

Peer Review for Josue Orellana

Amanda Luby

1 General Comments

Overall, this draft is a big improvement on the second draft. It ‘fits together’ much better now, and it’s more clear how the different sections fit together. For me, putting some time into formatting has made it a lot more readable.

However, there’s still some problems with notation and equations that aren’t fully explained. It would be helpful to give the equations some sort of name that makes it easier for the reader to remember, since you do a lot of referring back and forth to equations. I’m not sure what the standard is for neuro research, but there are still some terms that are used without definitions or references that really confused me.

2 Specific Comments, suggestions, and edits

- Line 17: I think the second part of this sentence is a little awkward. I’d split it into two sentences such as:
‘The brain uses populations of spiking neurons to encode, communicate, and combine sources of information. We are interested in optimizing this process as specified through bayesian inference
- Line 18: I thought this was too much detail of previous work for an abstract. I spent a lot of time trying to decode the technical words (sensorimotor, optimal combination, sensory input, neural modeling, bayesian inferences) that don’t focus on your work.
Maybe condense sentence 2 and 3 into one: For instance, previous work from Kording and Wolpert (2004) and Ma et al (2008) focused on the form in which inputs were combined to produce the posterior mean and variance.
- Line 35: Should this be: ‘In neural encoding terms, a population *code* represents information...’ ?
- Line 45: I think you need another sentence after ‘In this section we define a probabilistic model of population code (Eq. 3)’ to explain the outline of this section - what’s the difference between Eq 1, Eq 2 and Eq 3 and how do they fit together?
- Line 53: It’s awkward wording to use ‘*where* A_i and B_i are constants...’ before they’re used in an equation. Maybe use ‘We let..’ instead
- Line 81: In addition to ‘ θ , θ_{PDi} and μ_θ are directional values’, could you also give an intuitive explanation for what directions they represent?

- Figure 1: It would be helpful to have the parameter names included on all of the axis labels. (i.e. what parameter or variable corresponds to ‘response’)
- Line 91: I think you could use a couple citations to back up that ‘neural populations do exhibit correlations in firing rate’
- Line 101: ‘Bayesian Decoders’ is terminology we don’t know yet. Maybe a sentence to introduce what it means and why it’s important.

I also think you should introduce the symbols θ and r at the same time as ‘stimulus’ and ‘response’. It’s hard to comprehend the equation when we don’t know what θ and r stand for beforehand.

(reader expectations)

- Equations 5 and 6: It’s unclear to me whether these are two different equations, or if it’s just an extension of what the posterior can be computed with. If it’s the latter, you should make the \propto symbols align on each line. It’s also totally unclear to me where the four different terms of the likelihood came from.

You should also make *exp* non-italicized

(reduce cognitive load, math advice)

- Line 116: It’s a little hard to read this sentence, since it starts with ‘mathspeak’. I’d add a ‘Where’ or ‘Note that’ beforehand

(math advice)

- Line 197: I would make it clear that ‘credible interval size’ references L_B and ‘confidence interval size’ references L_{pv} .

(reduce cognitive load)