DE LA RECHERCHE À L'INDUSTRIE

Traces denoising with Machine Learning

June 3rd, 2025

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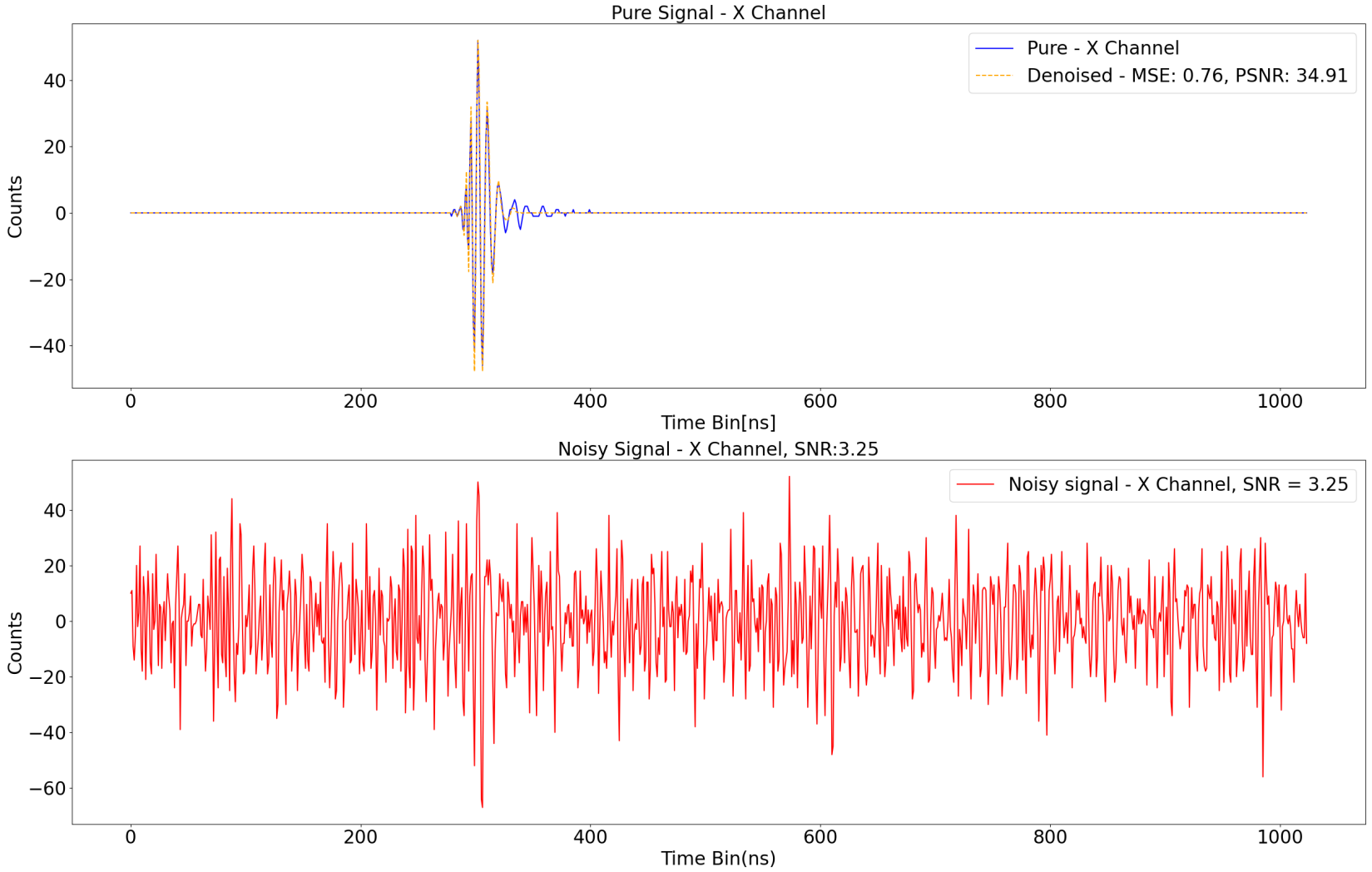
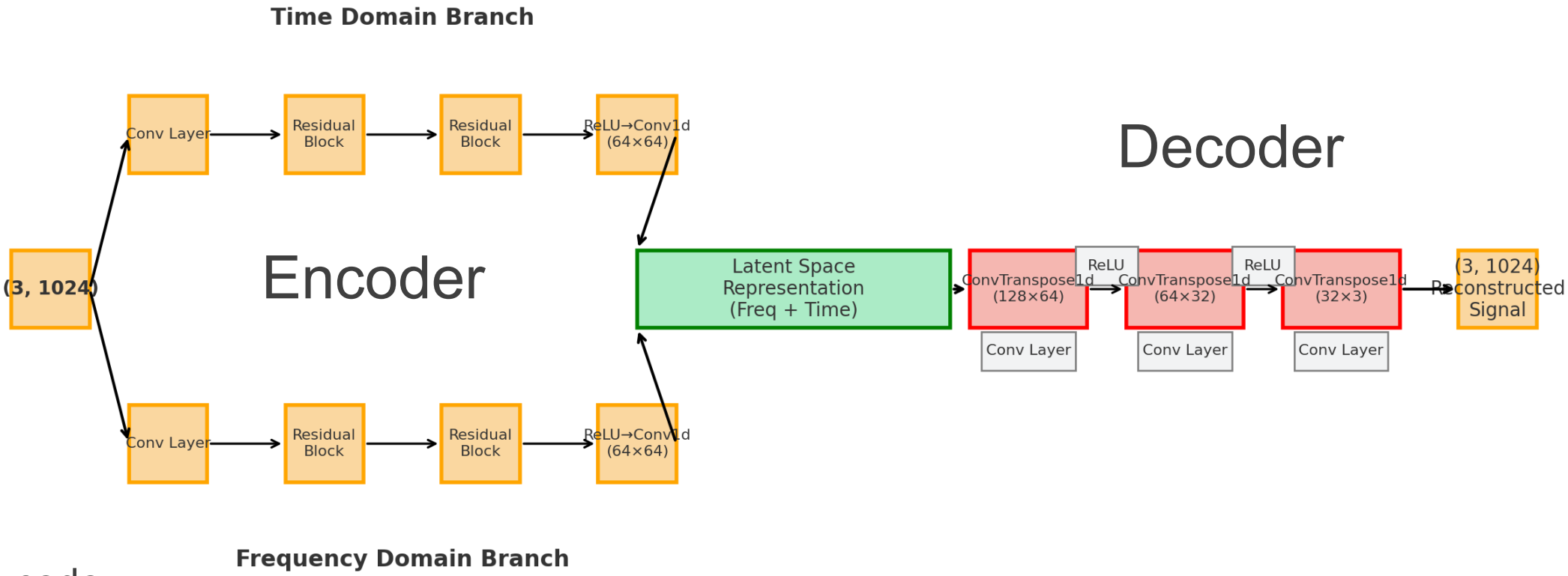
Objective: recover the signal hidden in the noise



- Architecture presented by Sam Lai, last year in Nanjing meeting

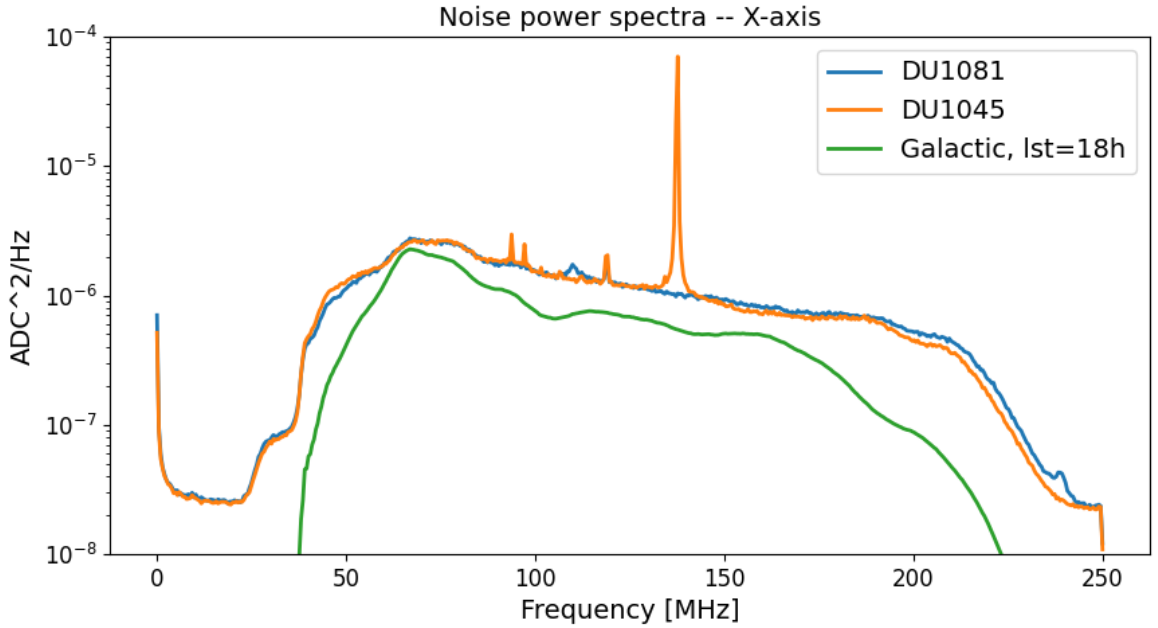


Sam's code
~64000 parameters
20ms inference time on my MacBookPro

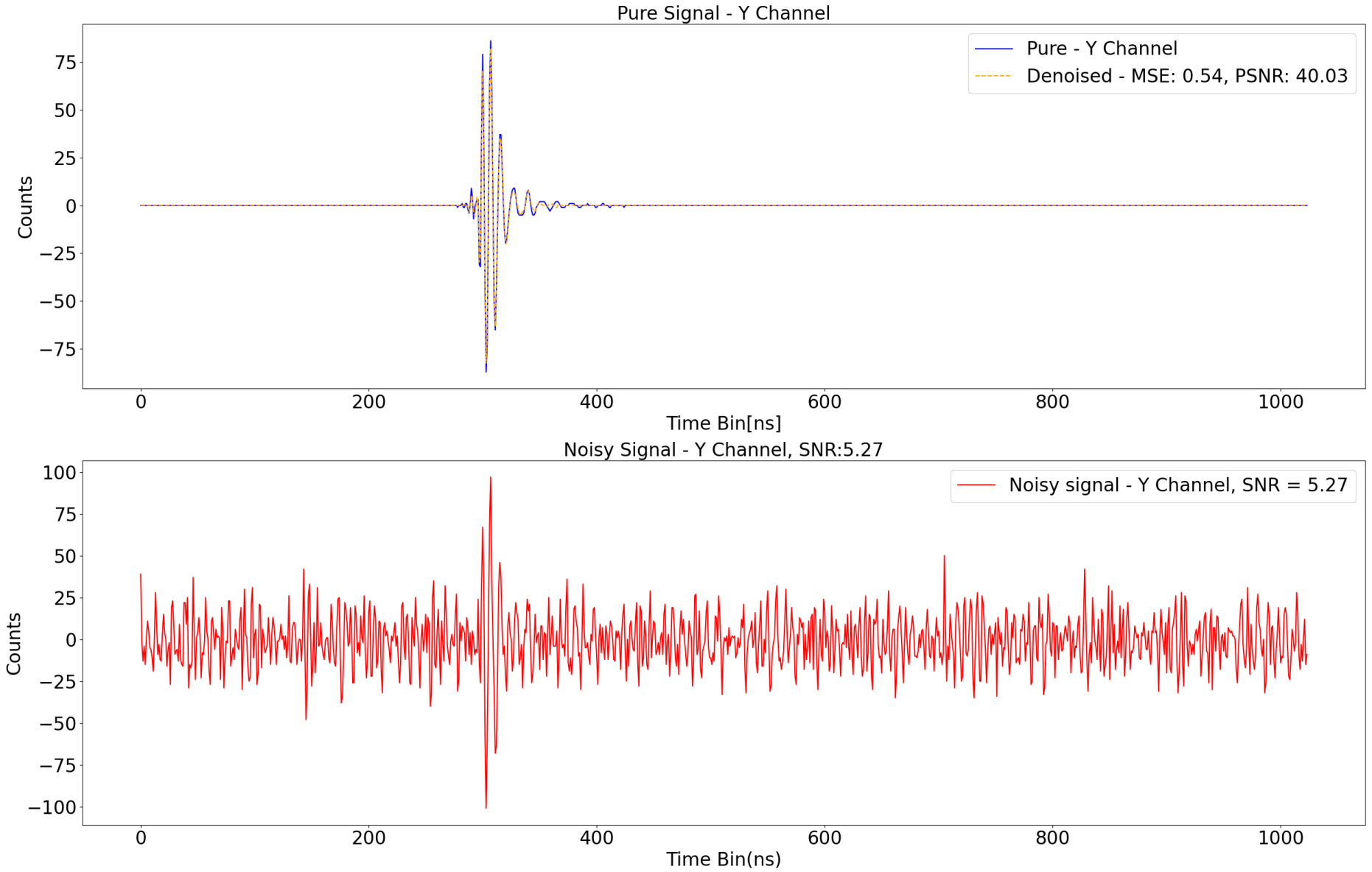
- Reprocessing of the 13k DC2 Efield to voltage using the latest L_eff maps and RF_chain with Arsène's code. In practice, only use 6000 events for training, and
- 3 different source of noise:
    - Gaussian Galactic background
    - Gaussian AN (AN = Adc Noise), from Pablo
    - AN noise traces

Model is:

- **trained** on **simulated** noise, but
- **tested** on **real** noise



A few examples: SNR > 5



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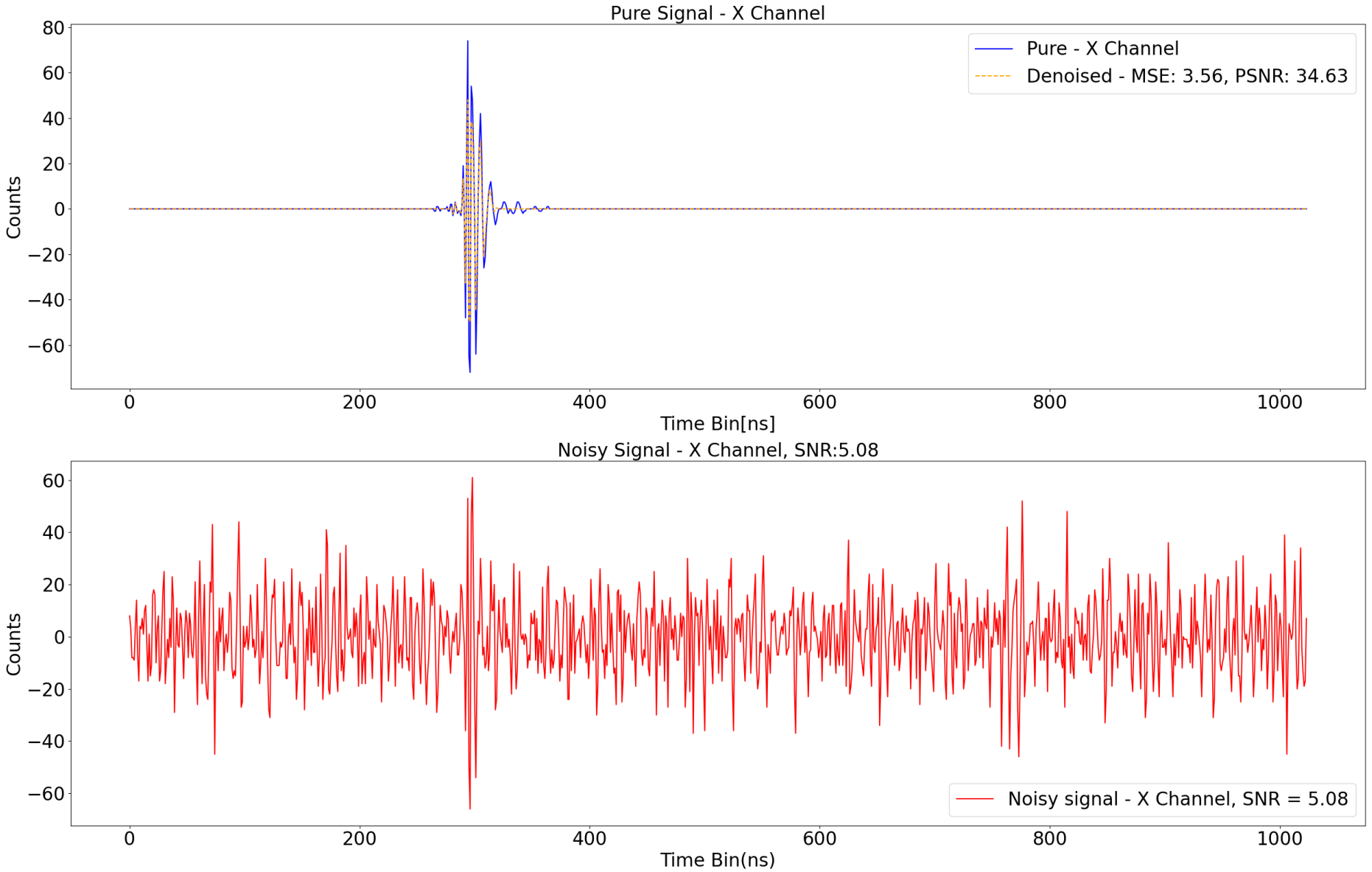
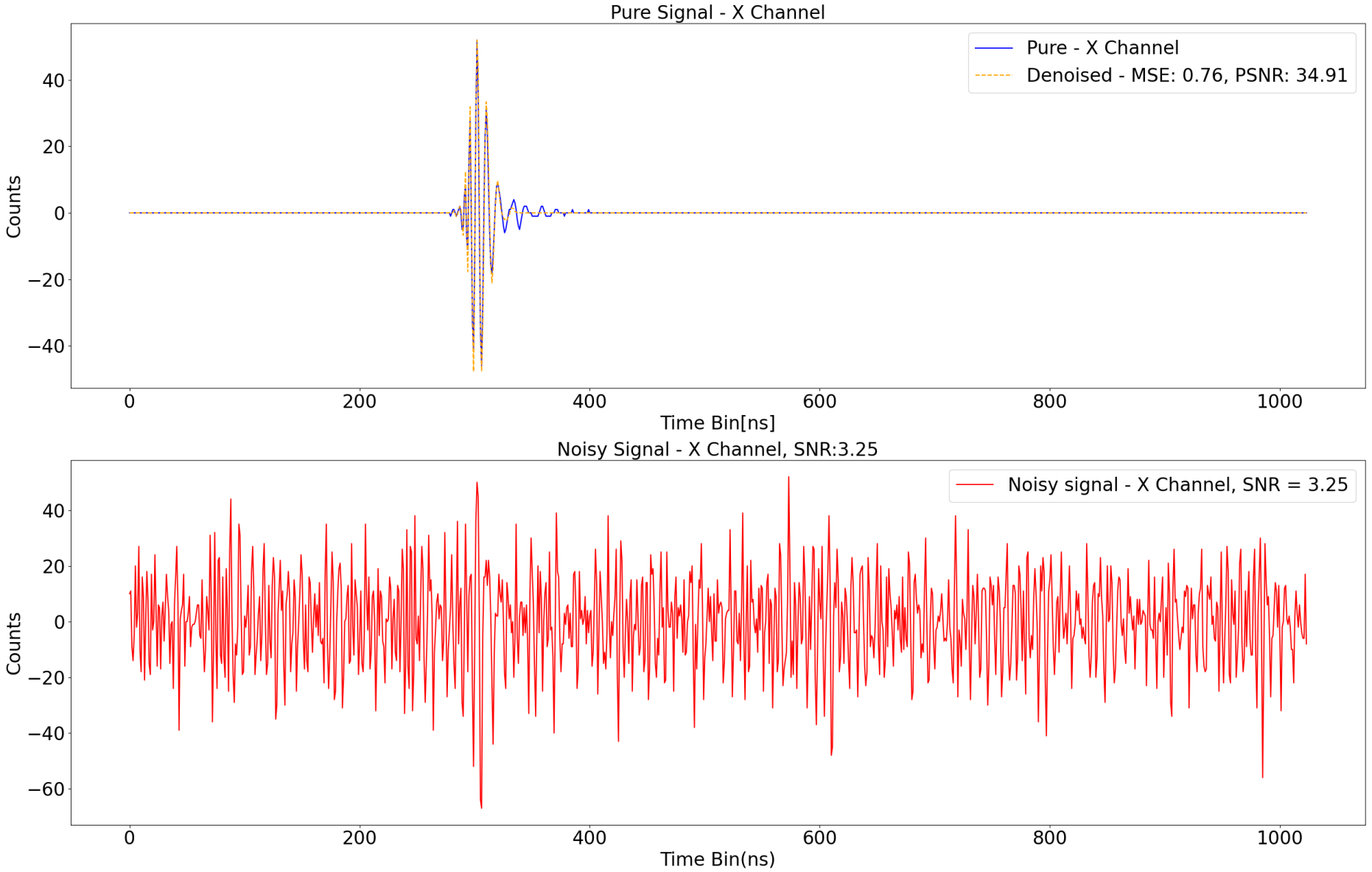


A few examples: intermediate SNR: 3 < SNR < 5



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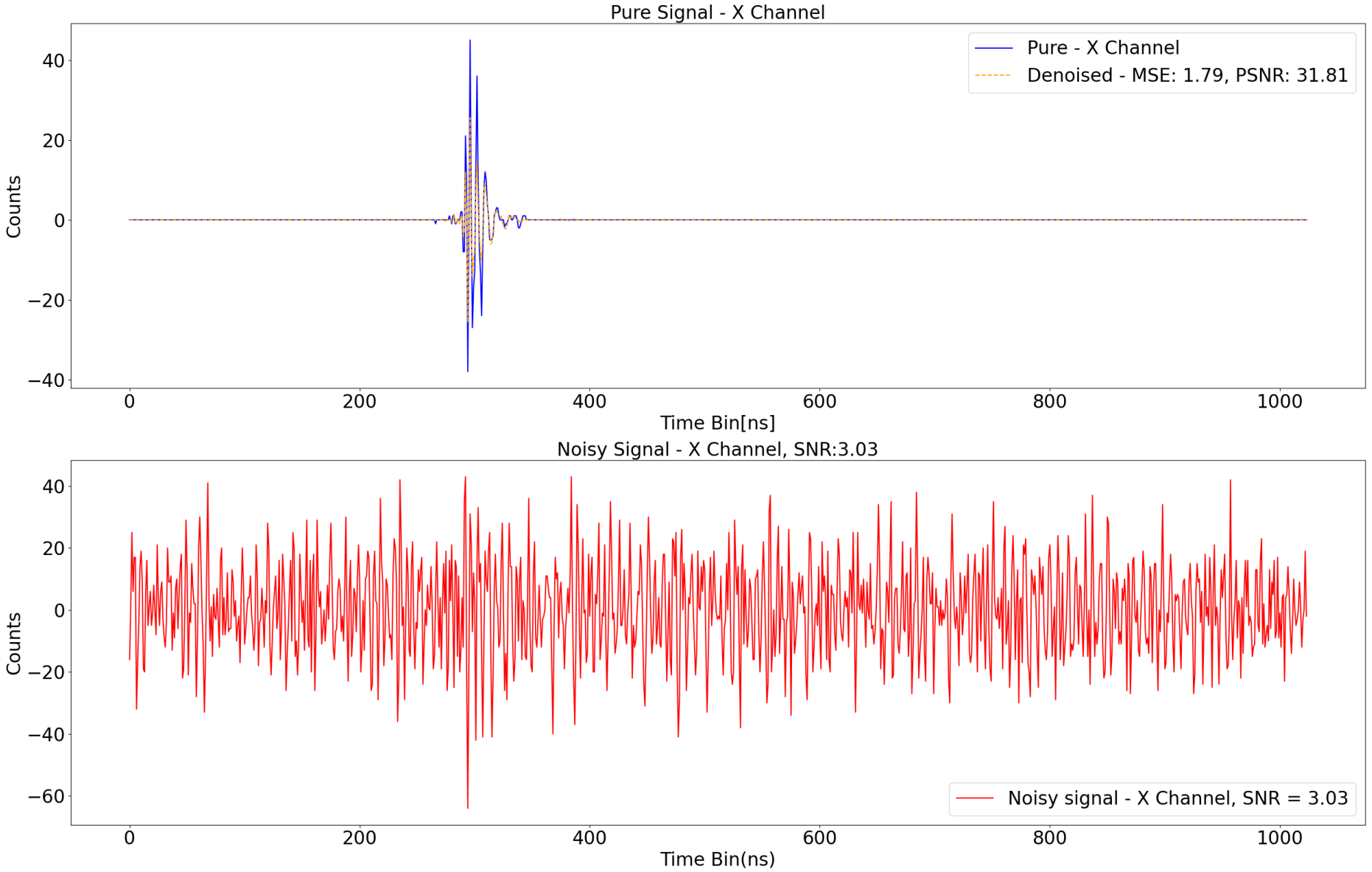
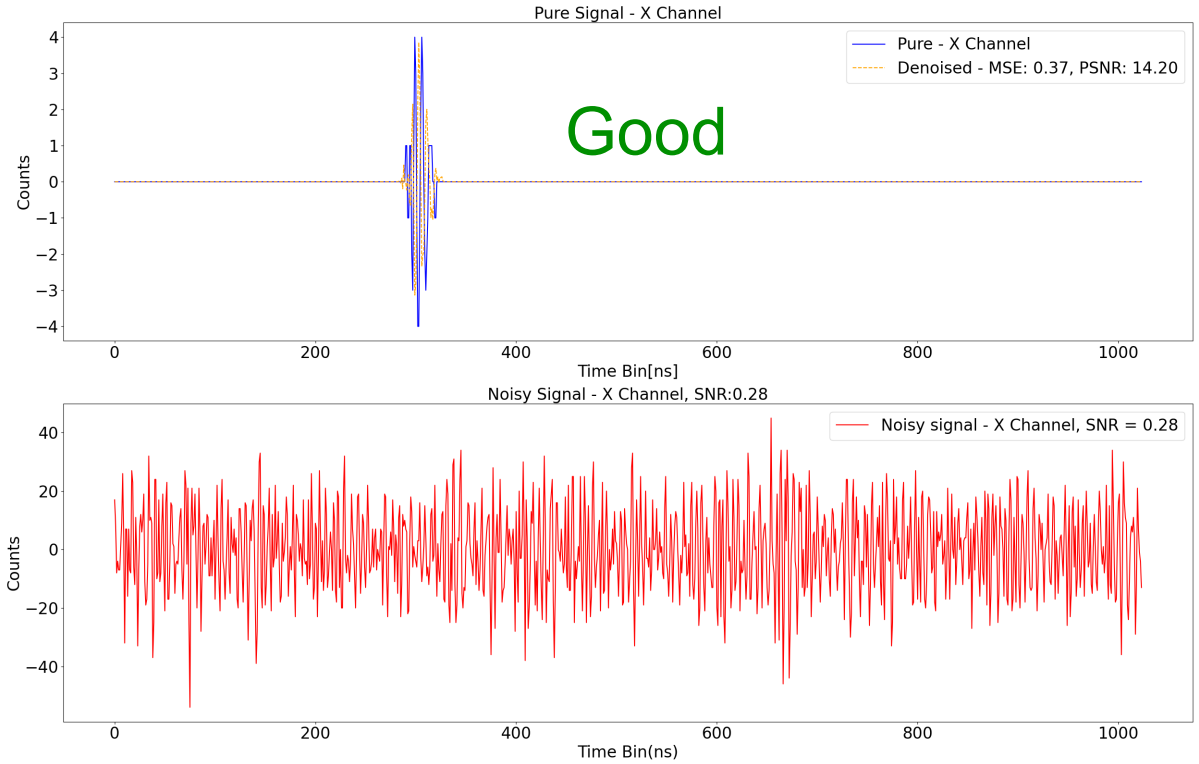
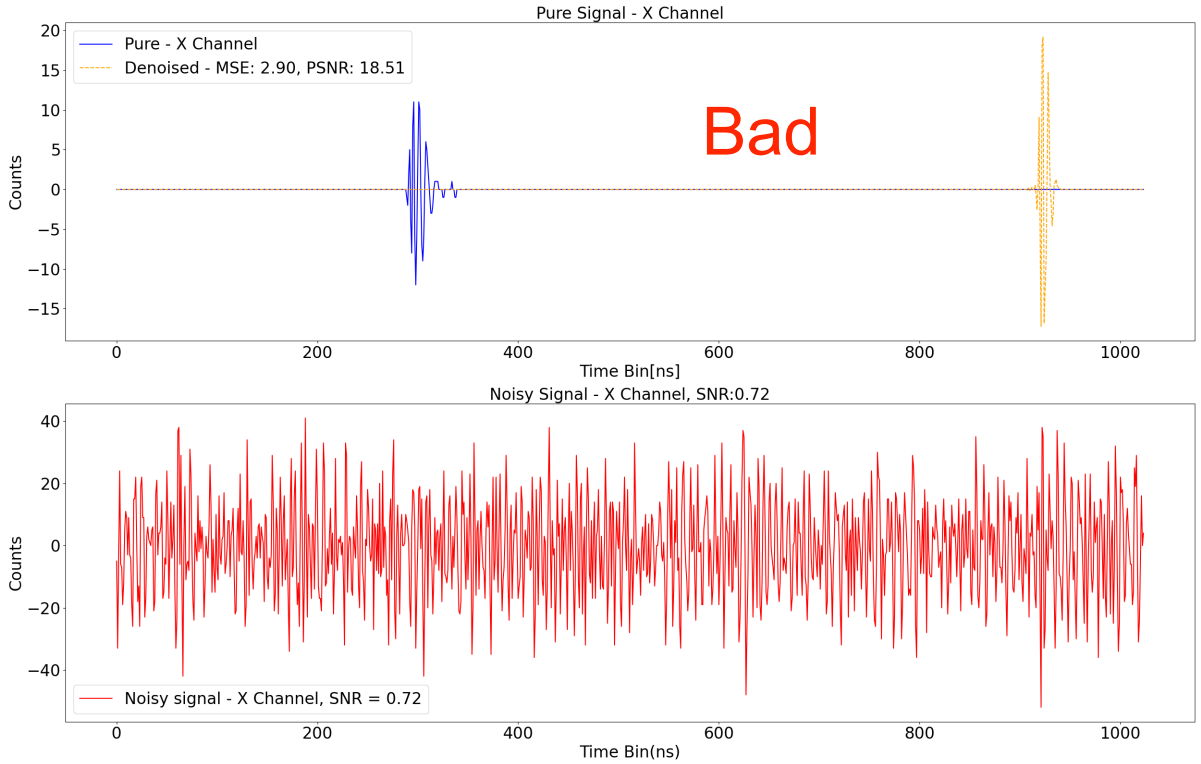
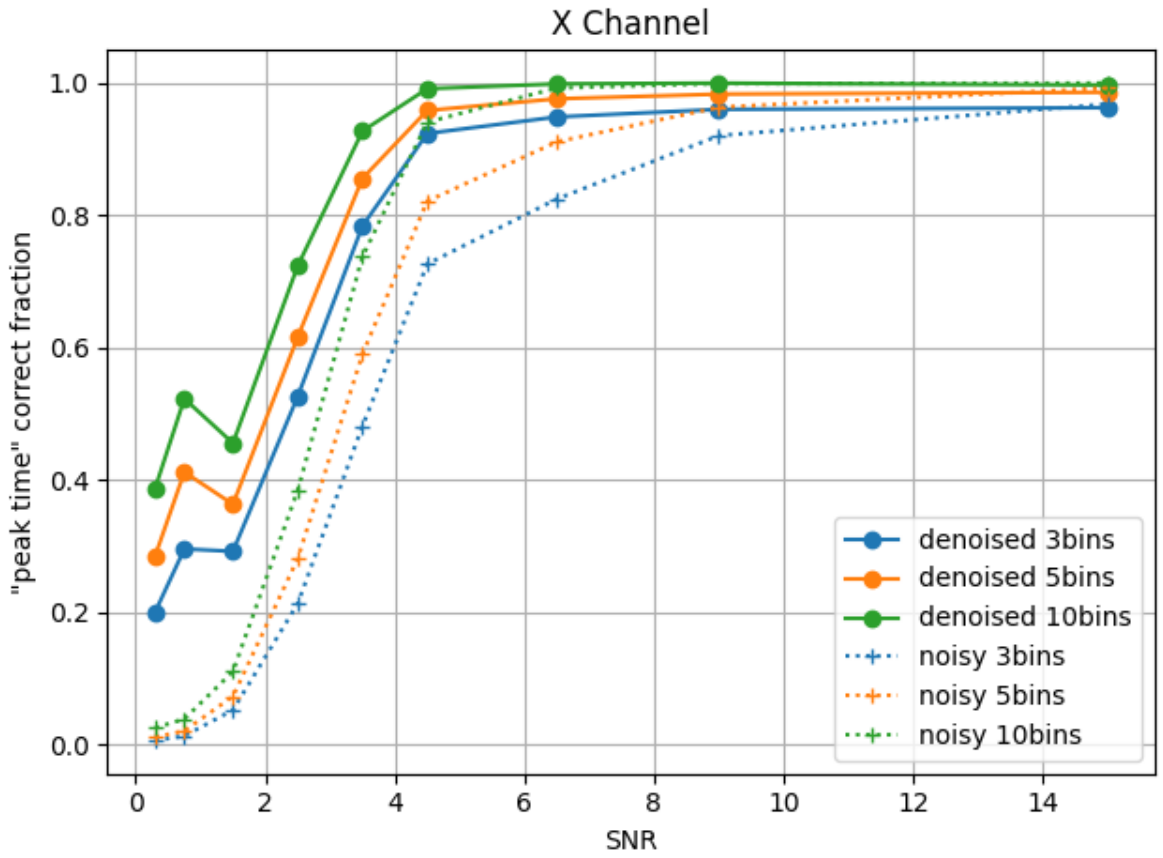


1. Correct peak time
2. Correct maximum amplitude

A trace is correctly « peak-time » denoised if the peak time is within 3/5/10 time bins of the noiseless peak time



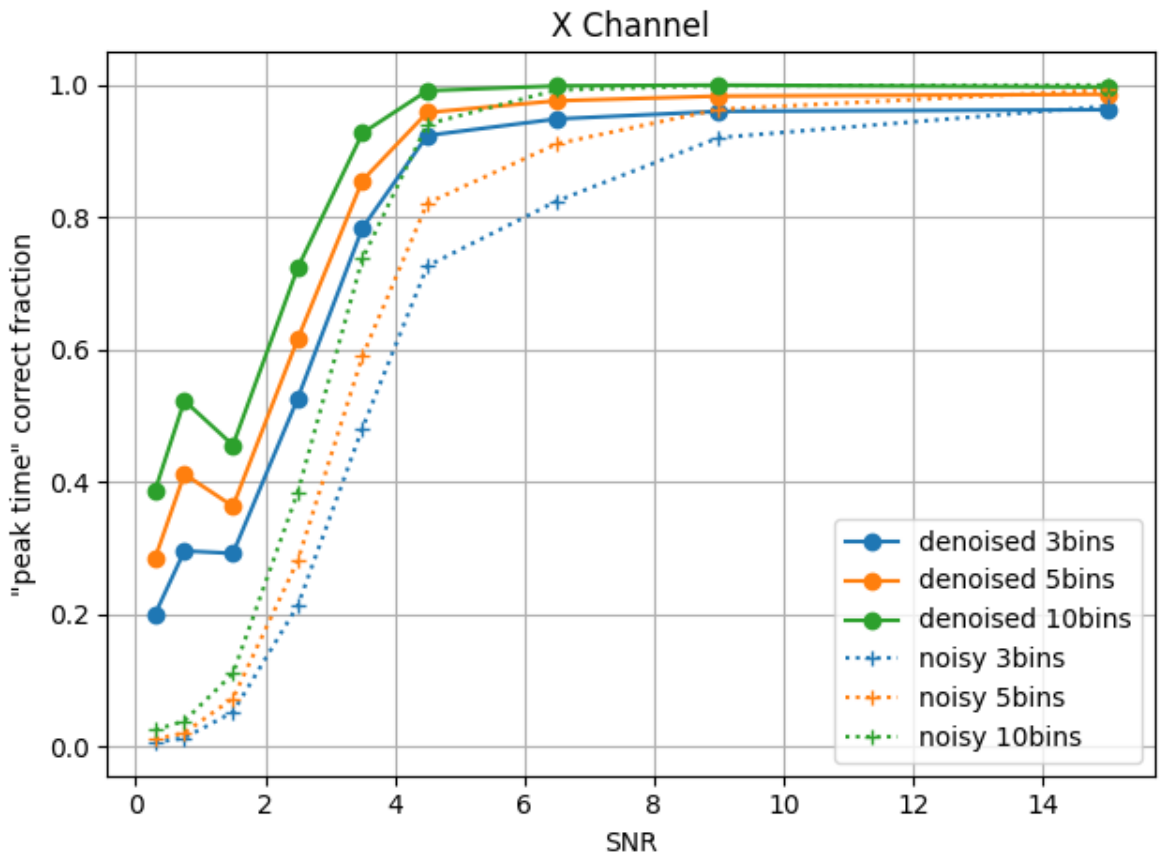


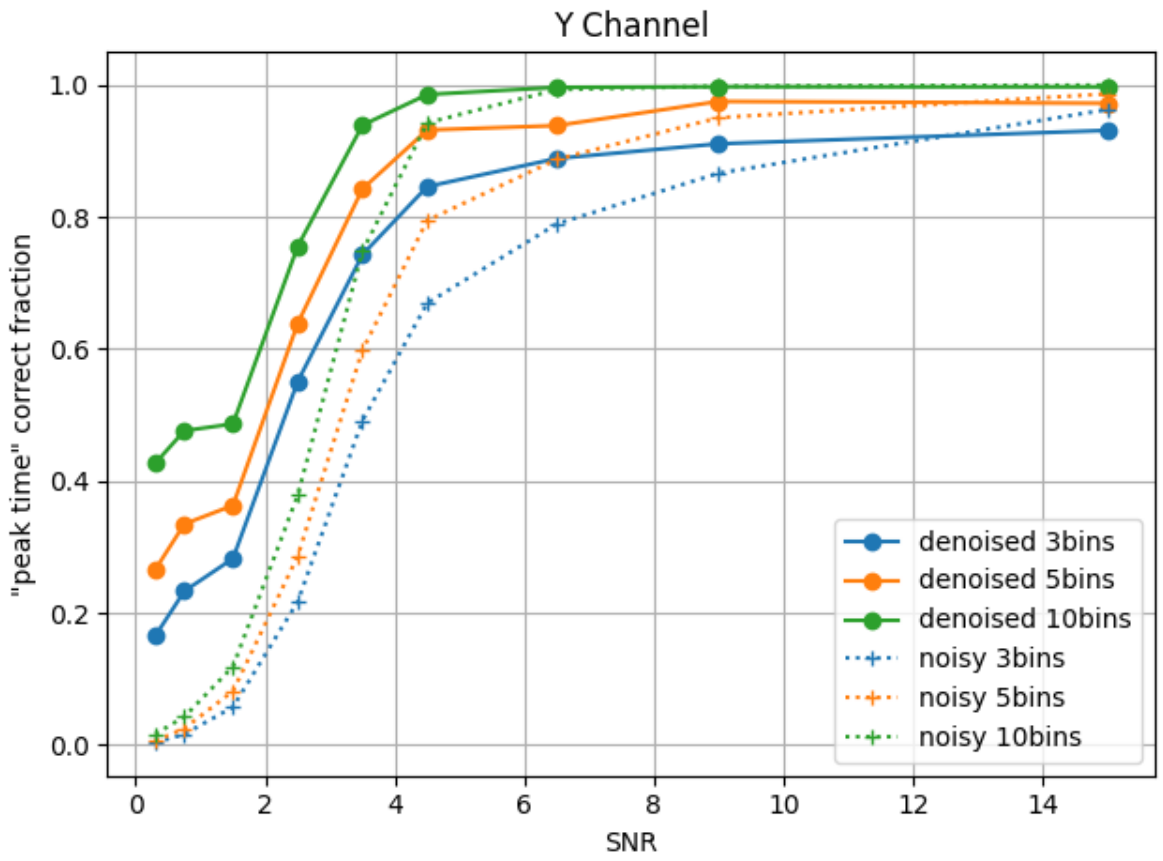


- on noisy data, even at high SNR, measured peak time can be off by a few bins
- denoising significantly alleviates this, even for SNR~3-4 traces!
- More work needed SNR<3.

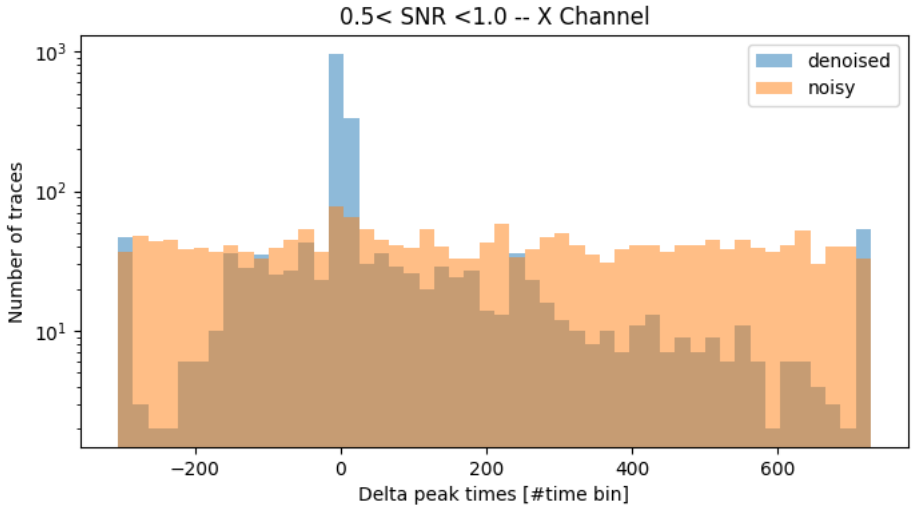
- **trained** on **simulated** Gaussian AN noise, but
- **tested** on **real** AN noise

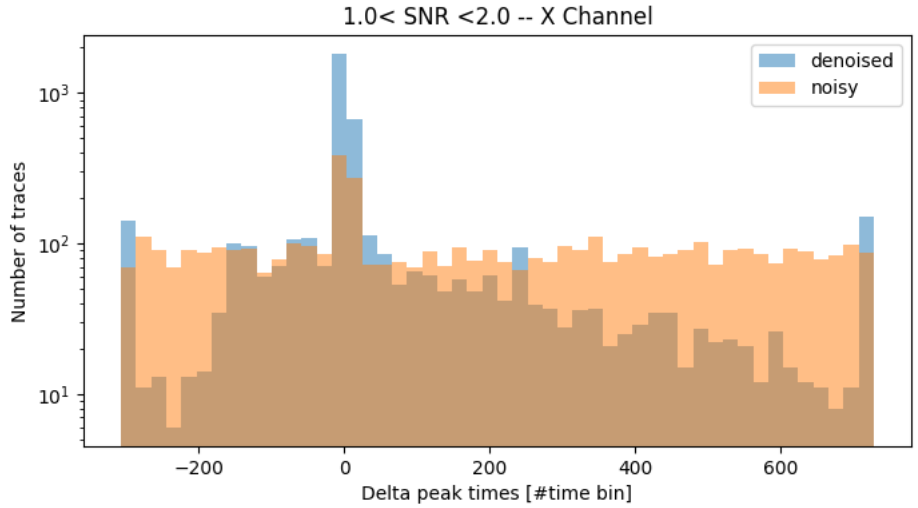
Summary plot

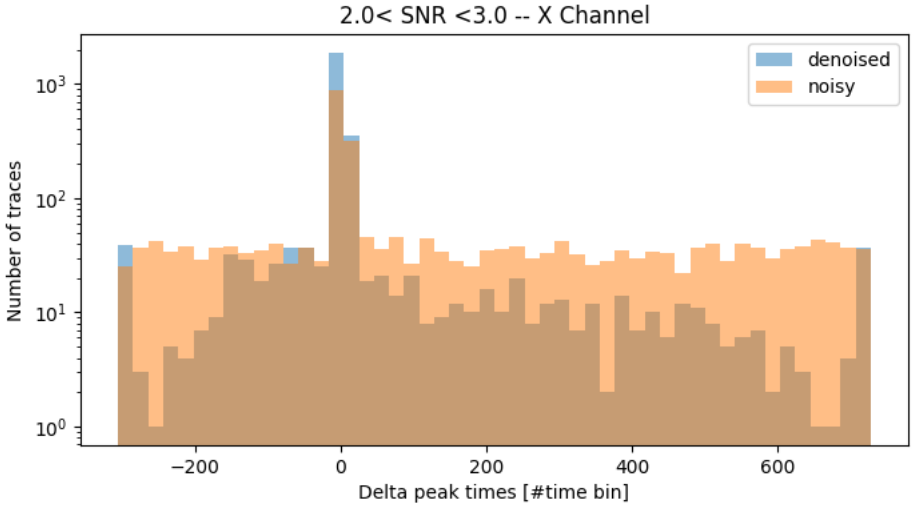


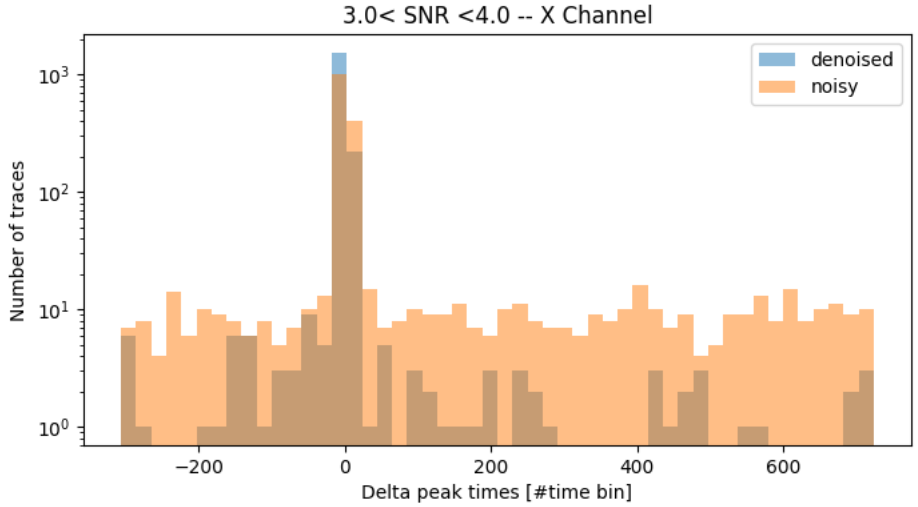


A bit more details

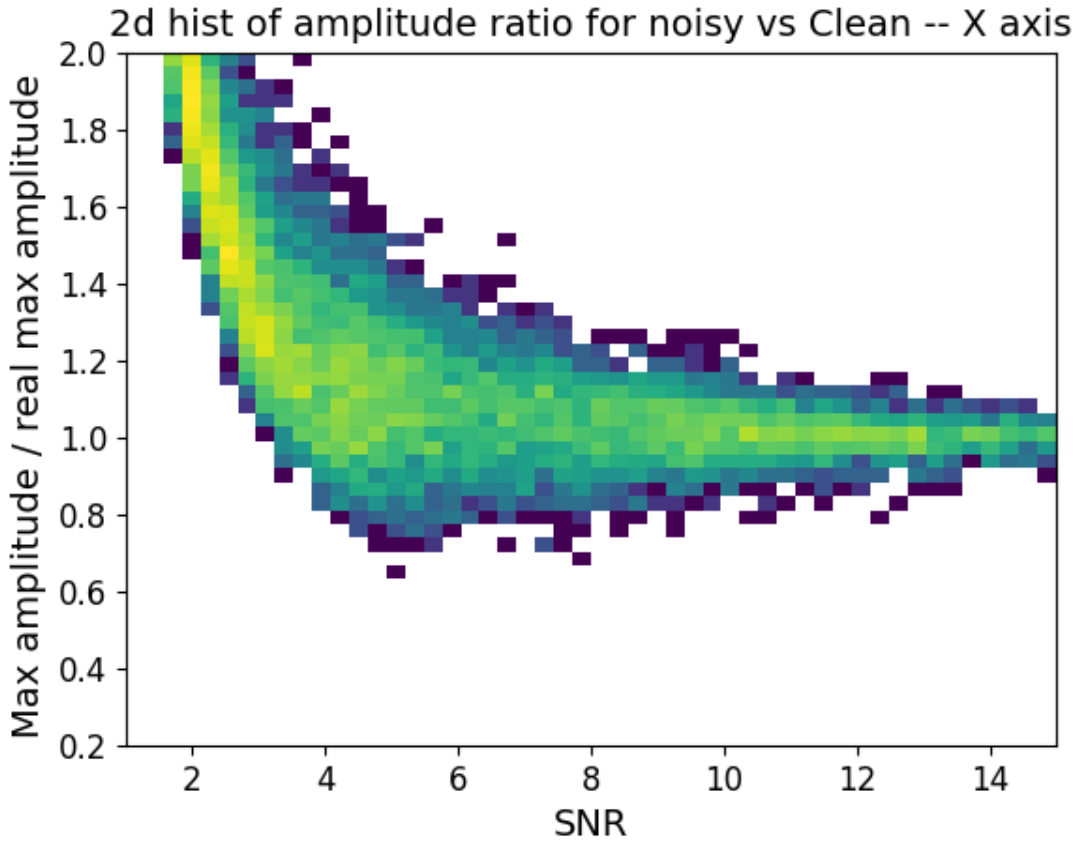


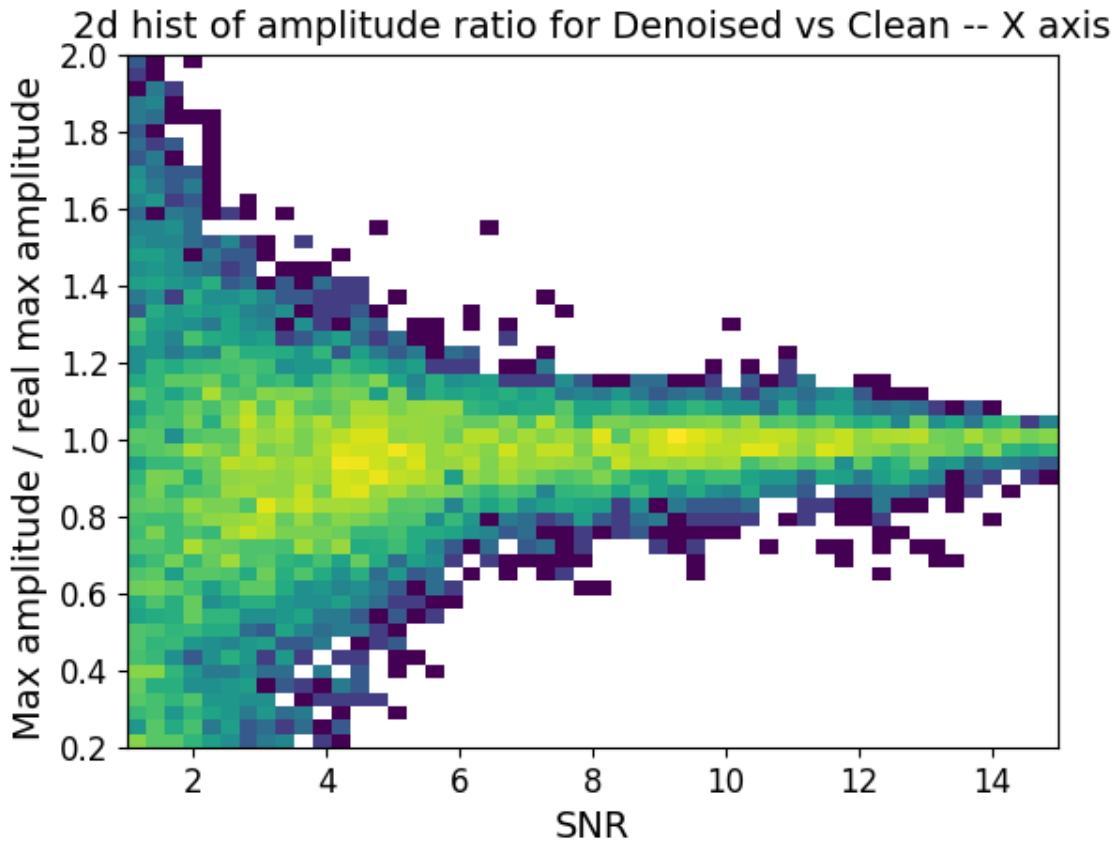




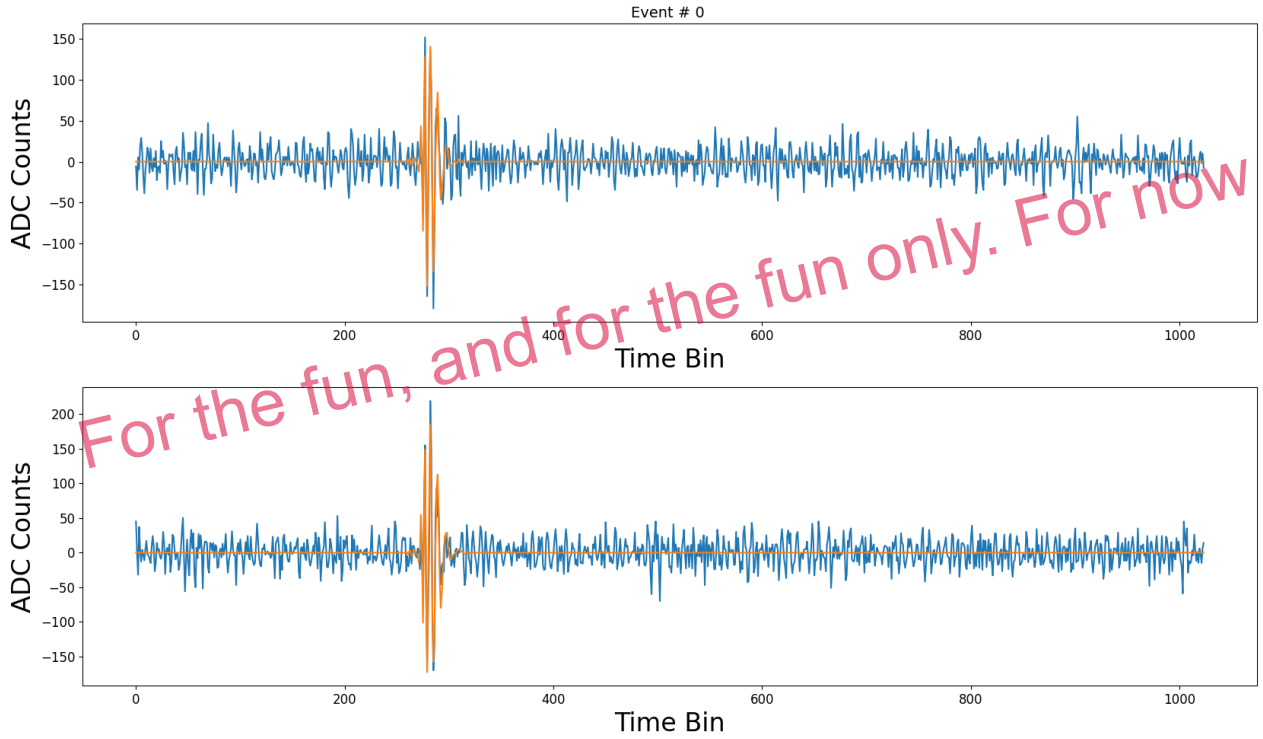


Amplitude ratio (WIP)





- Preliminary results on the latest DC2 shows that denoising is working and useful for intermediate SNR's traces (SNR ~3-5), maybe even lower.
- Need to apply this on data!



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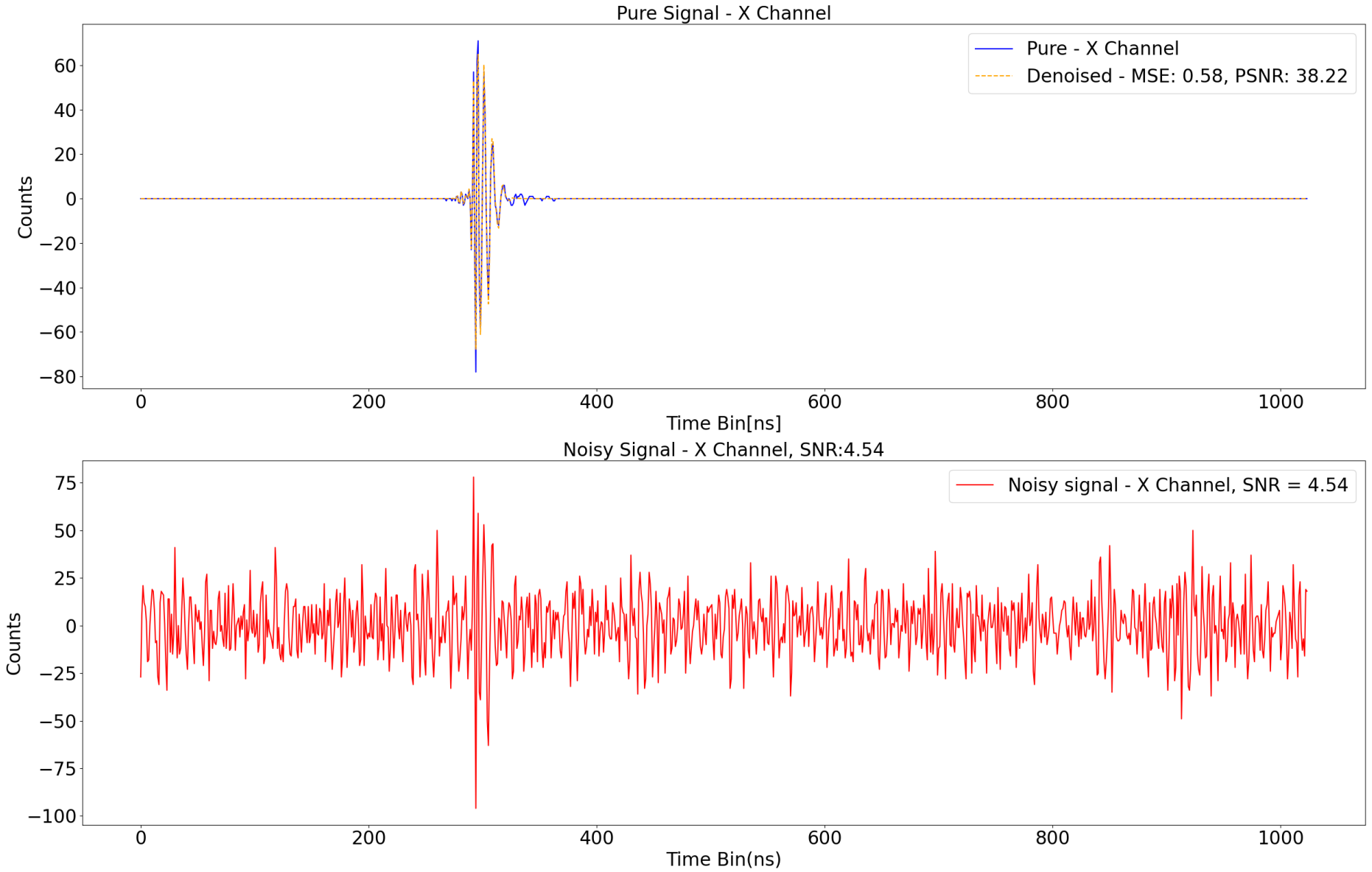

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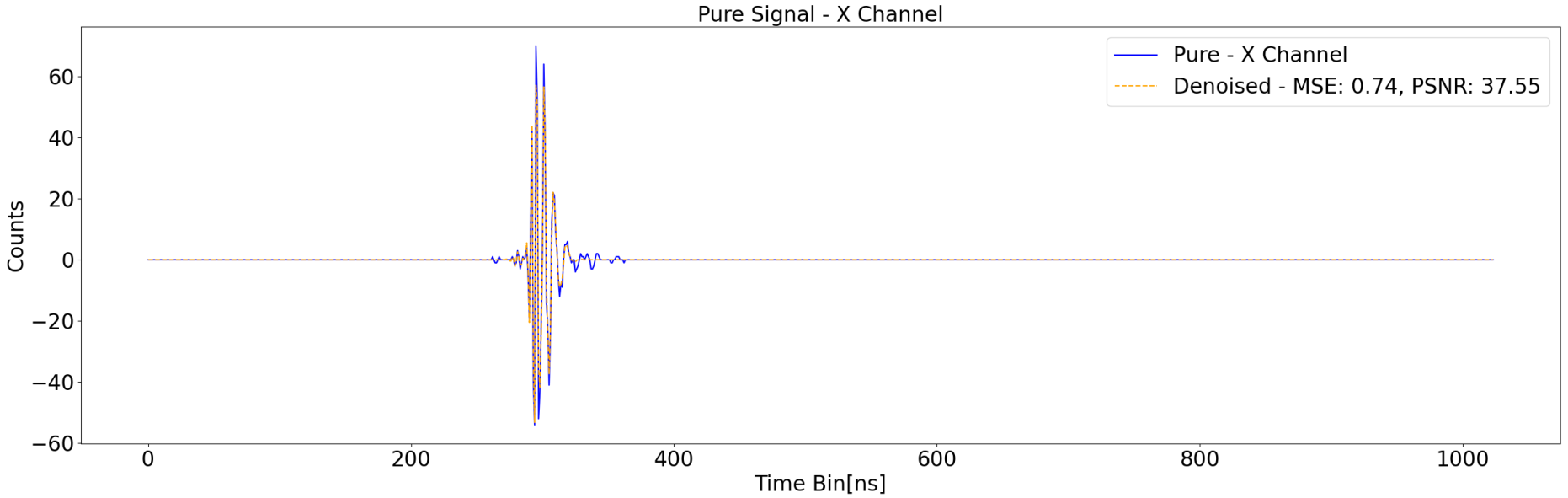

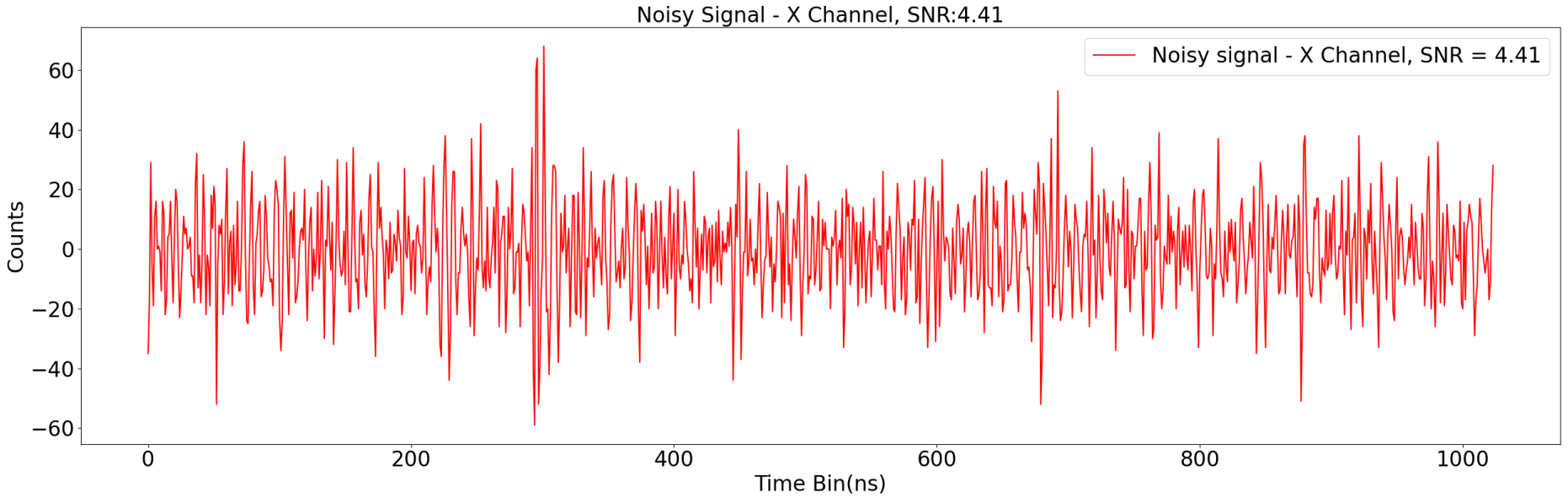

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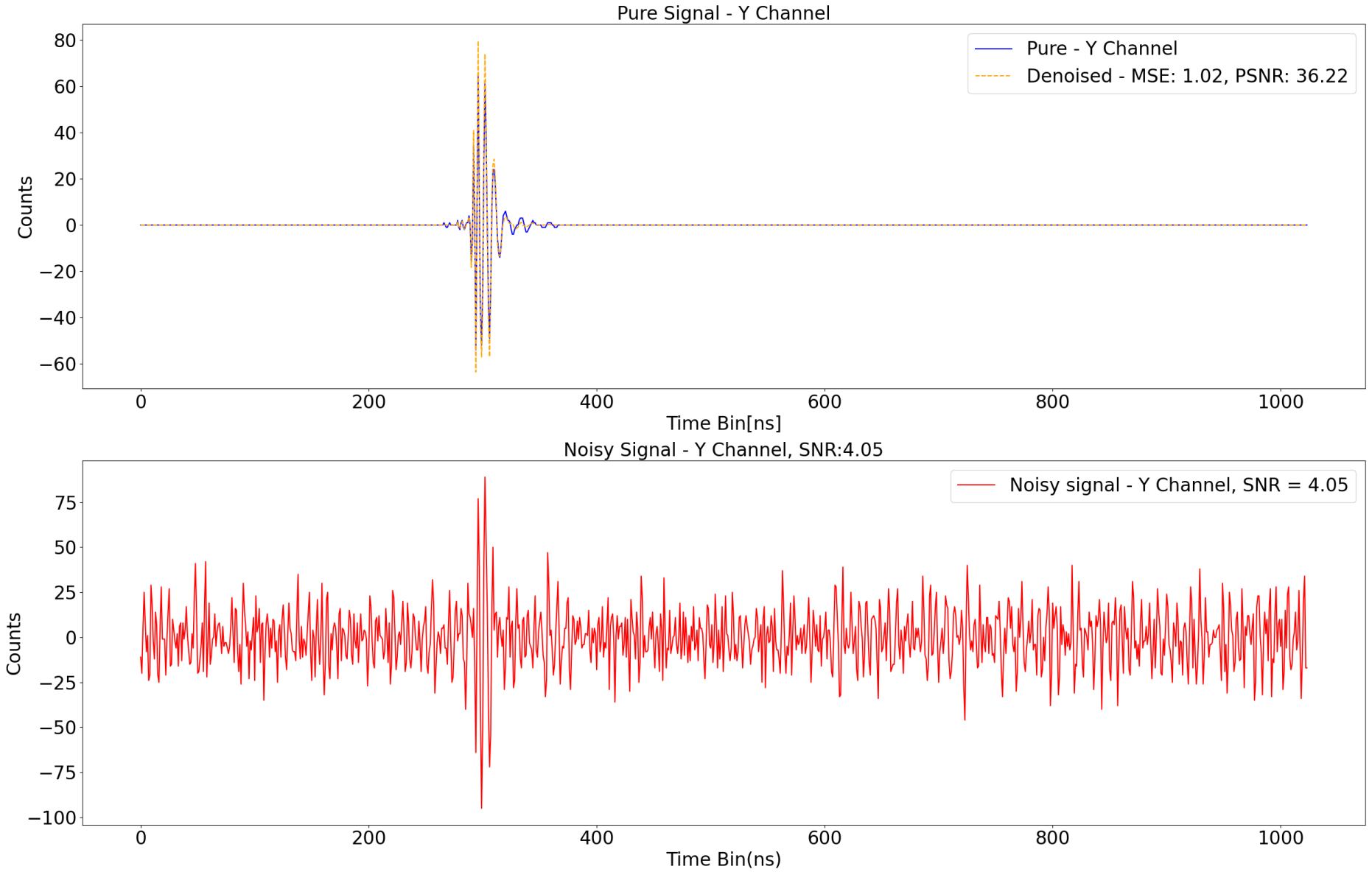

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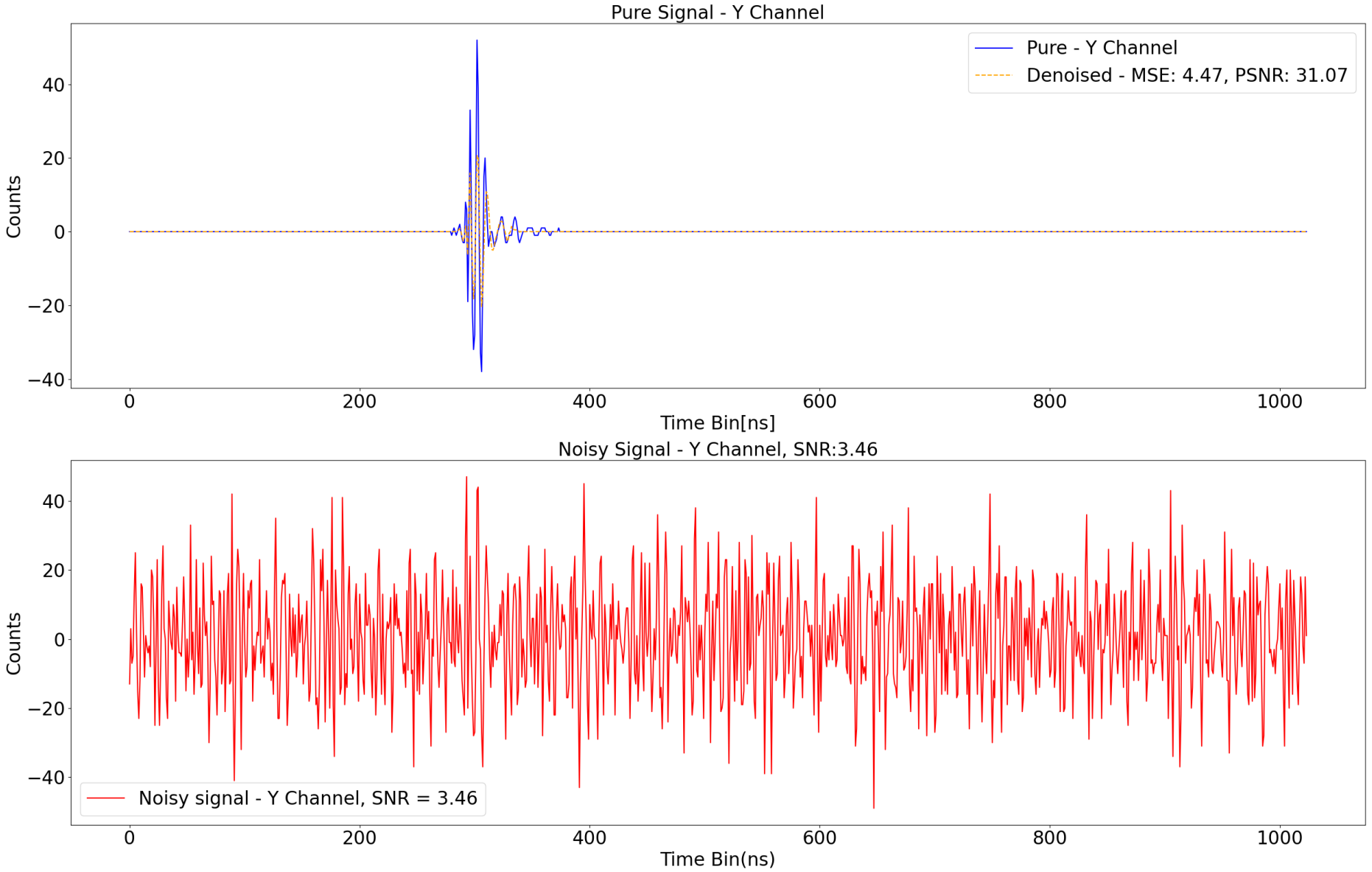
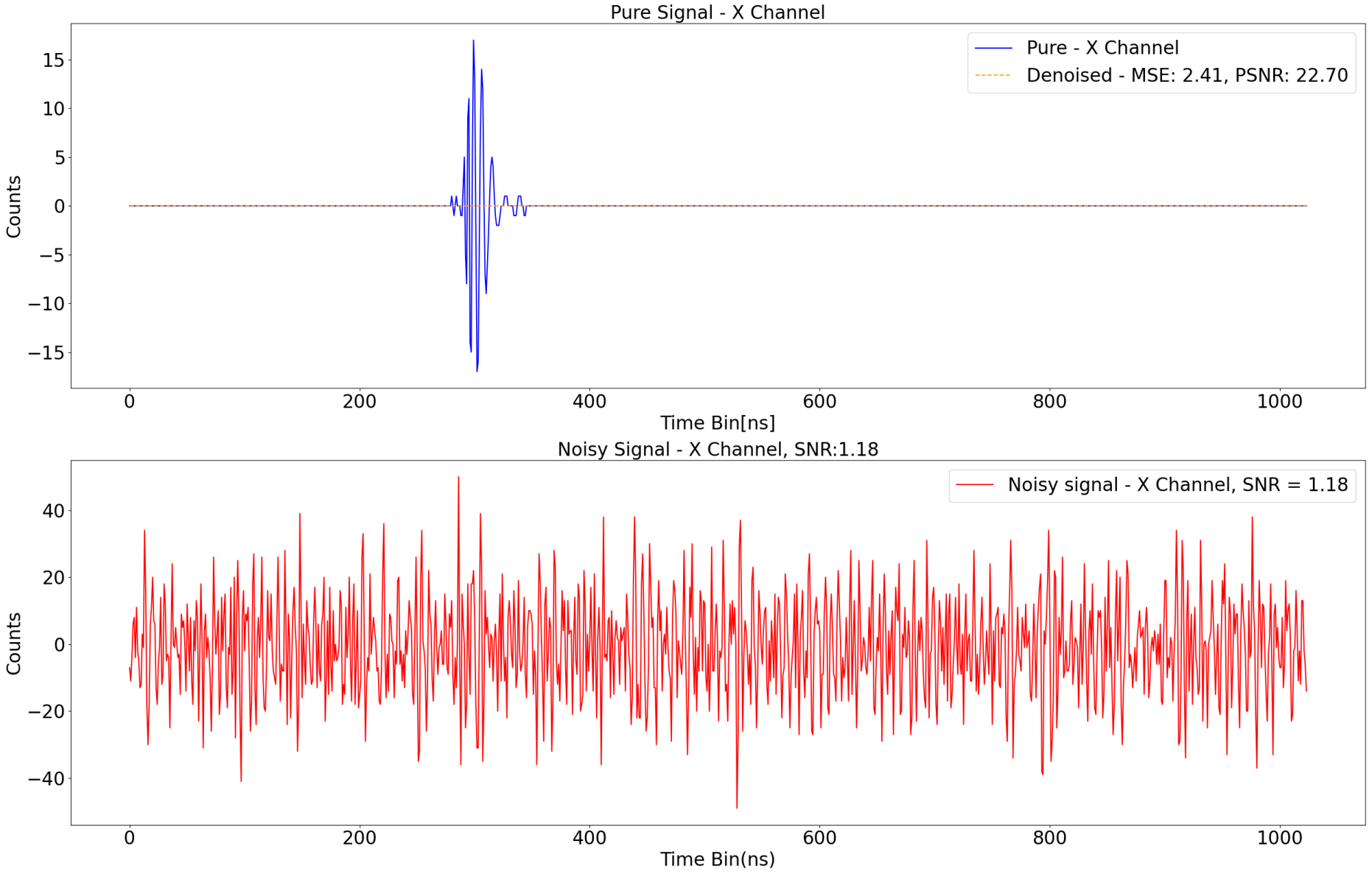


A few examples: low SNR: 1 < SNR < 3



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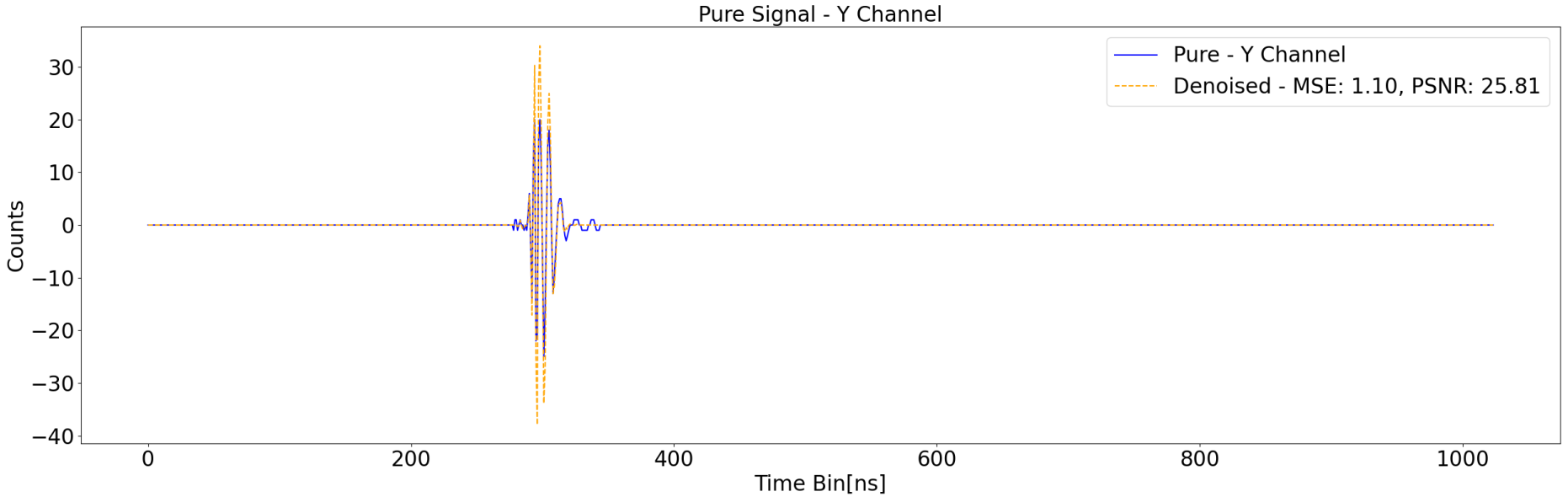

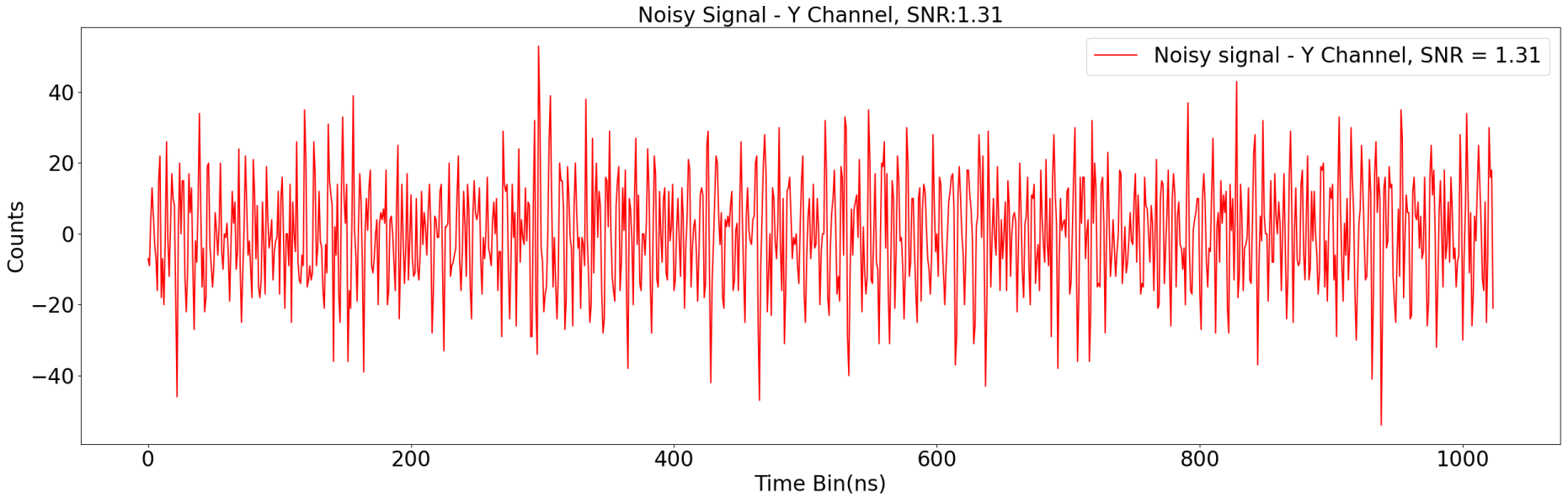

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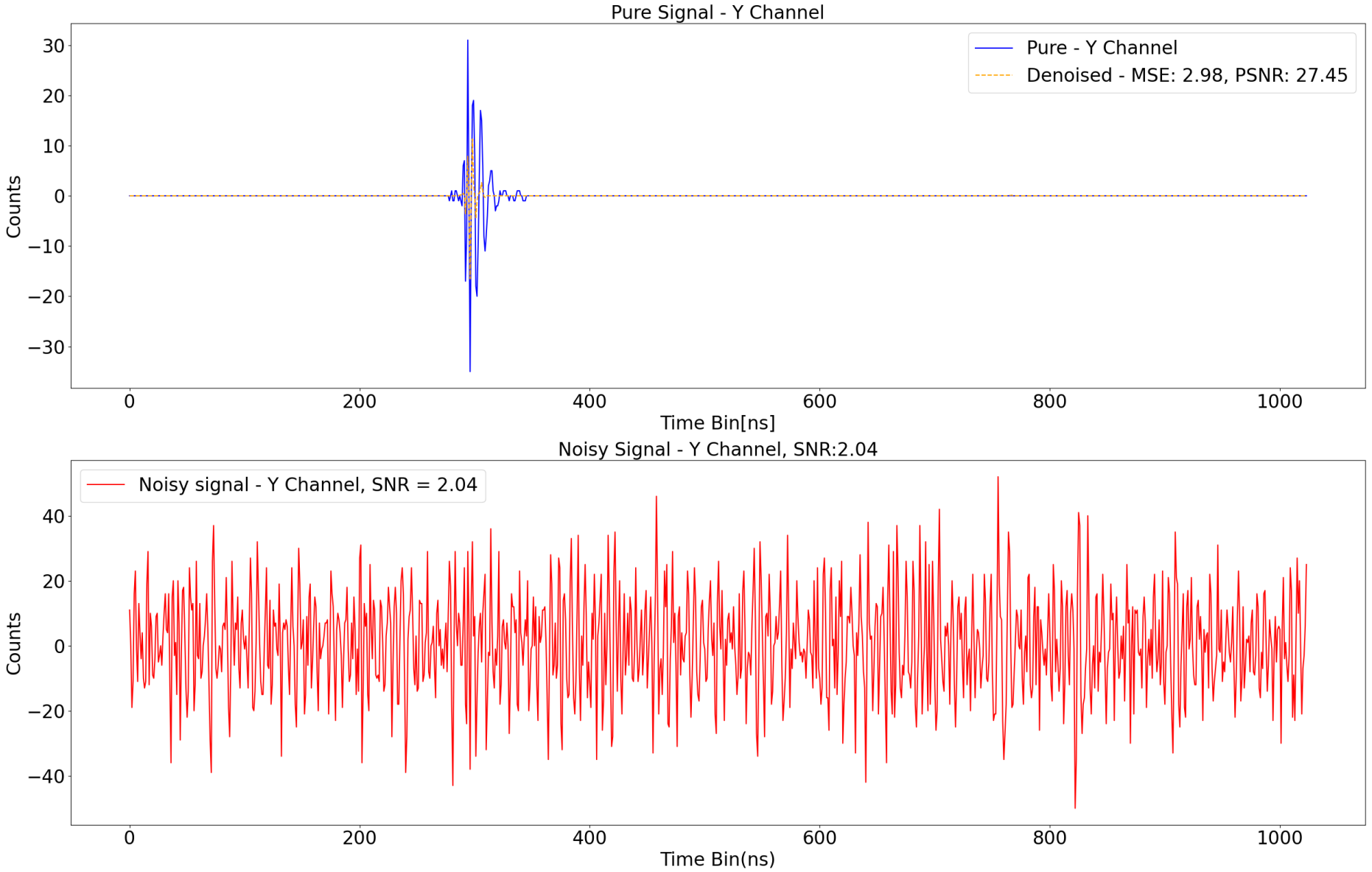

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