Visual discrimination and adaptation using non-linear unsupervised learning

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1. OUR WORK:

Development of algorithms based on non-linear ICA[1], Gaussianization and principal curves that can be tuned for different goals (information maximization or error minimization):

- Sequential Principal Curves Analysis (SPCA).[2]
- Principal Polynomial Analysis (PPA).[3]
- Rotation-Based Iterative Gaussianization (RBIG).[4]

2. NON-LINEAR TECHNIQUES:

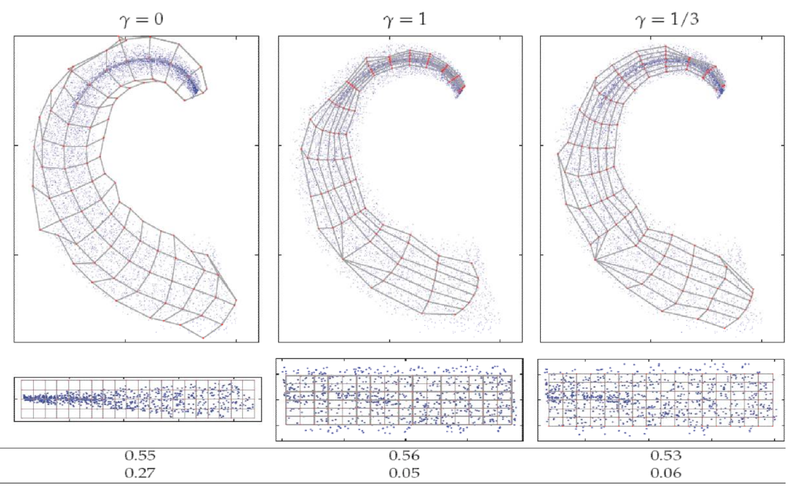
Unsupervised learning is based on considering the stimuli as vector, x, in a multidimensional space.[5] Then, one assumes a set of sensors or mechanisms that transform the input stimulus into a set of responses, r:

$$\mathbf{x} \underset{R^{-1}}{\overset{R}{\rightleftarrows}} \mathbf{r}$$

- Requirement of sensors:
  - Make experimentally testable prediction.
  - Invertibility.
  - Easy computation of discrimination measures in the input space.

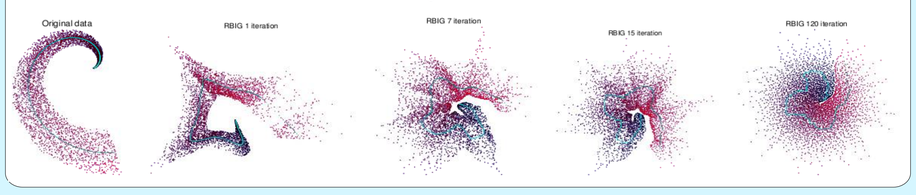
- Learning Strategies:
  - Identify the meaningful directions.
  - Mapping into a domain where the statistical properties are perfectly determined.

SPCA

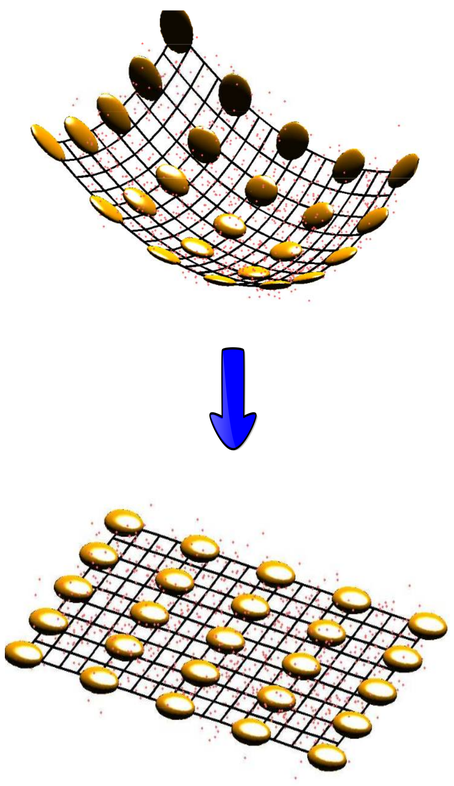


RBIG

$$p_{\mathbf{x}}(\mathbf{x}) = p_{\mathbf{y}}(\mathcal{G}(\mathbf{x}))|\nabla_{\mathbf{x}}\mathcal{G}(\mathbf{x})|$$

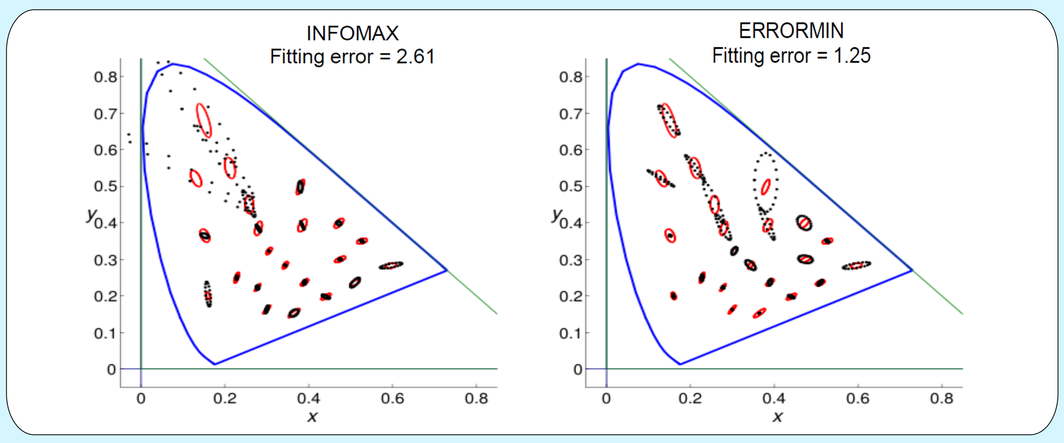


PPA

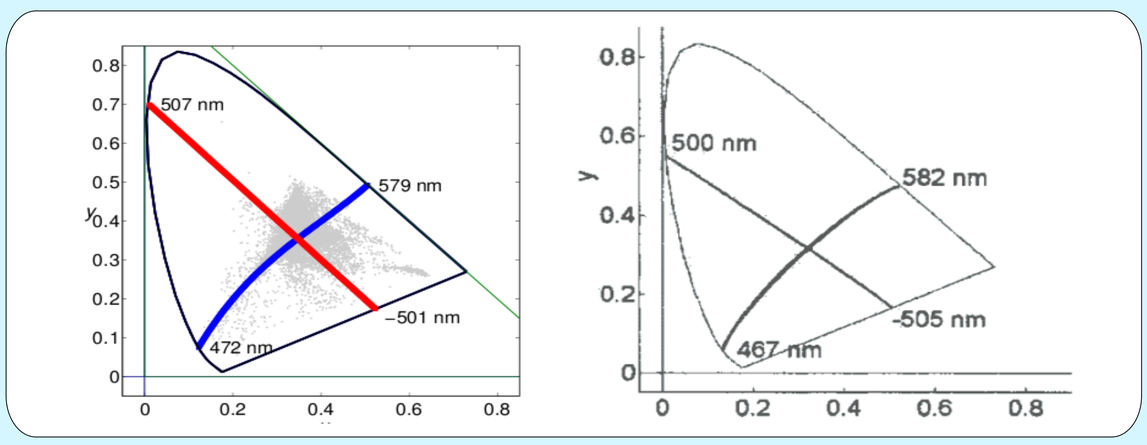


3. GALLERY OF PREDICTIONS:

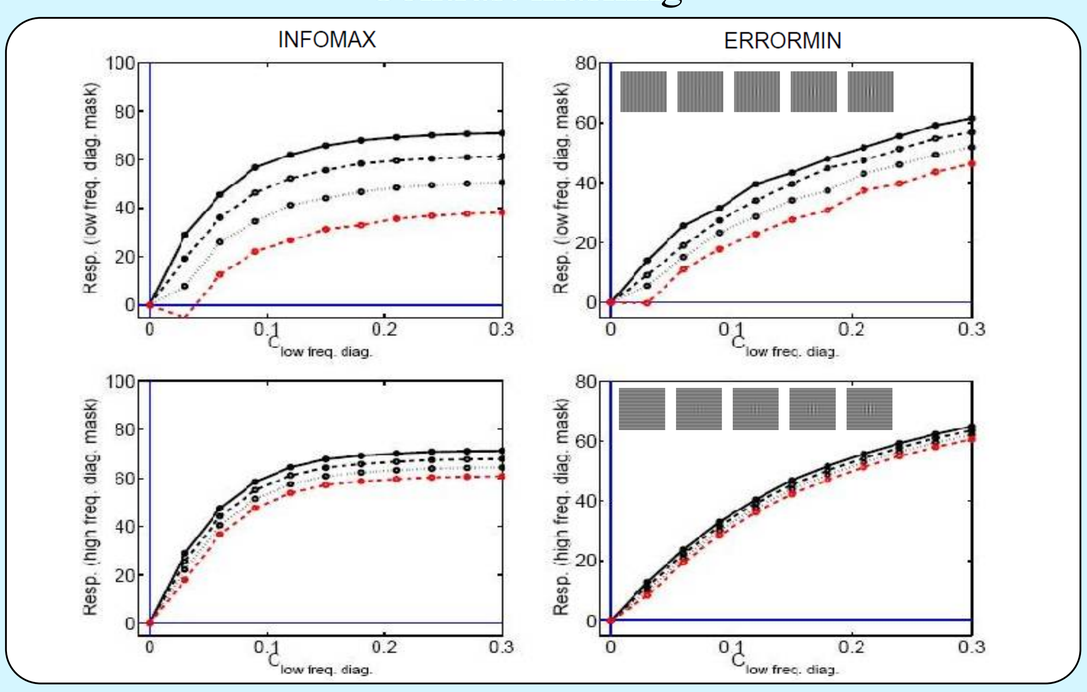
Color Discrimination [6,7]



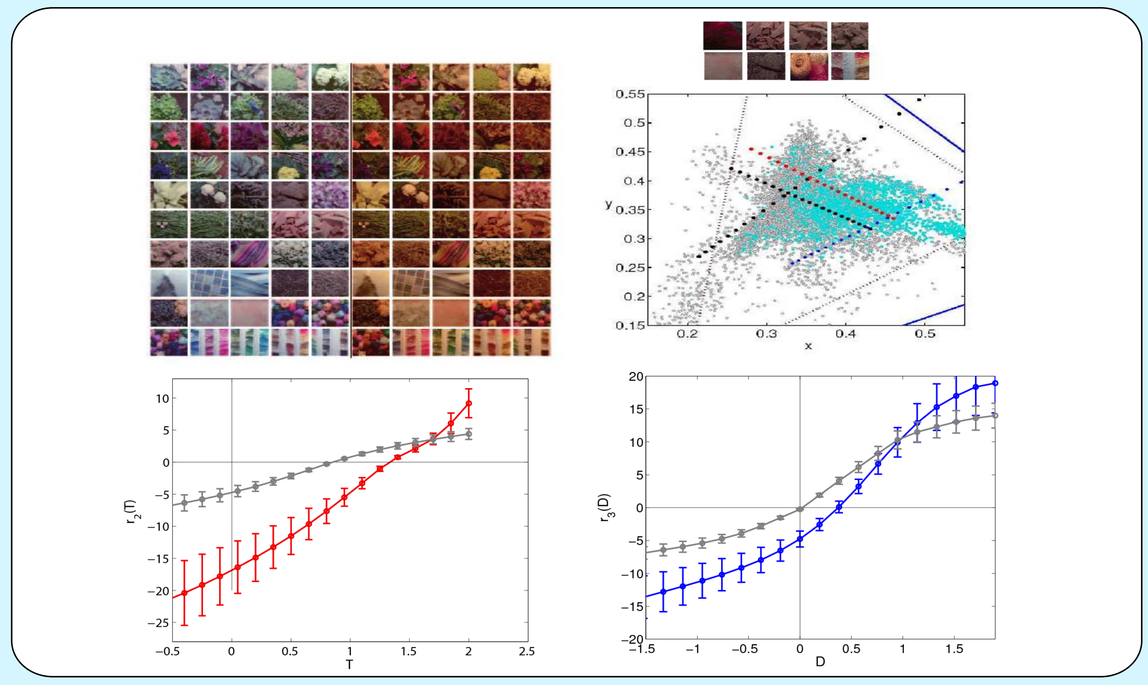
Non-linear color sensors [9,10]



Contrast masking [8]



Color aftereffects [11,12]



6. REFERENCES:

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