Remove Some Noise: On Pre-processing of Side-channel Measurements with Autoencoders

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Outlines

- Side-channel analysis
- Denoising autoencoder
- Denoising strategy: white-box setting
- Denoising strategy: black-box setting
- Conclusions and future works

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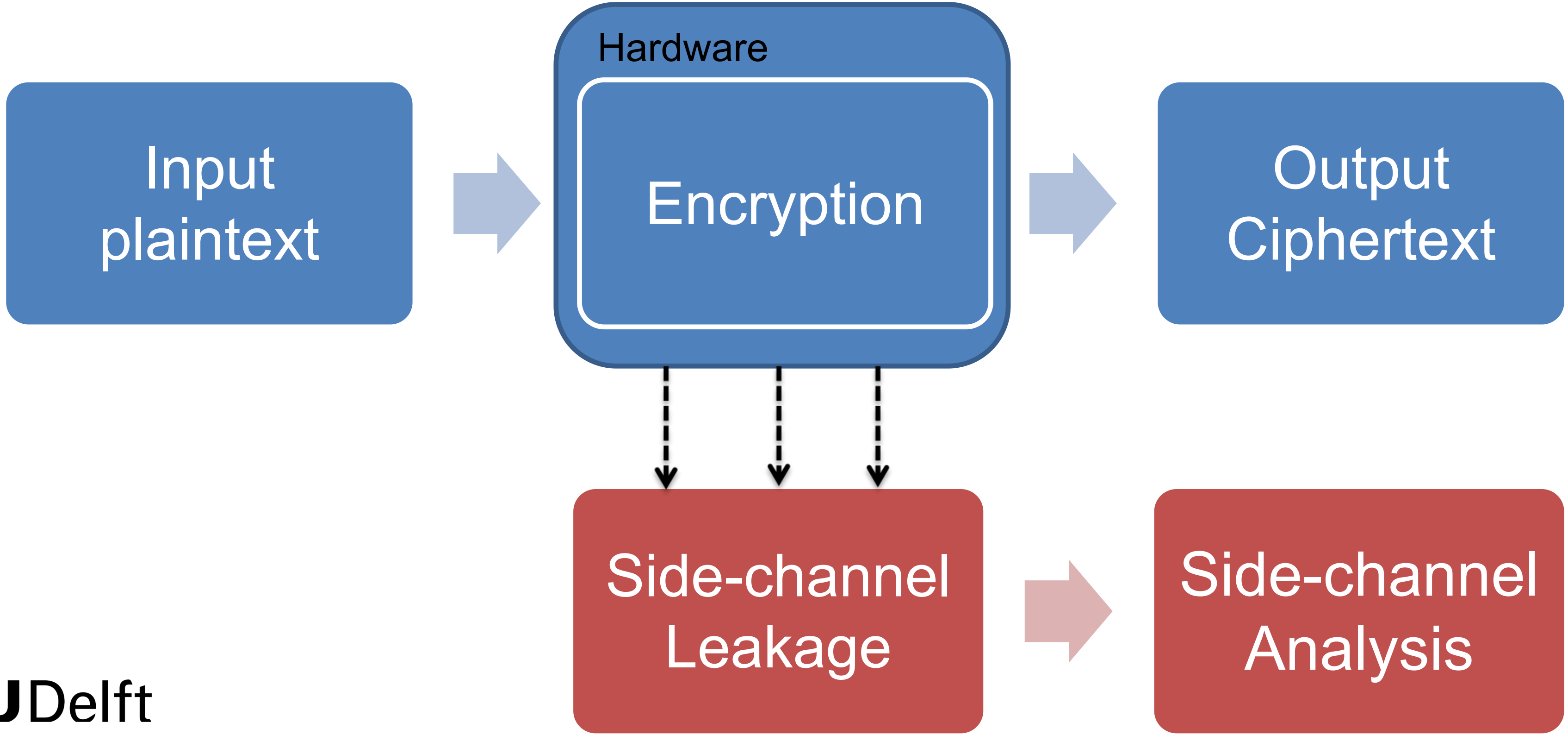
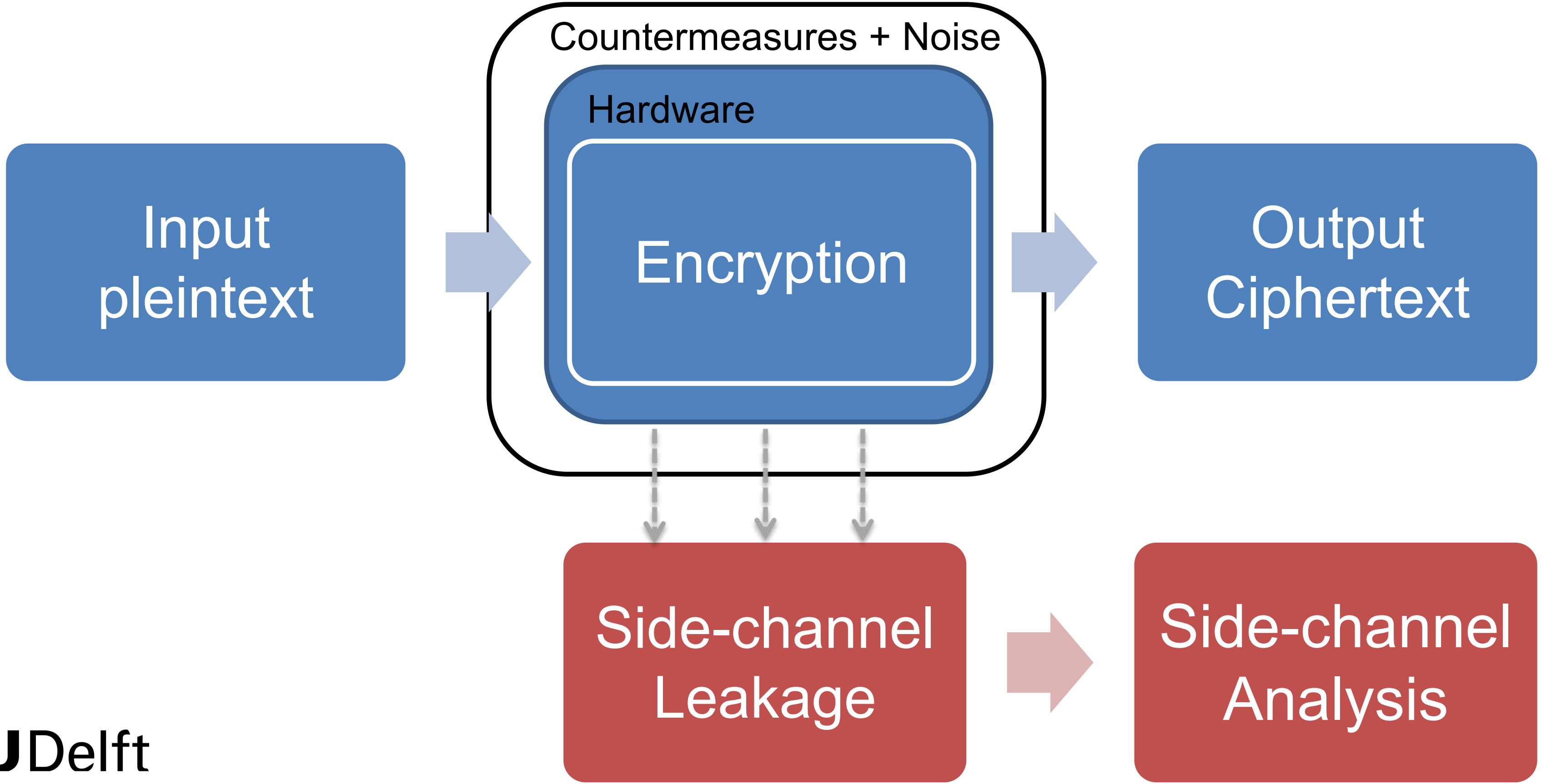
Side Channel Analysis



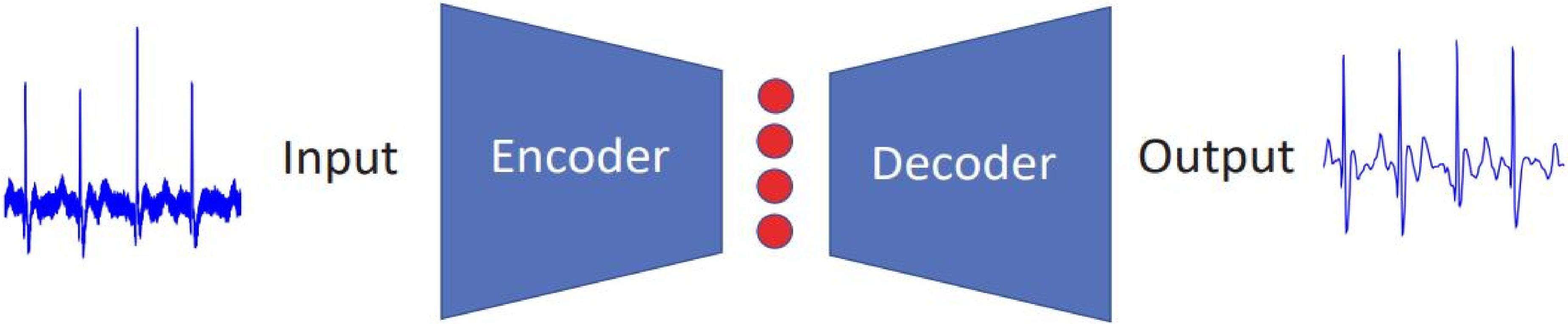
Side Channel Analysis



Remove the noise

Gaussian noise	→	Averaging
Misalignment	→	Static alignment
Gaussian noise + Misalignment	→	???

Denosing autoencoder



$$\phi, \psi = \arg\min_{\phi,\psi} \|X - (\psi \circ \phi)X\|^2$$

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Denoising strategy: white-box settings

- Denoising strategy
- Validation & Benchmark
  - Gaussian noise
  - Desynchronization
  - Random delay interrupts
  - Combined noise
  - Uniformed noise
  - Clock jitters
  - Shuffling

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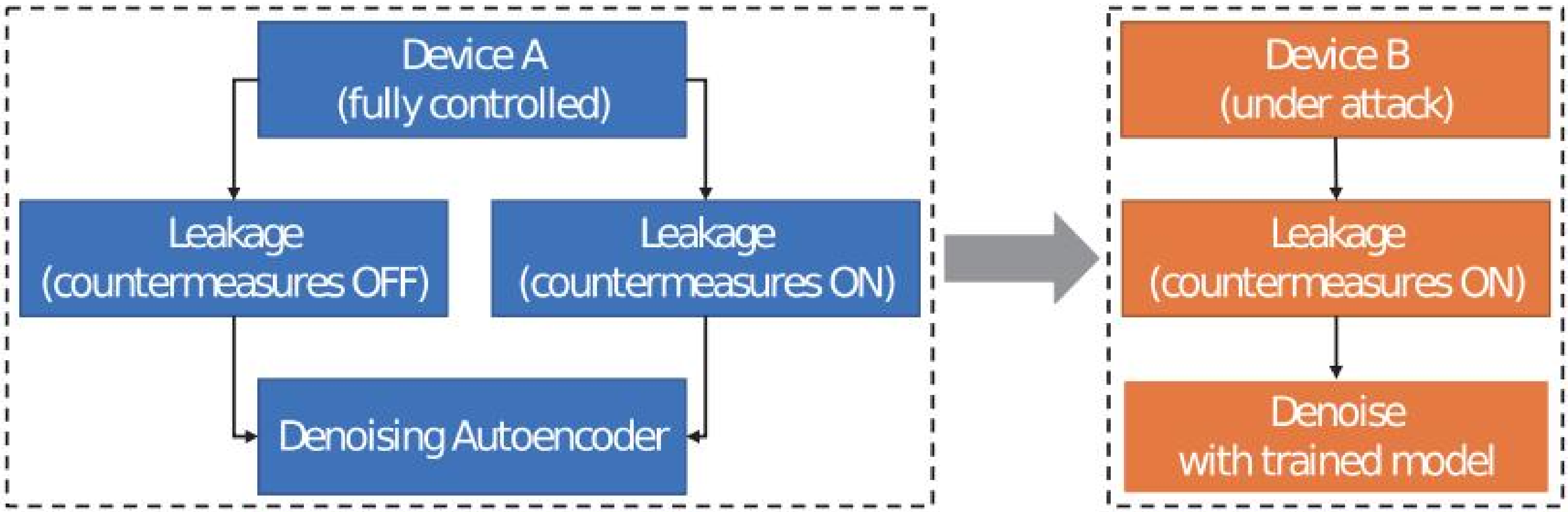
Denoising strategy: white-box setting



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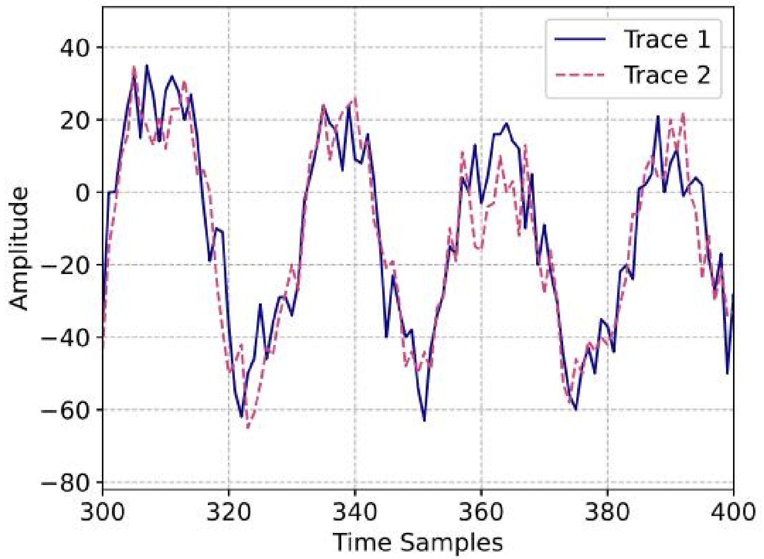
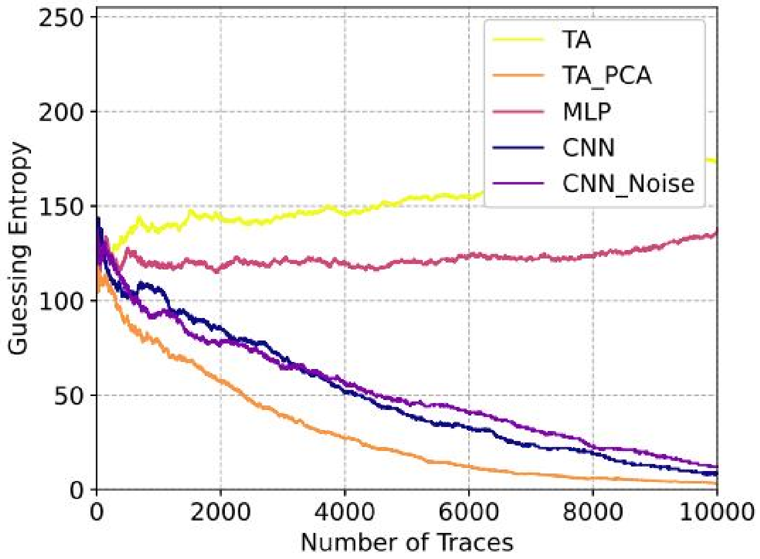
Add Guassian noise





Mean=0
Std=8

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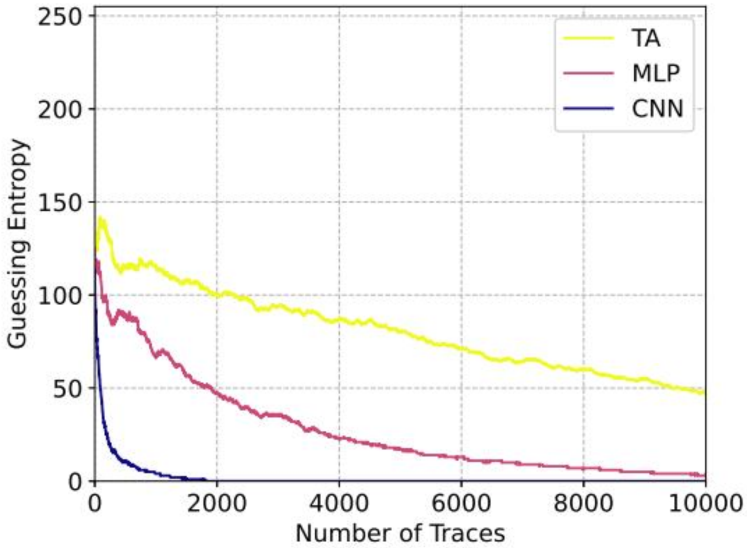
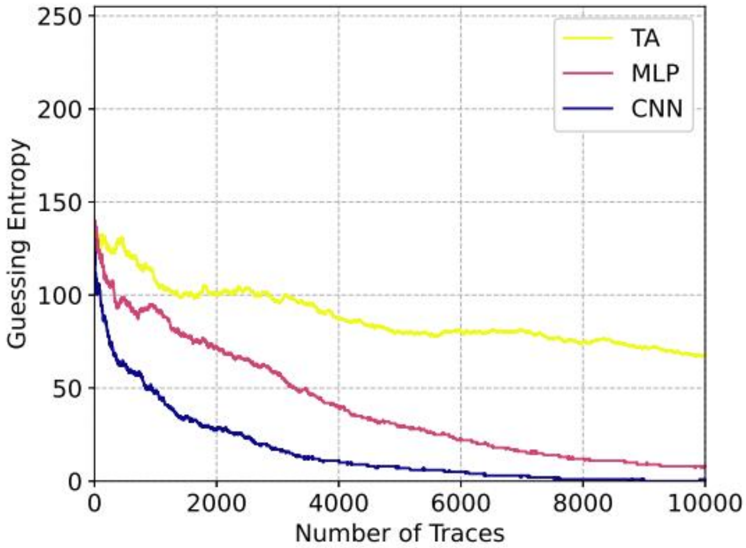
Remove Guassian noise

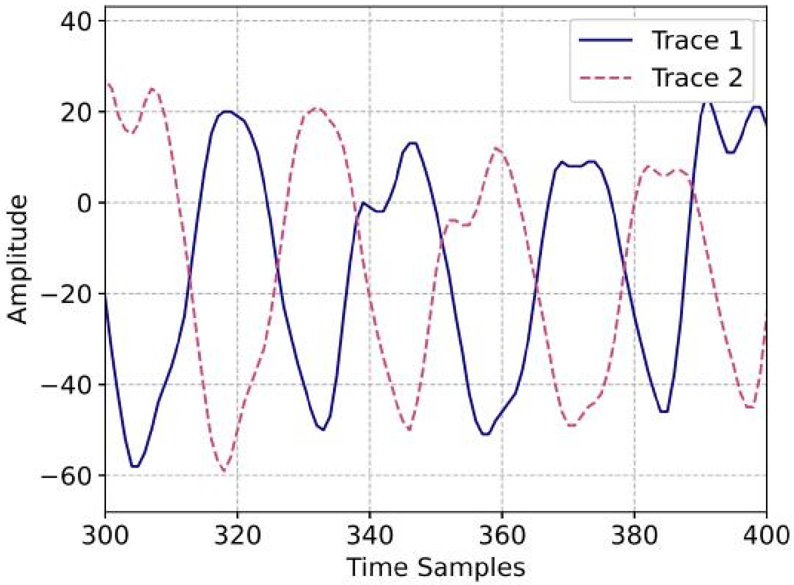


Averaging (10 traces)

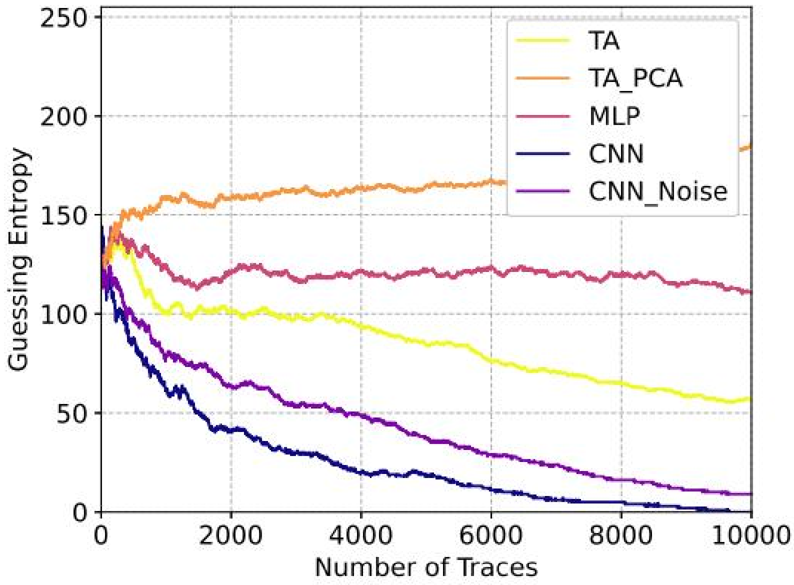


Denoising autoencoder

Add Desynchronization



Max=50



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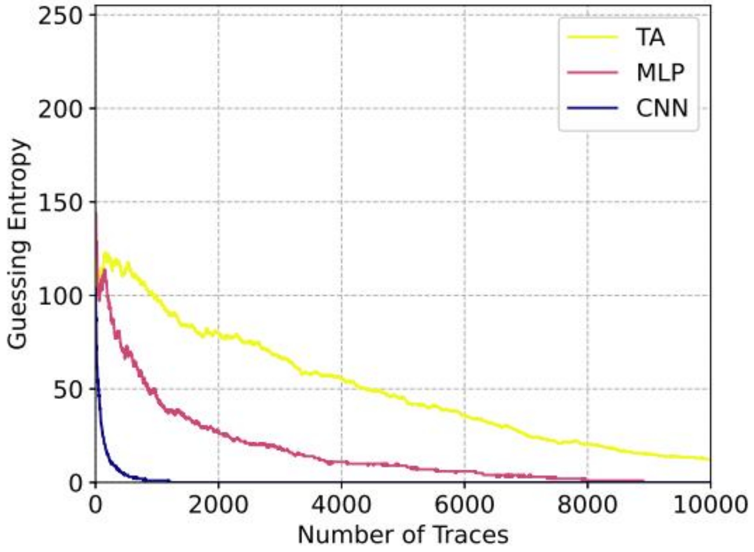
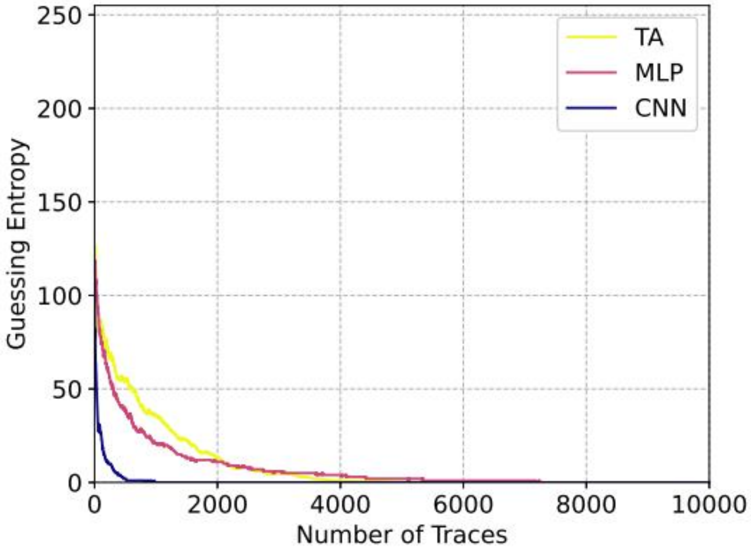
Remove desynchronization



Static alignment



Denoising autoencoder

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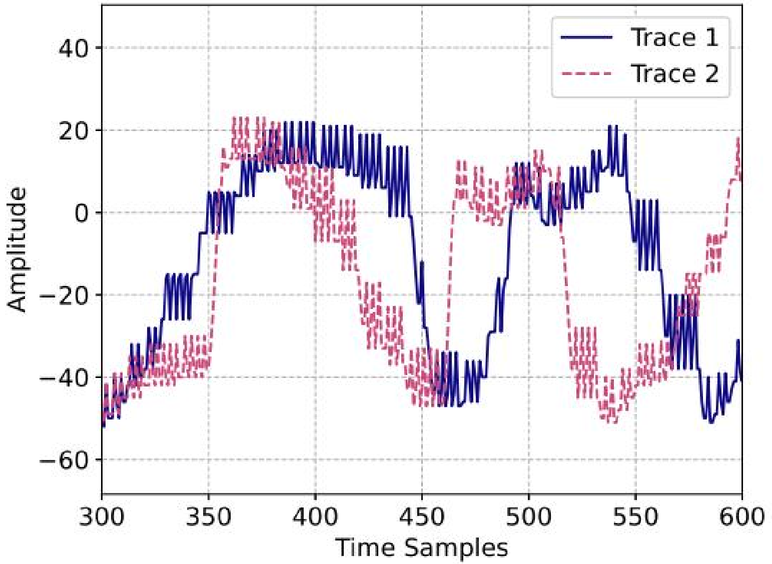
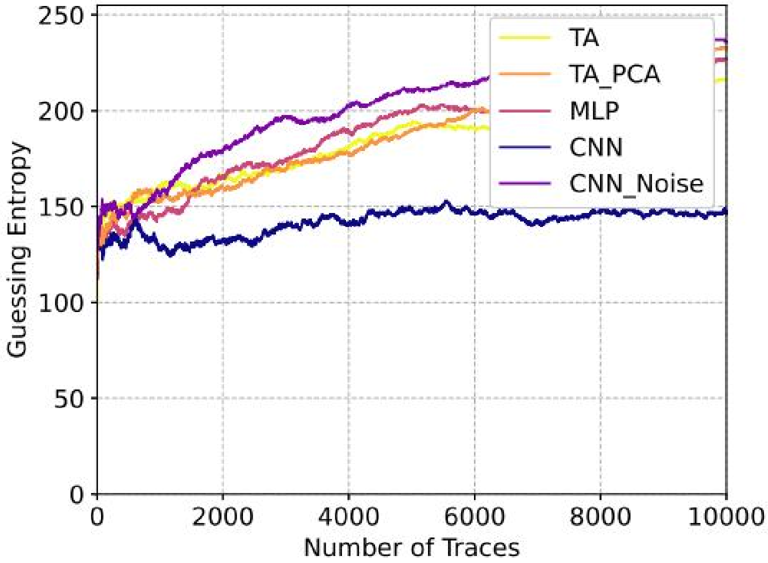
Add random delay interupts



Floating Mean method



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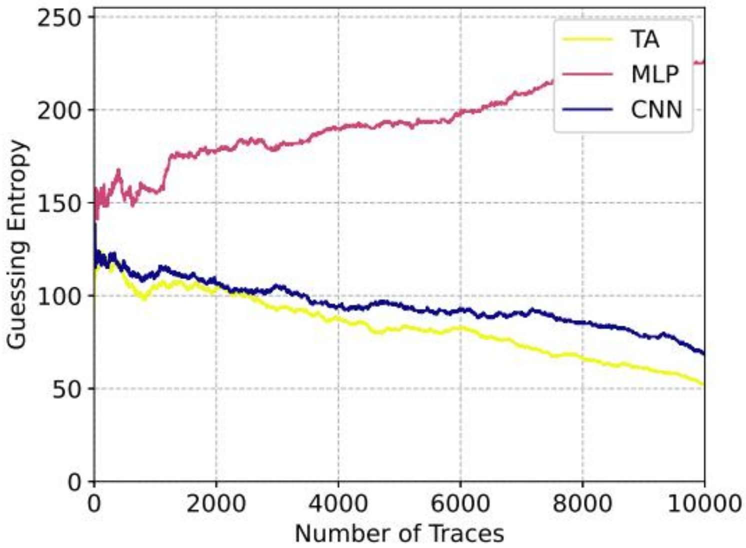
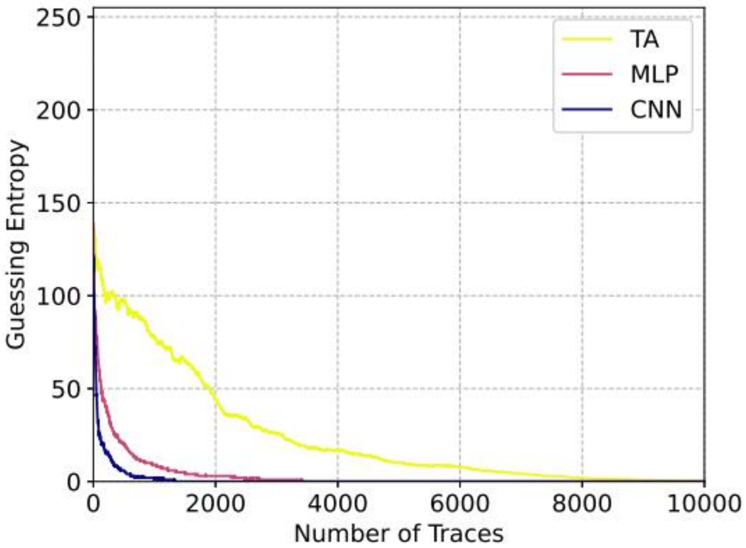
Remove random delay interupts



Frequency analysis



Denoising autoencoder

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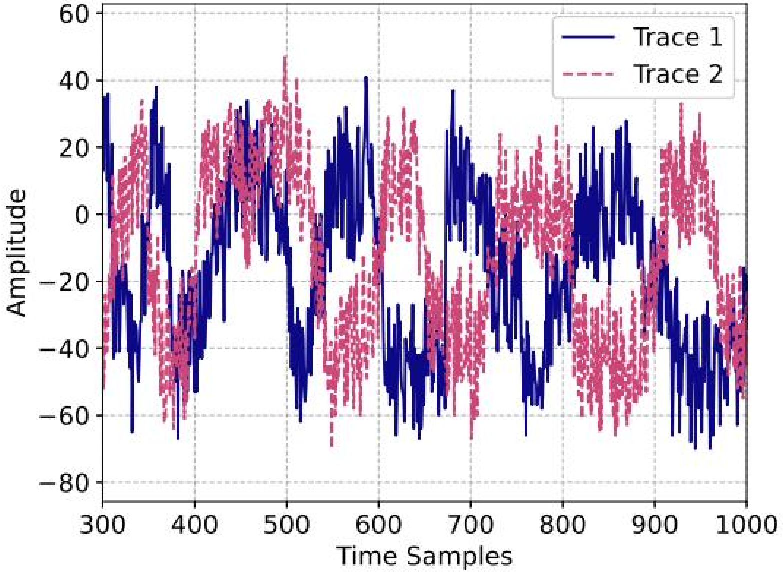
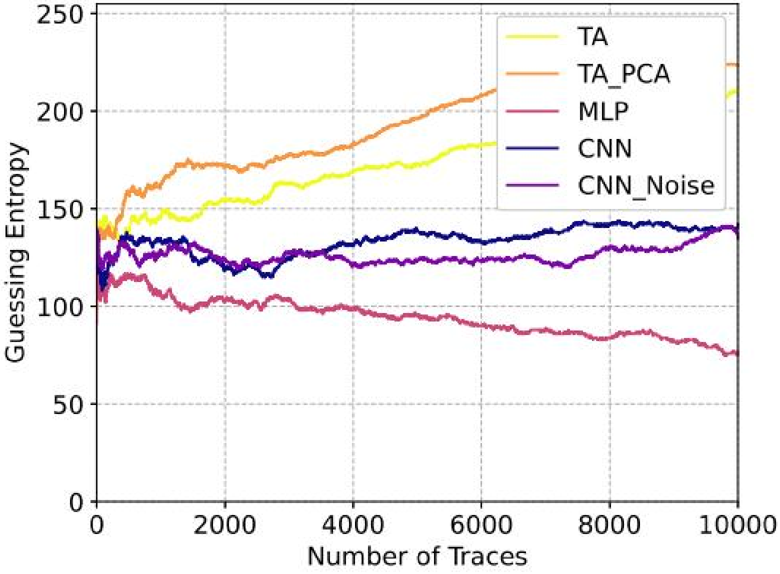
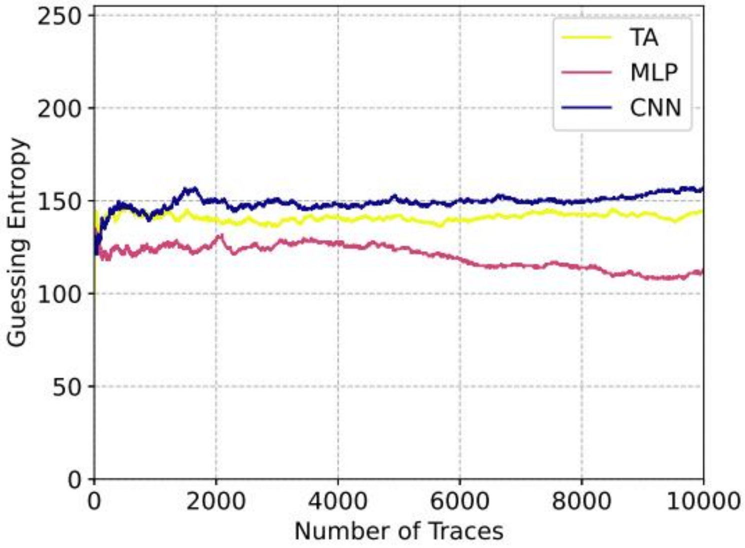
Add combined noise



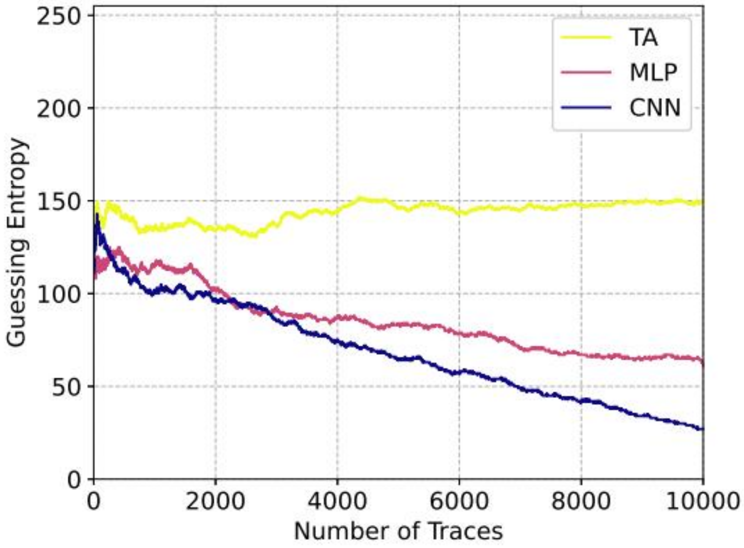


TUDelft

Remove combined noise



Frequency analysis



Denoising autoencoder

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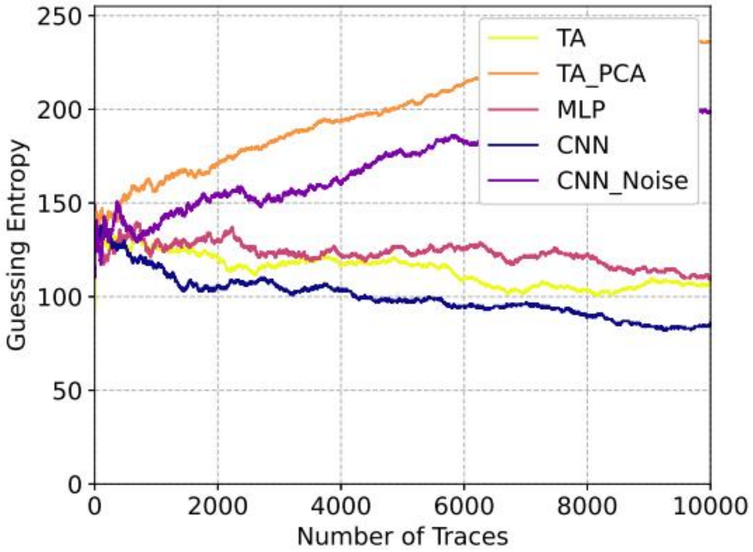
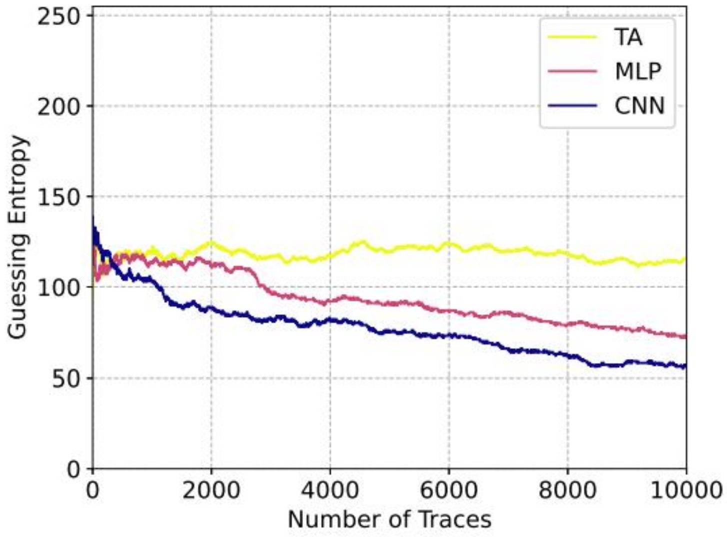
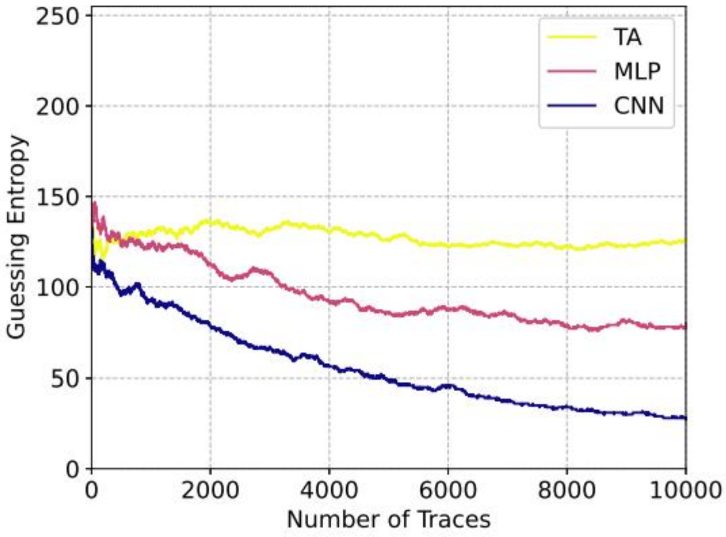
Add combined noise - random keys



Remove combined noise - random keys



Frequency analysis



Denoising autoencoder

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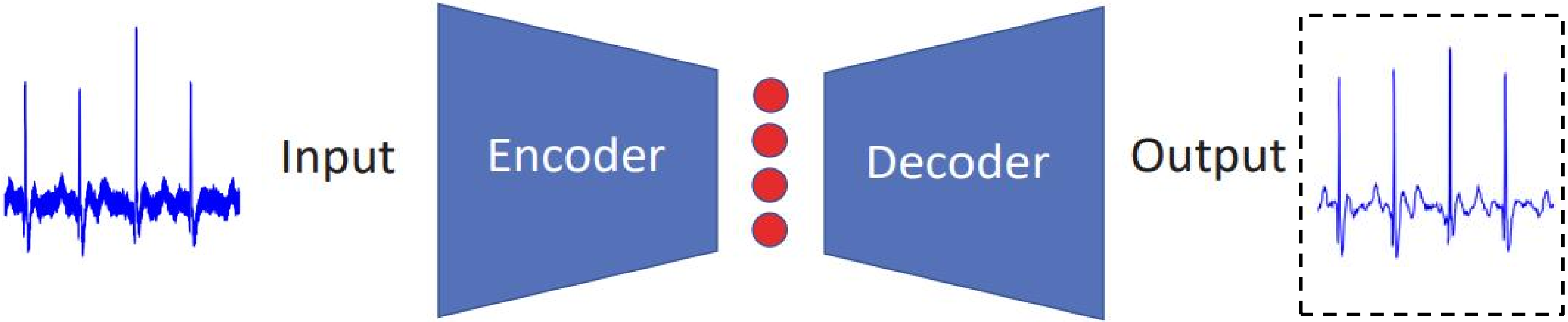
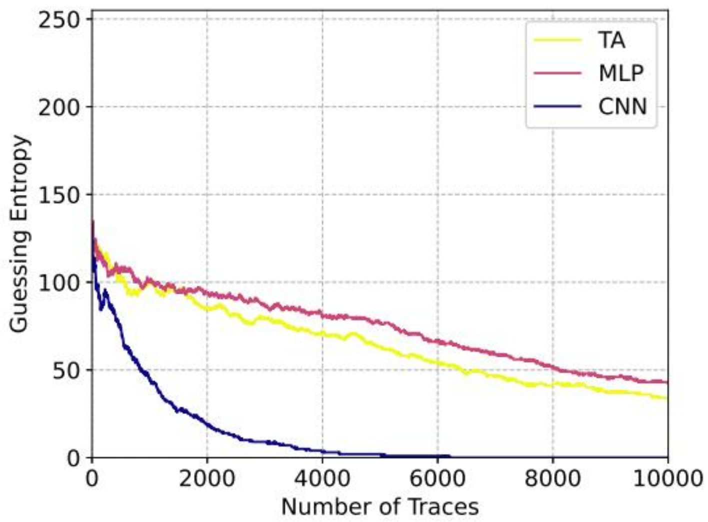
Denoising strategy: black-box settings

- Denoising strategy
- Remove Guassian noise & Desynchronization
- Remove Gaussian noise & Desynchronization (combined training)

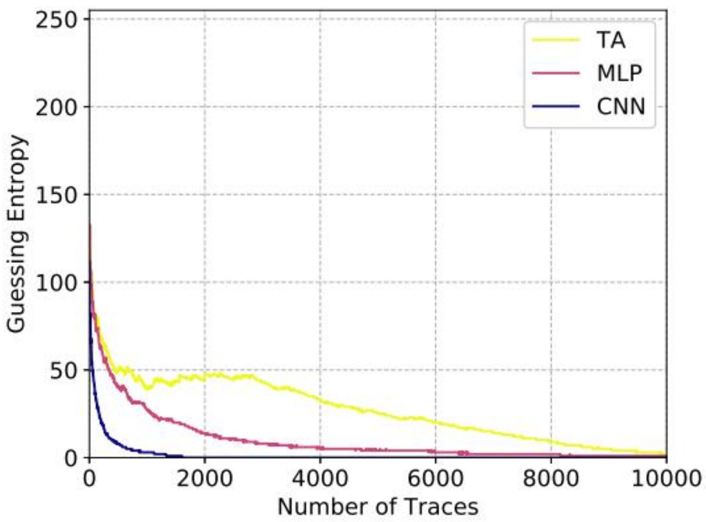
Denoising strategy: black-box setting



Remove Guassian noise & Desynchronization



Guassian noise



Desynchronization

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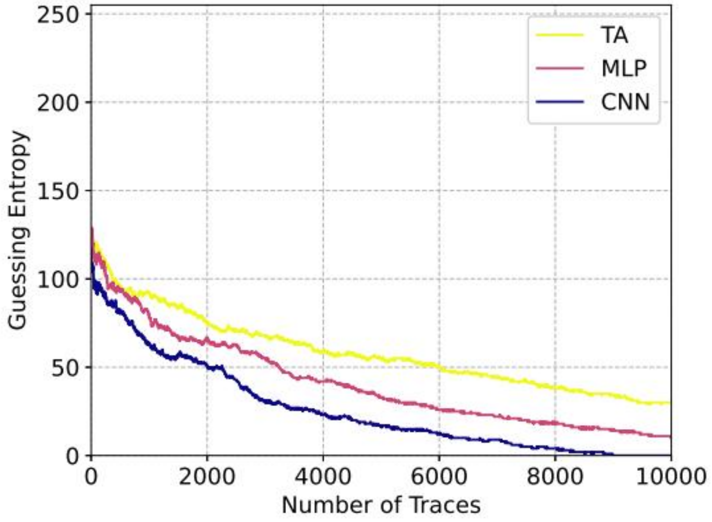
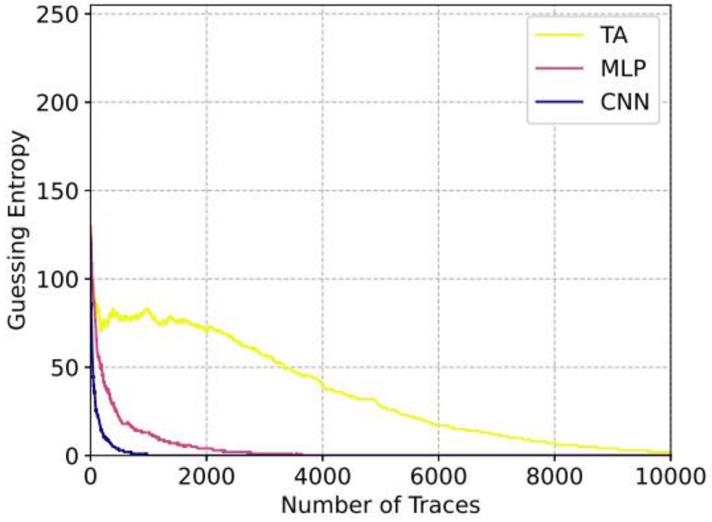
Remove Gaussian noise & Desynchronization (combined training)



Guassian noise



Desynchronization

Conclusions & Future Work

- CAE can remove/reduce various types of noise, countermeasures, and their conbinations
- Our approaches is powerful for white box setting
- We also demostrate the potential in black-box settings

- Will be interesting to use CAE to deal with portability problem
- Using encoder of CAE to launch attacks (transfer learning)

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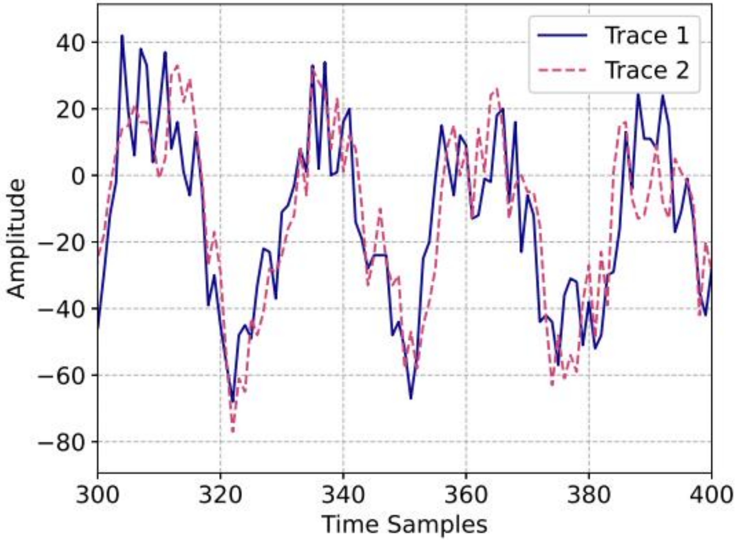
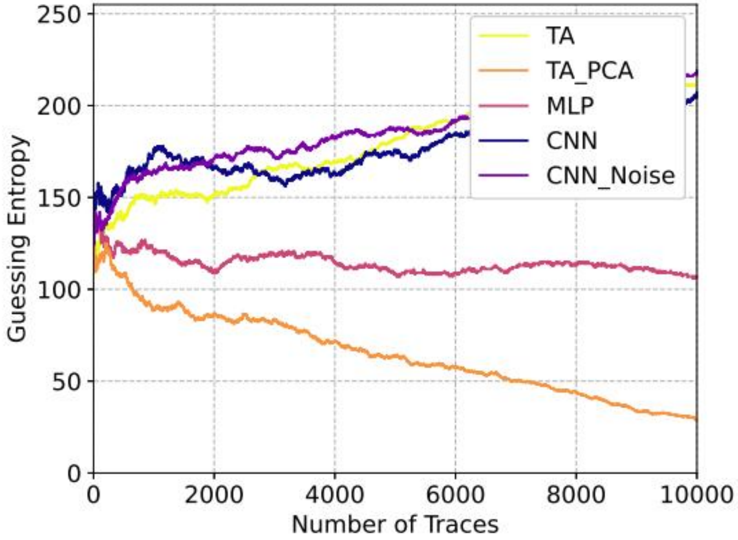
Thanks for your attention!

Add uniform noise



Max=20
Min=-20



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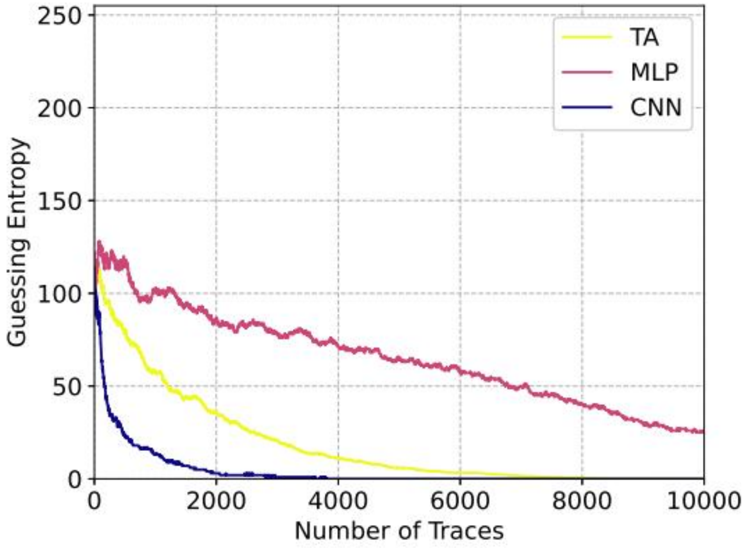
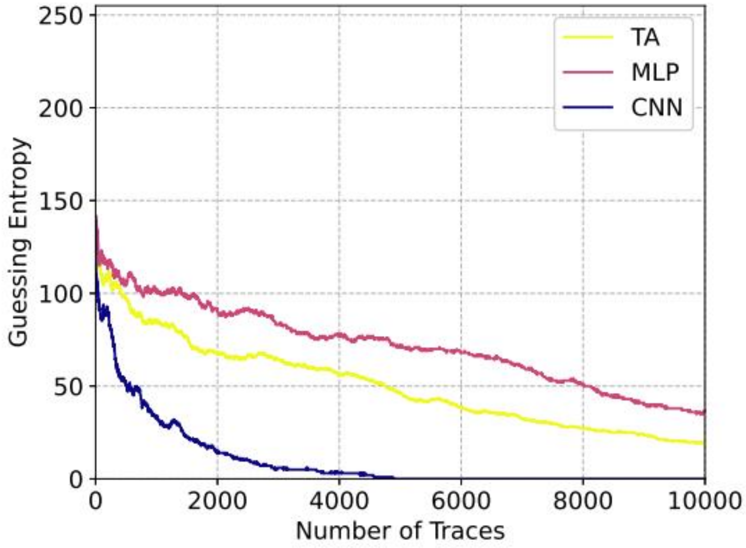
Remove uniform noise

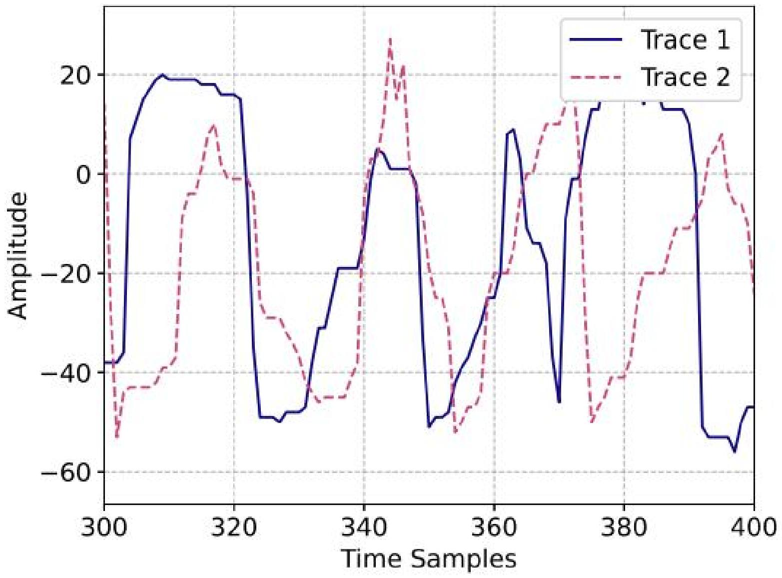


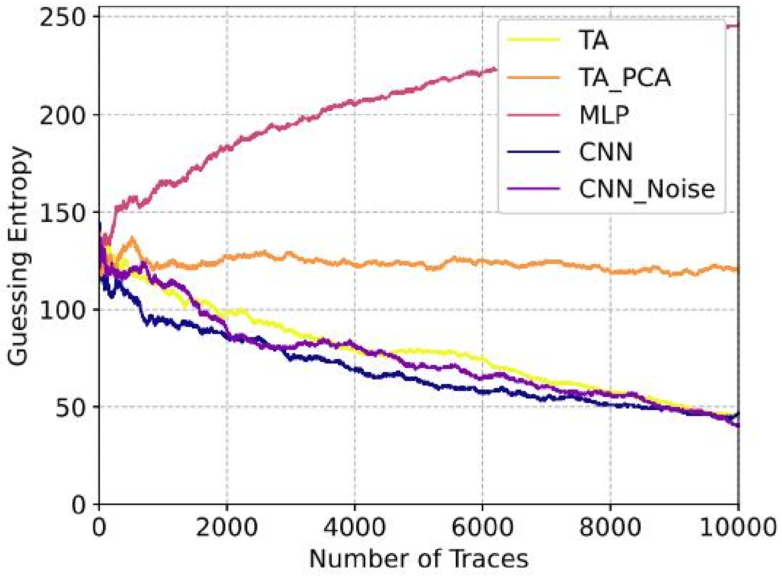
Averaging (10 traces)



CAE

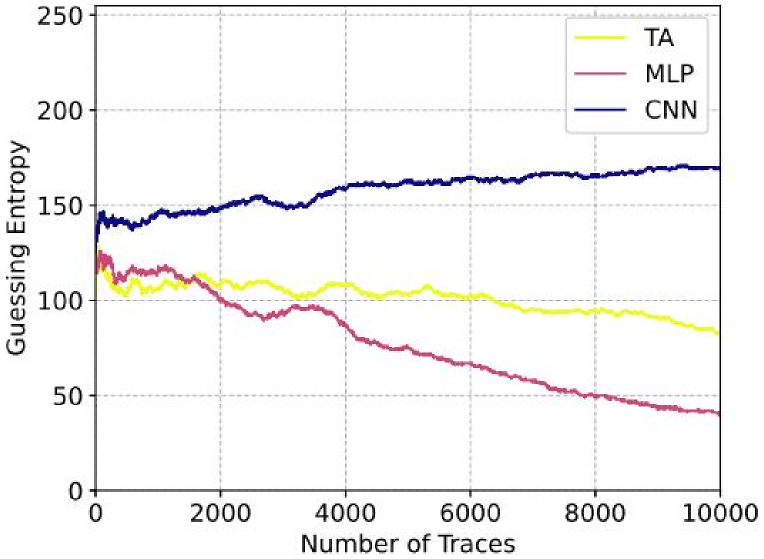
Add clock jitters



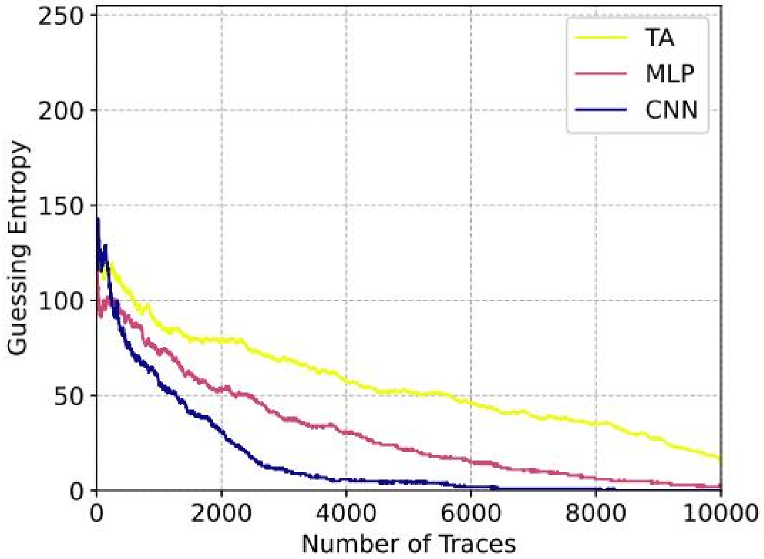


Max=4
Min=-4

Remove clock jitters



Frequency analysis



CA
E

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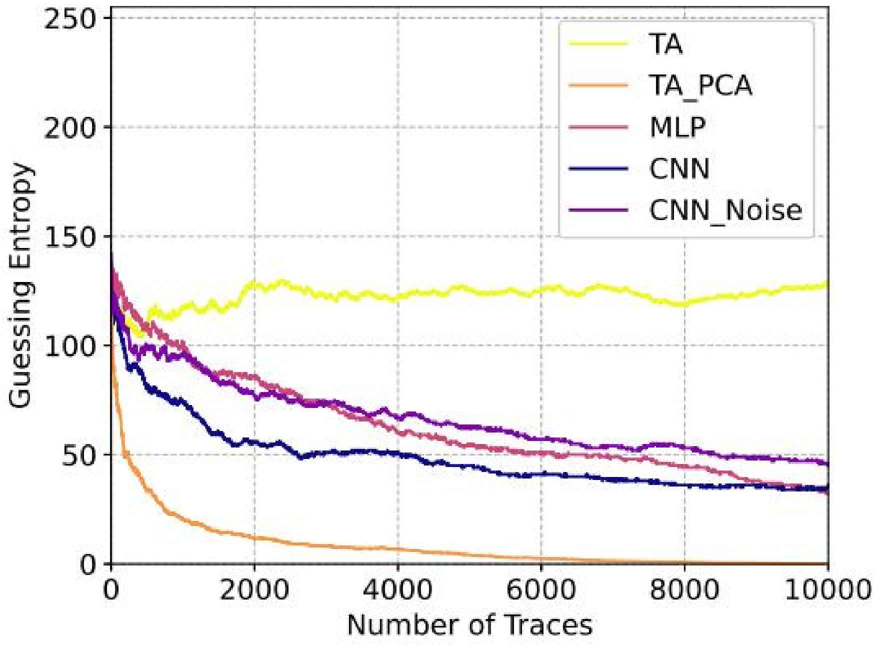
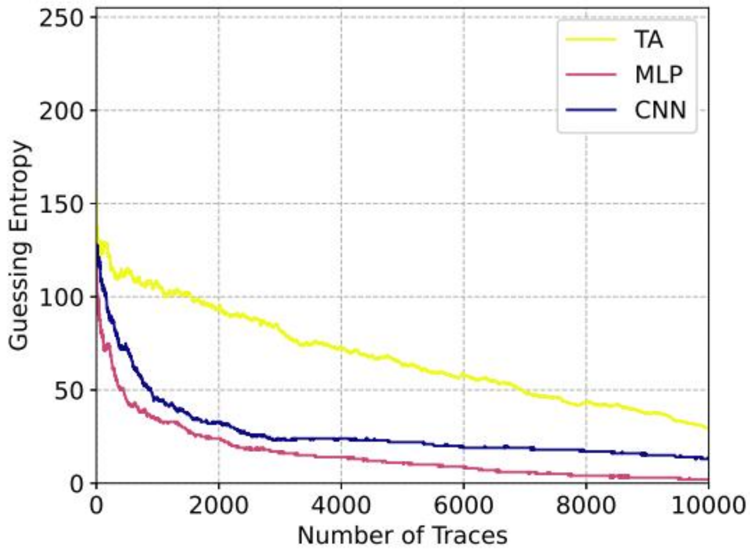
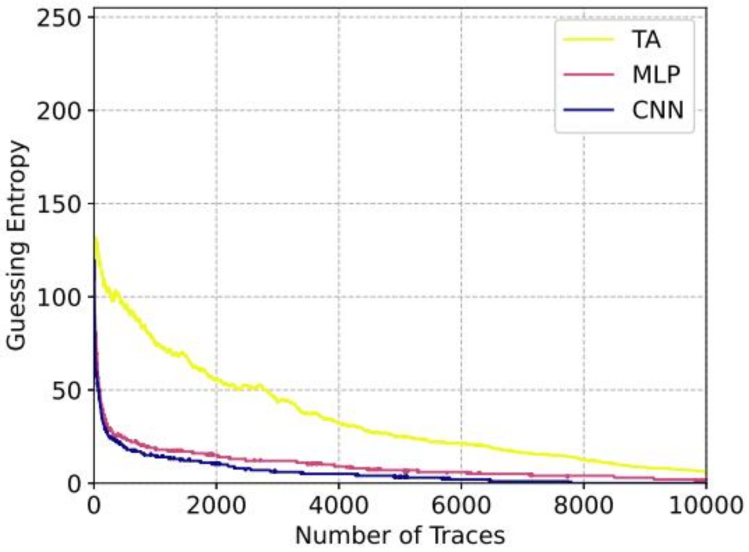
Add shuffling



Remove shuffling



+10,000 profiling traces



Denoising autoencoder

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