

POSTER PRESENTATION

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# Optimal information encoding for multiple, simultaneously presented stimuli

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Information in the brain is usually encoded in a way that distributes the activity over a population of neurons, referred to as *population coding*[1]. Population coding has been observed in almost all brain systems and renders the neural code robust, accurate, and failure resistant.

The coding of single stimuli in population codes is relatively well understood [2], and in particular the noise models, correlations, neural heterogeneity and links to psychophysics have been studied. However, the situation is much less clear when multiple stimuli are simultaneously encoded [3].

Theoretical studies (e.g., [4]) have thus far only examined linear supposition schemes that encode a probabilistic stimulus ensemble. However, experimental studies (c.f. [5], [6], [7]) suggest a non-linear encoding scheme using a maximum rule, where the response of a single neuron to a pair of stimuli equals the response to the constituent that on its own produces the maximum response, i.e.

$$R_{A,B} = \max(R_A, R_B)$$

We investigate the theoretical implications of these findings by comparing different encoding strategies and examine the decoding accuracy. The goal is to find the optimal encoding scheme for multiple stimuli.

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In our current study, we focus on the simultaneous coding of visual stimuli representing overlapping

movements of two groups of points in different directions. We investigate different ways of decoding these, among them a Maximum Likelihood decoder and estimate error rates made by these predictors, comparing to maximum rule to a linear rule.

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#### References

1. Pouget A, Dayan P, Zemel R: **Information processing with population codes.** *Nature Reviews Neuroscience* 2000, **1**(2):125-132.
2. Averbeck B, Latham P, Pouget A: **Neural correlations, population coding and computation.** *Nature reviews Neuroscience* 2006, **7**(5):358-66, doi:10.1038/nrn1888.
3. Treue S, Hol K, Rauber H: **Seeing multiple directions of motion-physiology and psychophysics.** *Nature neuroscience* 2000, **3**(3):270-6, doi:10.1038/72985.
4. Zemel R, Dayan P: **Distributional population codes and multiple motion models.** *Advances in Neural Information Processing Systems* 1999, **11**.
5. Gawne T, Martin J: **Responses of primate visual cortical neurons to stimuli presented by flash, saccade, blink, and external darkening.** *Journal of neurophysiology* 2002, **88**(5):2178-86.
6. Lampl I, Ferster D, Poggio T, Riesenhuber M: **Intracellular measurements of spatial integration and the MAX operation in complex cells of the cat primary visual cortex.** *Journal of neurophysiology* 2004, **92**(5):2704-13, doi:10.1152/jn.00060.2004.
7. Oleksiak A, Klink P, Postma A, van der Ham I, Lankheet M, van Wezel R: **Spatial summation in macaque parietal area 7a follows a winner-take-all rule.** *Journal of neurophysiology* 2011, **105**(3):1150-8, doi:10.1152/jn.00907.2010.

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