

Assignment 4: Visual RF

Computational Neuroscience

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Part I: Recovering the filter

As shown in figures 1 and 2, the filter recovered from the impulse and the noise differ greatly. The reason for this is because in order to recover the appropriate filter, we need random noise as it is one of the assumptions made to derive the formula used to compute the spike-triggered average response.

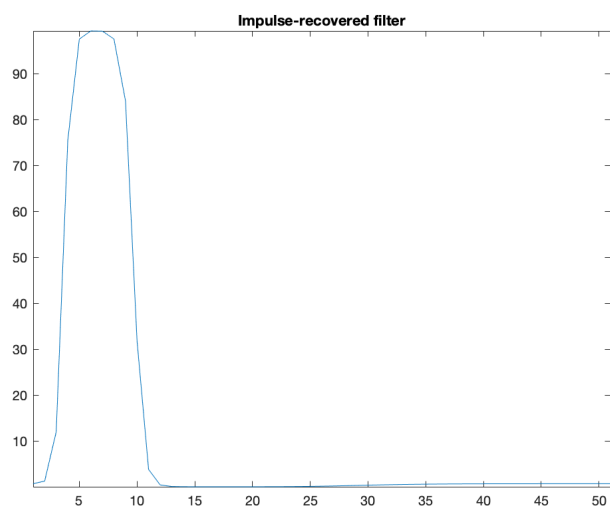


Figure 1

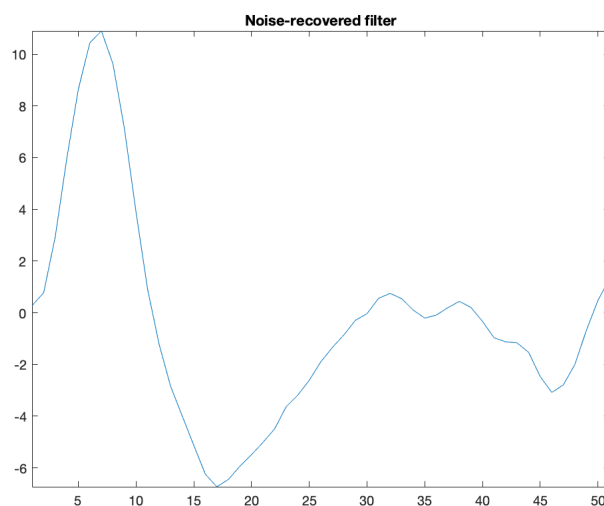


Figure 2

In figure 3, the predicted response using the noise-recovered filter is shown in contrast to the observed response of the neuron. Given that we assumed a linear model, the predicted response does not exactly fit the observed data, hence the negative values.

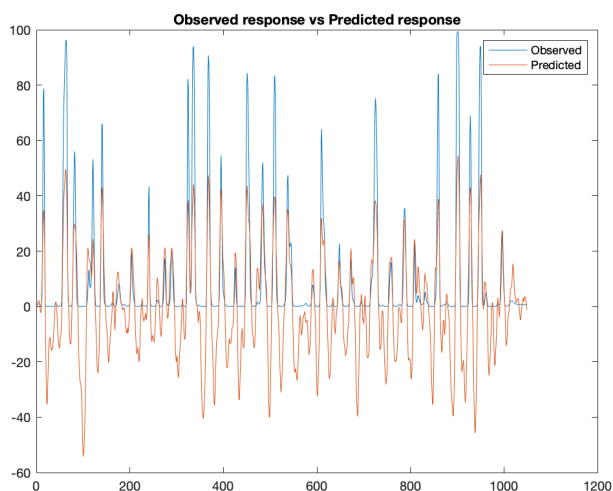


Figure 3

Part I: Testing the filter

In this section, we apply non-linearity to the model by introducing a sigmoid function transformation. The constants were selected by eye (trial-and-error). In figure 4, the difference in the MSE between the predicted and observed responses using the linear model and the non-linear model is illustrated using a bar graph.

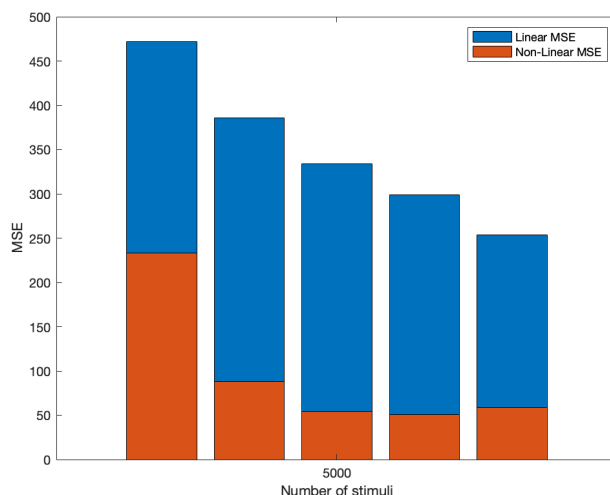
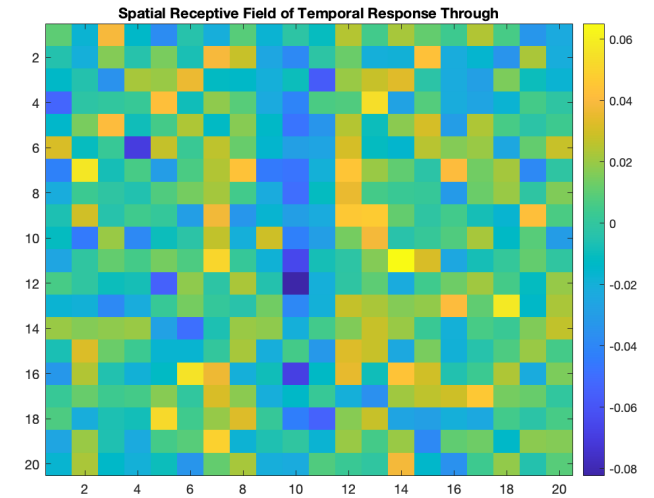
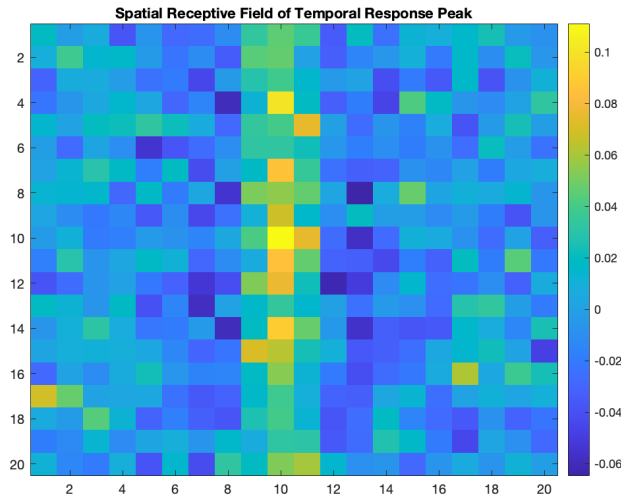


Figure 4

Part II: Spike-triggered averaging with three-dimensional input

As shown in figure 5, the preferred orientation of the V1 neuron is a vertically oriented bar in the center of the receptive field. If we compute the spatial receptive field at the trough of the temporal response, then we see the opposite. In other words, figure 6 is a representation of the average stimulus that activated the surround region of the neuron's receptive field.



The coding part of the assignment was done in collaboration with Austin Cooper mainly through discussion of the concepts seen in class.