Representation and Computation in Natural Vision

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Pattern recognition systems that are invariant to shape, pose, lighting and texture are never sufficiently selective; they suffer a high rate of ``false alarms". How are biological vision systems both invariant and selective? Specifically, how are proper arrangements of sub-patterns distinguished from the chance arrangements that defeat selectivity in artificial systems? The answer may lie in the nonlinear dynamics that characterize complex and other invariant cell types: these cells are {\em temporarily} more receptive to some inputs than to others (*functional connectivity*). One consequence is that pairs of such cells with overlapping receptive fields will possess a related property that might be termed *functional common input*. Functional common input would induce high correlation exactly when there is a match in the sub-patterns appearing in the overlapping receptive fields. These correlations, possibly expressed as a partial and highly local synchrony, would amount to a physiological signal for a composition of parts, thereby preserving the selectivity otherwise lost to invariance

In search of experimental confirmation of this proposed answer to the selectivity/invariance dilemma, the investigators employ new statistical and methodological techniques to study new questions about the receptive-field properties of invariant cells, and to measure new variables in the joint statistics of invariant cells with overlapping receptive fields.

PI Website

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Project Publications

S. Geman. Invariance and Selectivity in the Ventral Visual Pathway. Submitted for publication.

A. Amarasingham, T.-L. Chen, S. Geman, M. Harrison, and D.L. Sheinberg. Spike Count Variability and the Poisson Hypothesis. Submitted for publication.

Paradiso MA, MacEvoy SP, Huang X, Blau S. The importance of modulatory input for V1 activity and perception. Progress in Brain Research. In press.

Huang X, Paradiso MA. Background changes delay information represented in macaque V1 neurons. In revision.

Huang X, Blau S, Paradiso MA. Temporal aspects of human discrimination and detection correlate with the dynamics of macaque V1 neurons. In revision.