server on-site in KAGRA for DeepClean