

Convolutional autoencoder for compression of neural data

CNN for signal compression

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RWTH Aachen

Wednesday 15th February, 2023

Background

Goal : Investigation of pathological firing in pain receptors

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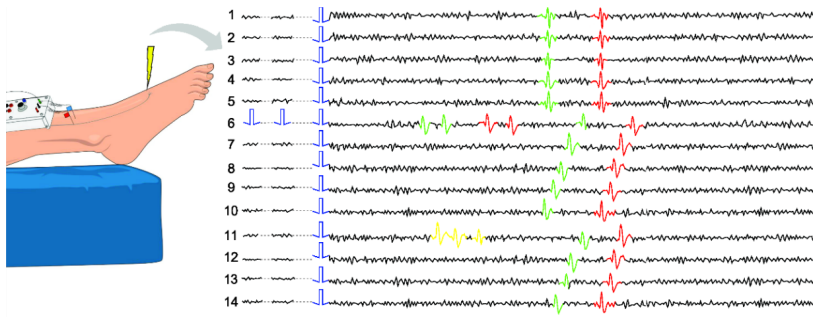
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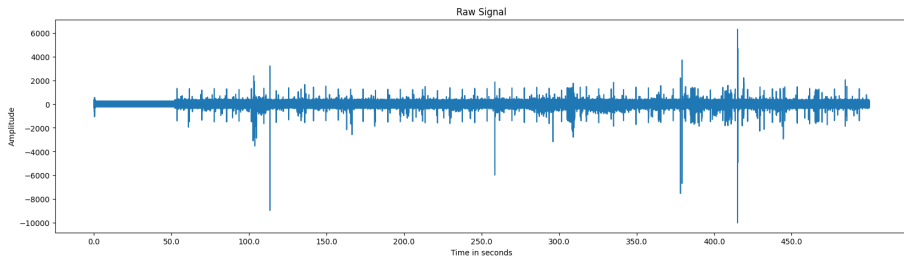
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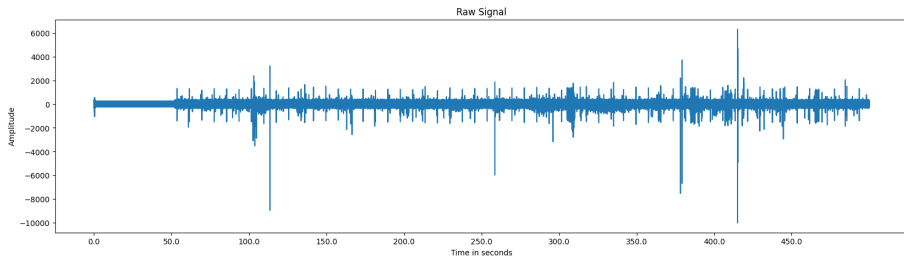
Example of the marking method

Why signal compression?



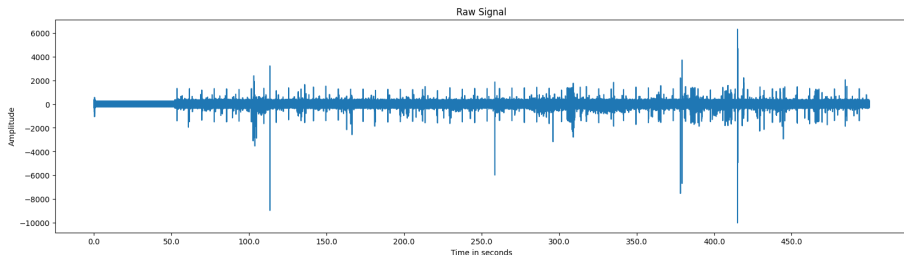
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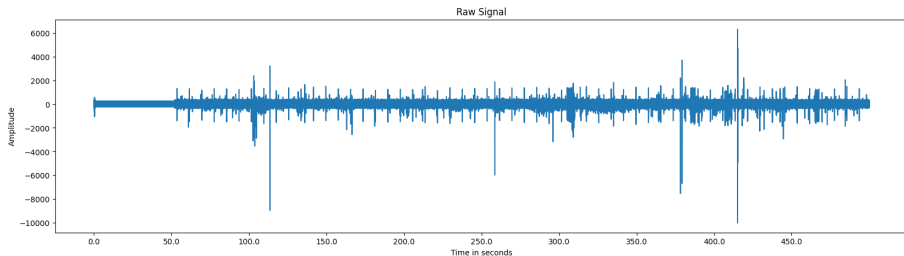
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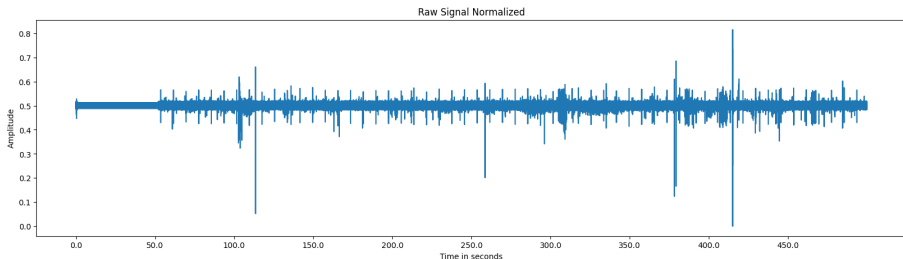
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- For the following: Normalize Signal to range $[0,1]$

How does the compression work?

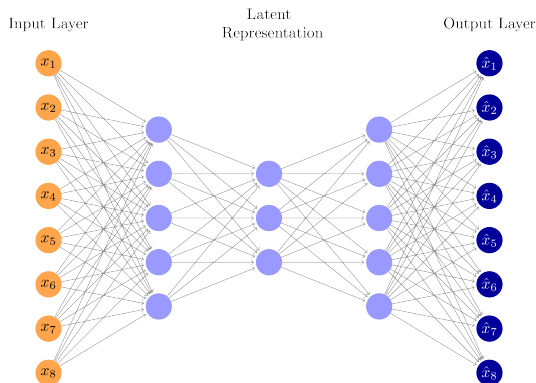
- Machine Learning

How does the compression work?

- Machine Learning Neural Network (Autoencoder)

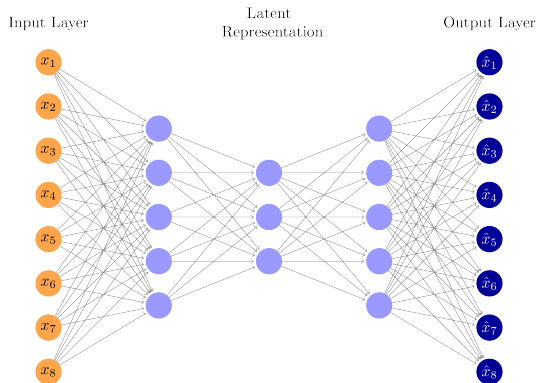
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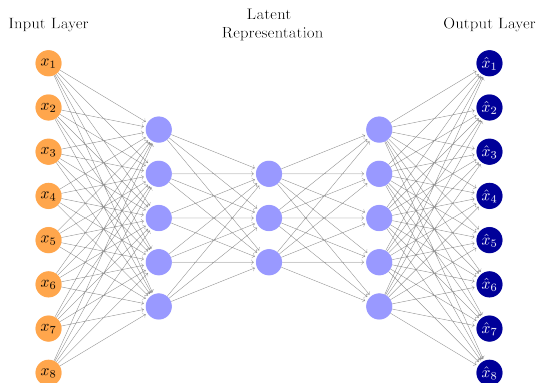
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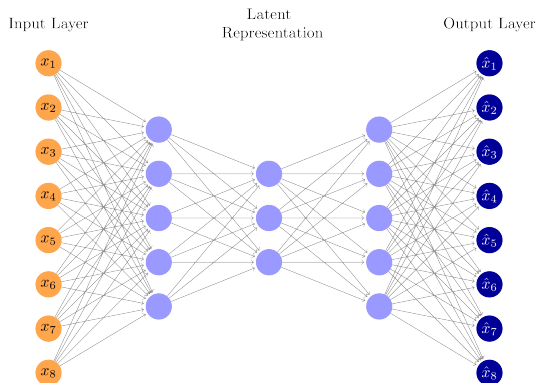
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- Input Dimension = Output Dimension
- Latent Dimension < Input Dimension

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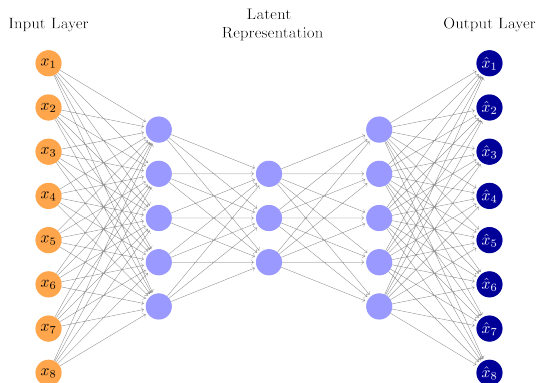
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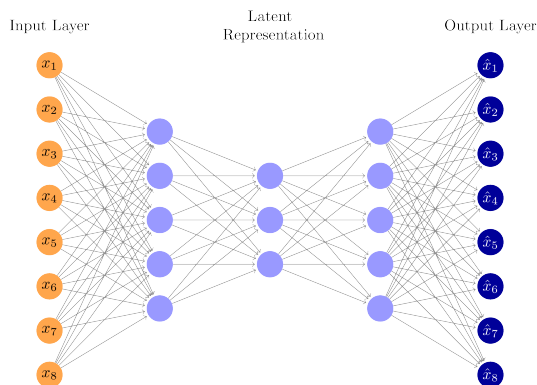
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$$CR = \frac{\text{Input Dimension}}{\text{Latent Dimension}}$$

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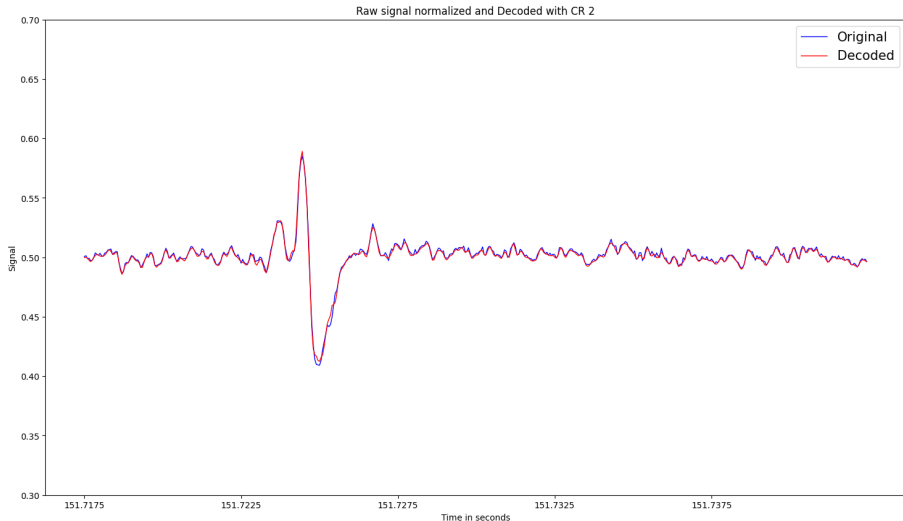


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- Input Dimension = Output Dimension
- Latent Dimension $<$ Input Dimension
- Training: Minimize the MSE between Input and Output
- Compression Rate
$$CR = \frac{\text{Input Dimension}}{\text{Latent Dimension}}$$
- Different Network Architectures can have different CRs
- We're going to inspect CRs 2,4,8,16,32,64,128

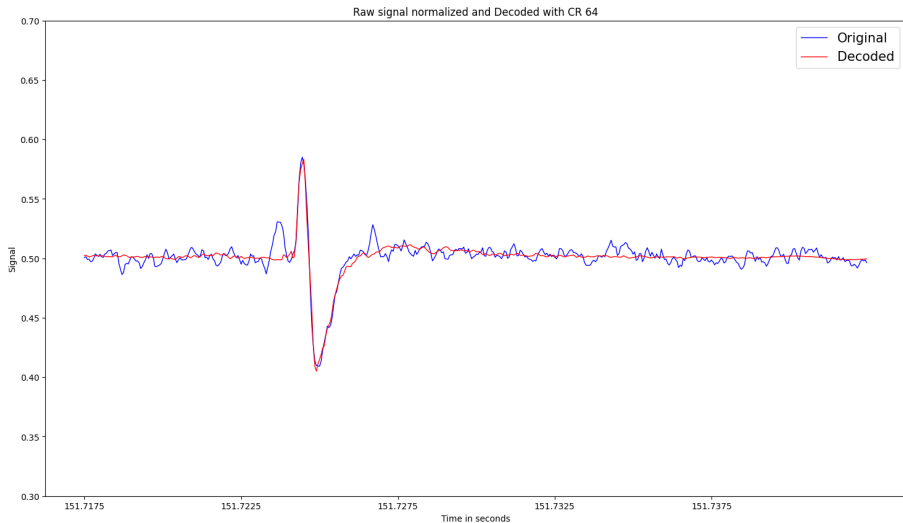
Examples



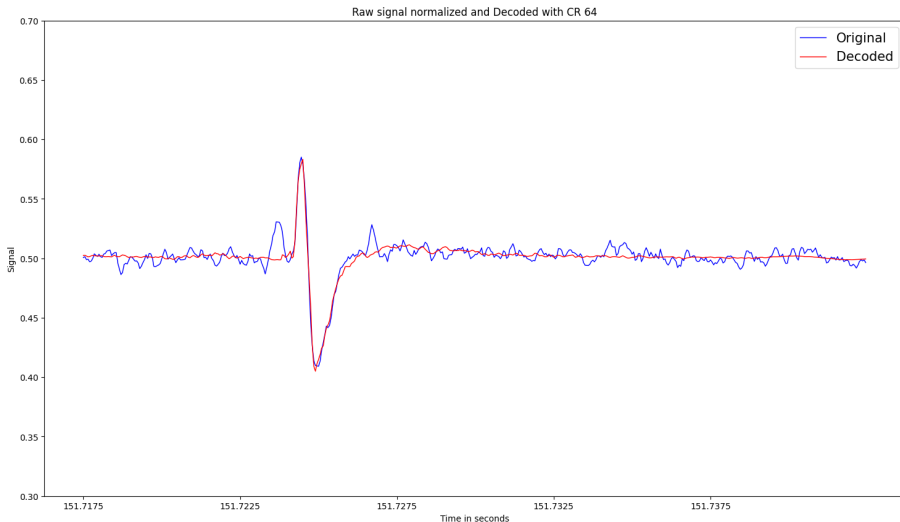
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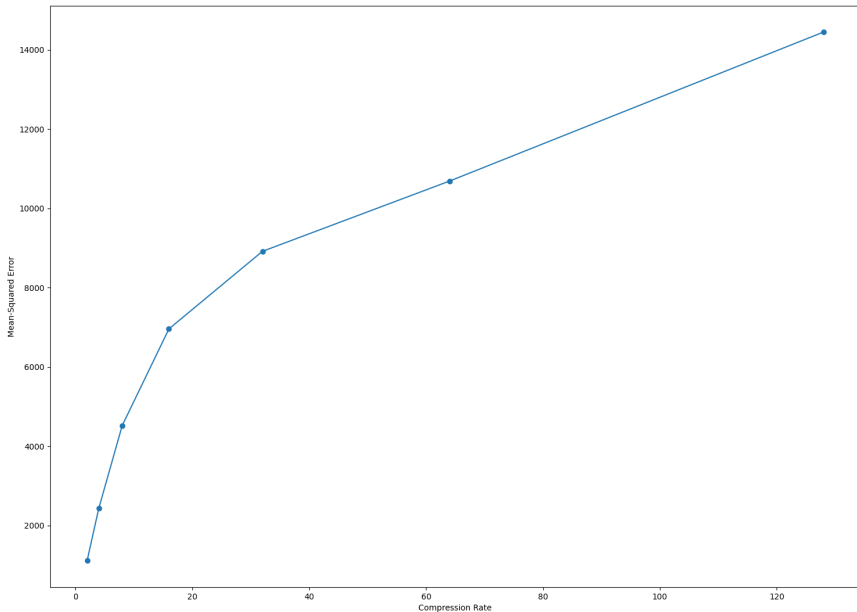


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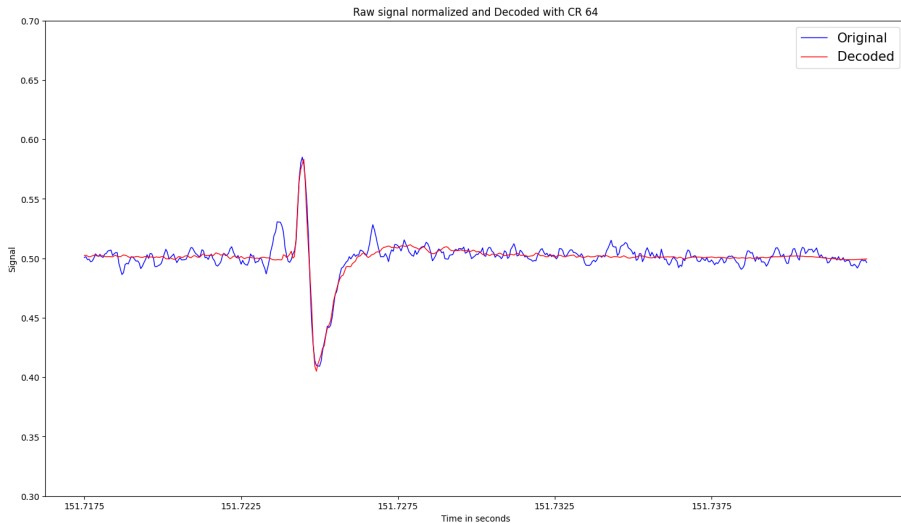


- About 500 sample points
- After compression only 8 points are stored!

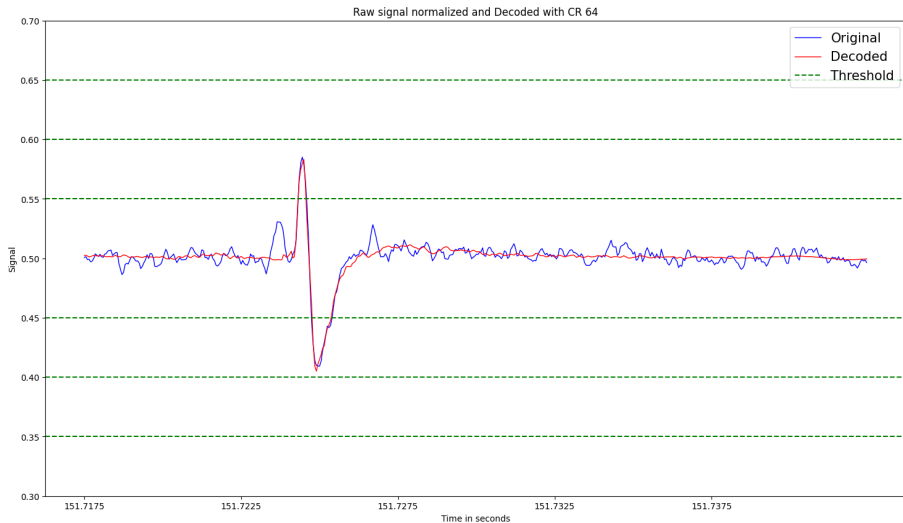
Evaluation



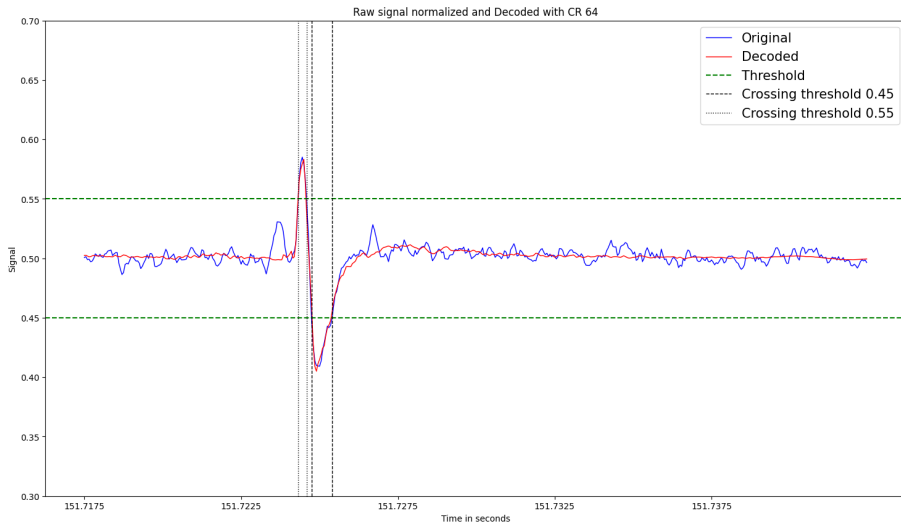
Example continued



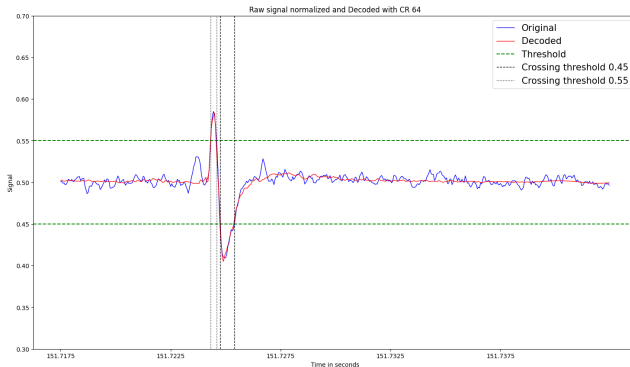
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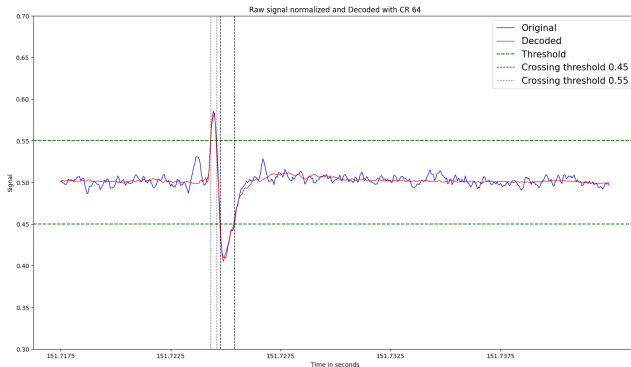


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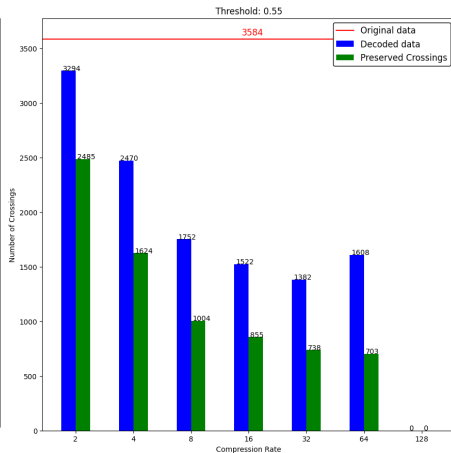
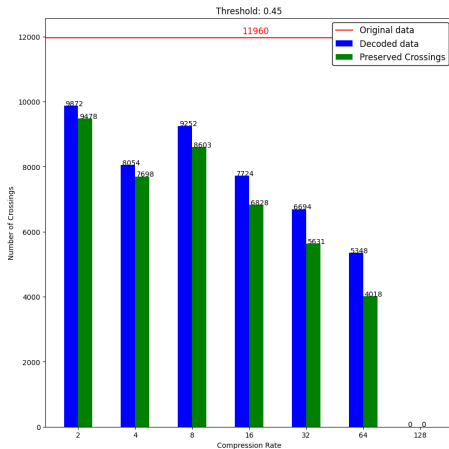
- How often does the original signal cross a threshold?
- How often does the decoded signal cross a threshold?

Example continued

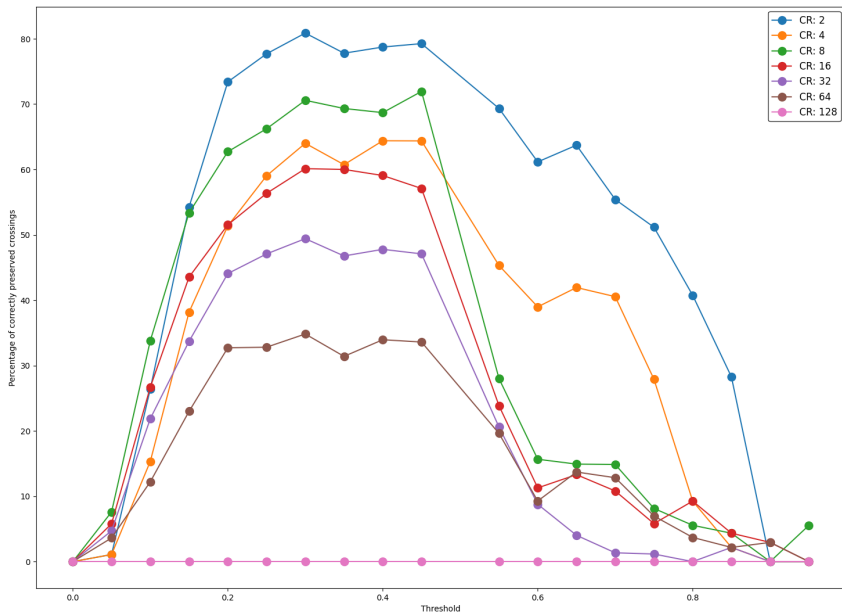


- How often does the original signal cross a threshold?
- How often does the decoded signal cross a threshold?
- How often does the original and the decoded signal cross a threshold at the exact same position? (preserved crossing)

Evaluation continued



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- Basic architecture of an autoencoder
- De-noising and smoothing of the signal
- Performance differences for different compression rates

Future Work

- Practical evaluation
- Optimize the autoencoder with more meaningful metric

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- Optimize the autoencoder with more meaningful metric
- Check more auto-encoders, with smaller jumps in compression rate

Thank you for listening!