Exploring computational models of visual object perception

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Encoding and decoding ventral activity

- Models of perception in anterior stages of the visual stream are few in number and tests of these models' consistency with neural data have been limited
- Cadieu et al have demonstrated HMAX's ability to predict responses in V4
- We explore HMAX's ability to describe fMRI activity throughout the ventral stream

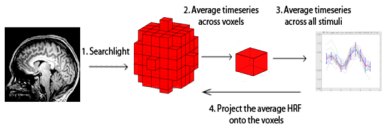
Experimental design

- Participants shown images of 60 objects, 6 x each

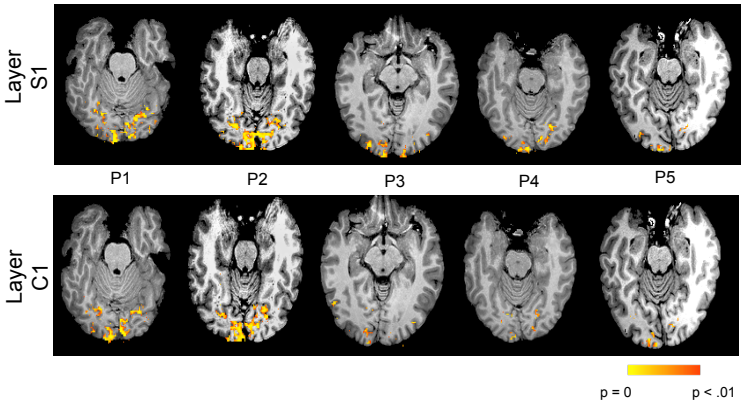
- BOLD signals recorded with slow event-related design (2 sec TR, partial coverage)

Measuring responses—Searchlight Projection

- Constructed "searchlight"—123 voxel sphere—centered at each voxel (Kriegeskorte et al., 2006):



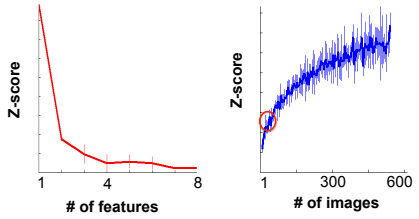
Fitting results for the first pair of layers



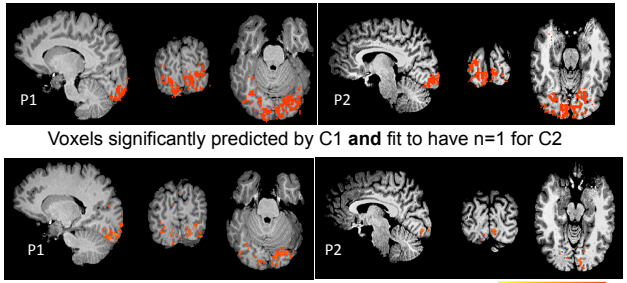
Simulated C2 performance

Second pair of layers best model fMRI data

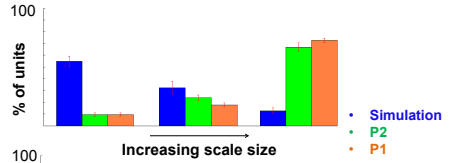
- selecting for fewer C1 units
- using 5x as much training available to us



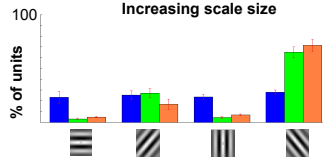
Fitting results for the second pair of layers



- Preference for larger edges



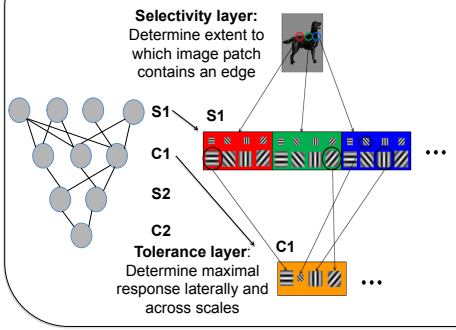
- Preference for and



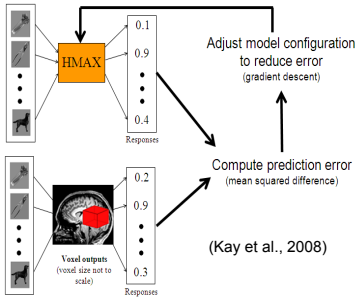
Discussion

- The first two selectivity and tolerance layers are reasonable in accounting for responses in early visual areas
- Fitting of the second pair of layers appears to be noise limited—a larger stimulus set might help
- While HMAX was designed to model individual neurons, more-limited selectivity and tolerance computations are also observable on voxel-scale cortical activity

The HMAX model:

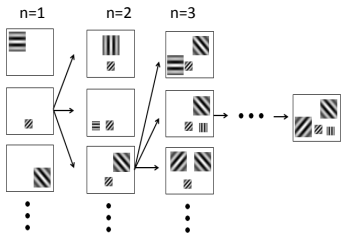


Fitting the 1st pair of layers



Fitting the 2nd pair of layers

- Determine feature selectivity for the second pair of layers using a greedy search algorithm (Cadieu et al., 2007)



References

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Acknowledgments

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