Investigating Optimal Visual Inputs for Cortical Neurons

A CNN-based Approach for MEI-Gabor Comparison

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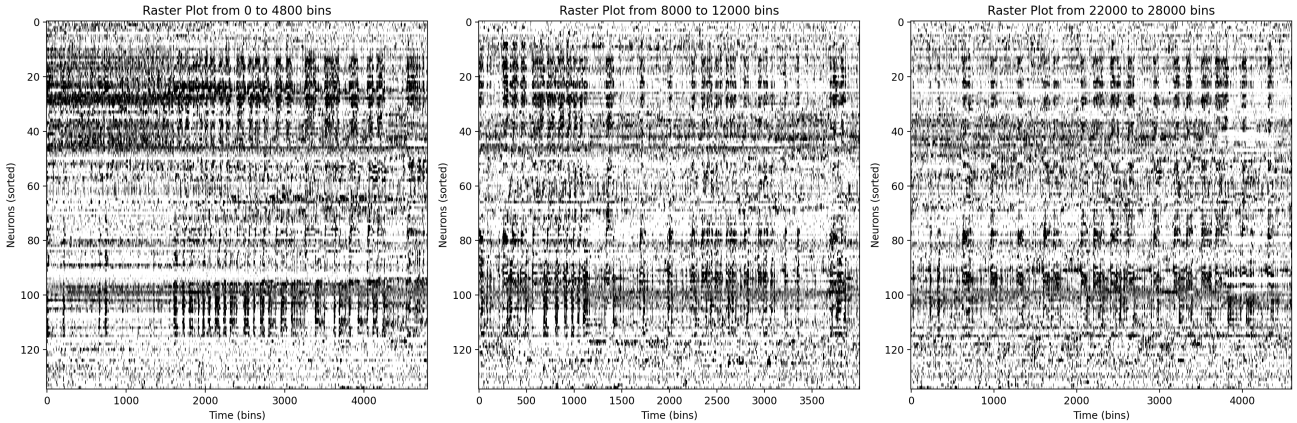
Scope of the Study

- **Goal**: Identify and generate the Most Excitatory Input (**MEI**) for a single neuron. MEIs are specific visual stimuli that are designed to maximally activate the neurons.
- **Methods**: Deep learning techniques on most informative neurons.
- **Validation**: We test the robustness of our findings using Gabor filters as benchmarks.

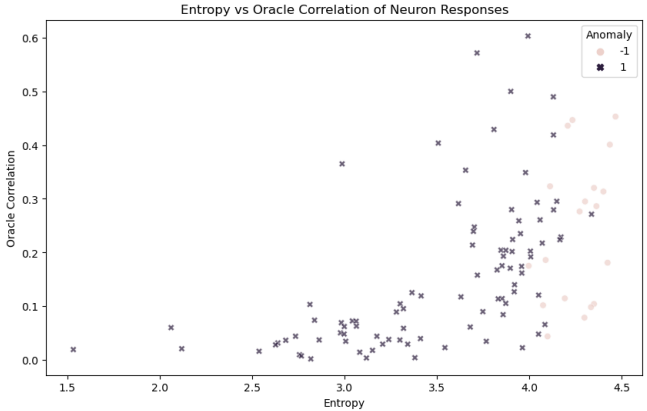


Most Important Neurons (MINs)

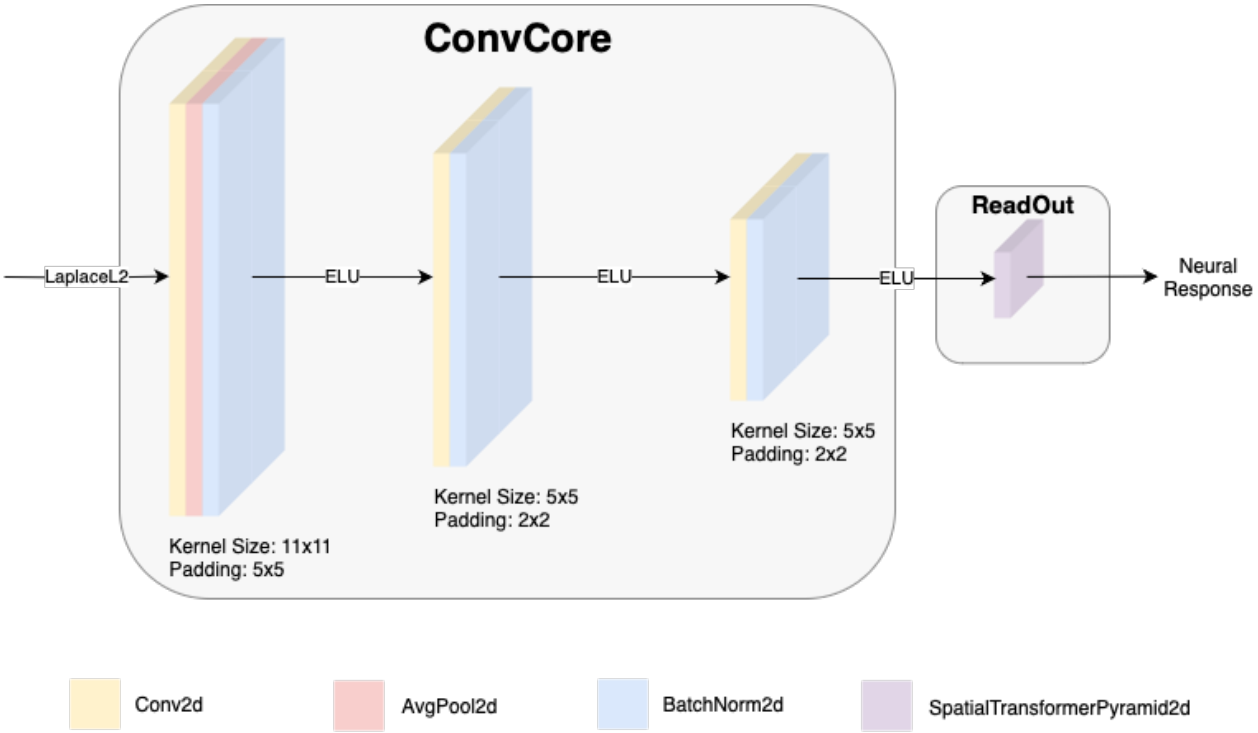
We developed a two step method:

1. **Oracle Correlation**: Compute the *Pearson correlation* of a neuron's response across images, comparing a random response to the average on other trials.
2. **Average (50 runs)**: Repeats the analysis 50 times (typical trial count) and calculates average scores.

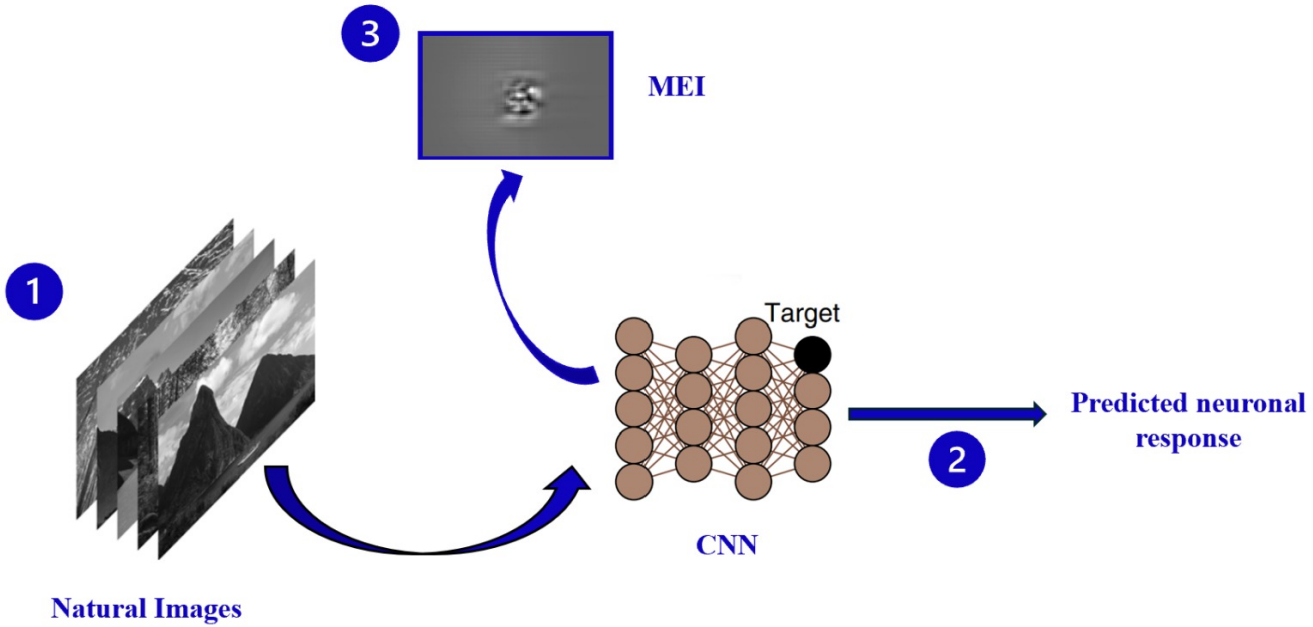
Filter neurons above 60-th percentile of oracle correlation and above 50-th percentile of variance and choose neurons which perform best with the **CNN**.



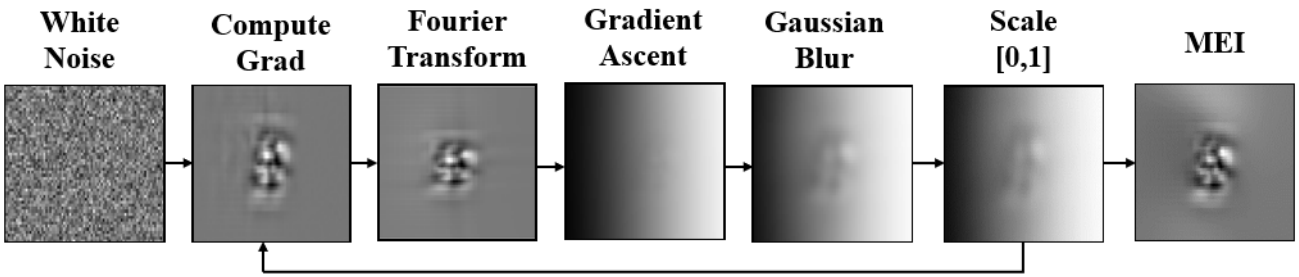
Convolutional Neural Network (CNN)

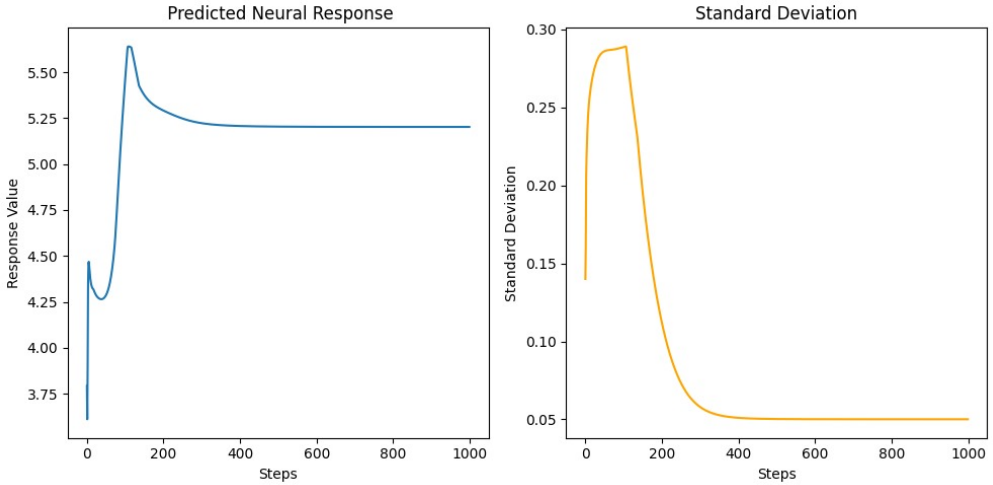


From CNN to MEI

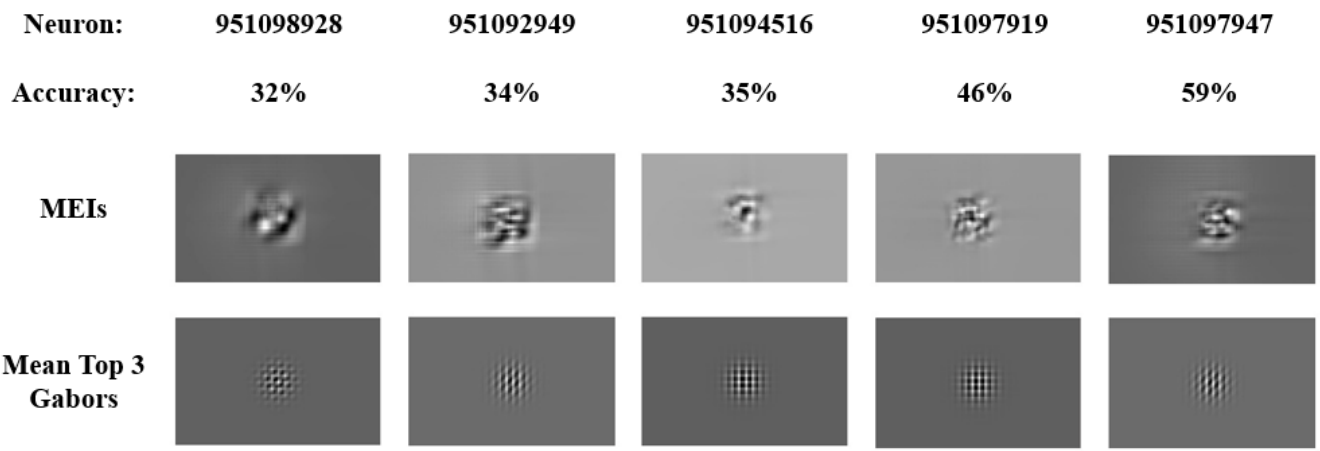


Most Excitatory Inputs (MEIs)





Gabor Comparison



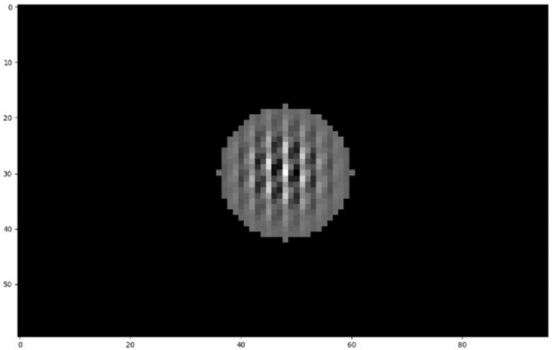
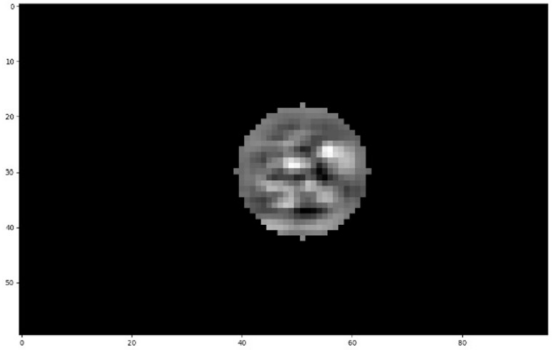
Metrics and Results I

Comparative Analysis:

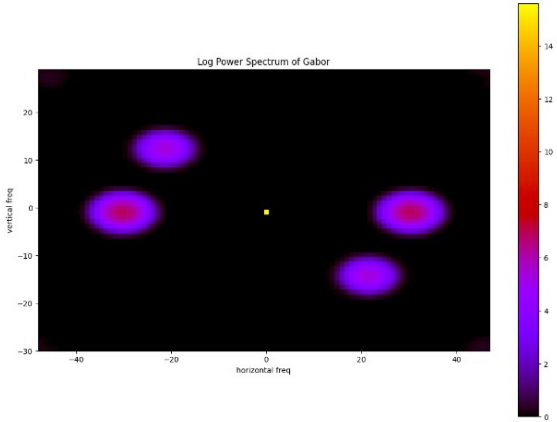
	MEI	Gabor
Luminance	0.4496	0.4097
Contrast	0.1511	0.1323
1-Fold Symmetry Index	0.9696	0.9992
2-Fold Symmetry Index	0.9845	0.9975

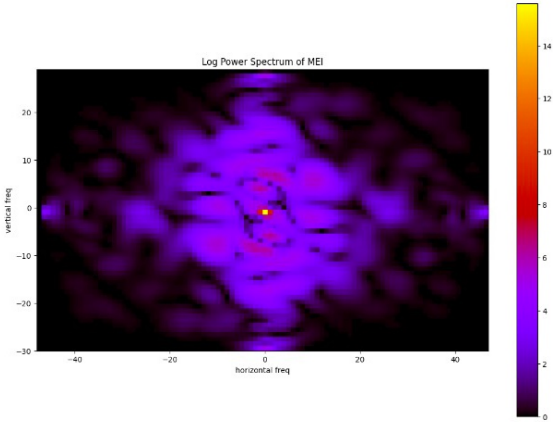
Metrics and Results II

Luminance and Contrast:

Power Spectrum:





Final

Thank you for the attention!