Image decomposition into a bounded variation component and an oscillating component.

$f(x)$, $x = (x_1, x_2)$ is the grey level of the given image at $x \in \mathbb{R}^2$

If the point x is black, $f(x) = 0$ while $f(x) = 1$ if x is white

A black and white image is a function in $L^\infty(\mathbb{R}^2)$.

Most functions in $L^\infty(\mathbb{R}^2)$ are not natural images.

Modelling natural images.

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URA CNRS ...
Université de Paris-Dauphine

Natural images reflect the geometrical organization of the external world.

Modelling natural images should be consistent

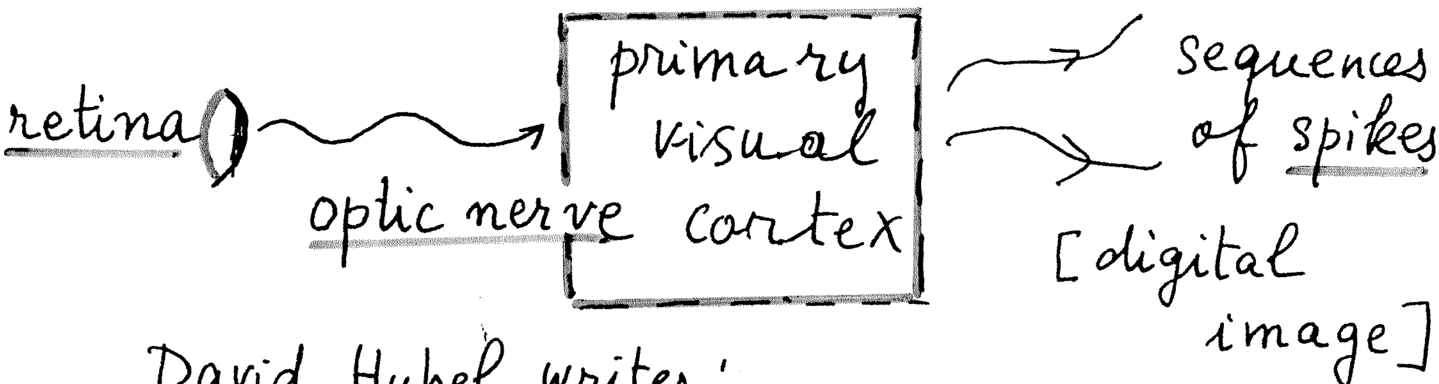
(1) with geometry

(2) with perception

Role of contours in perception

Place du Maréchal de Lattre de Tassigny 75775 PARIS cedex 16
Téléphone : (1) 45 05 14 10 - 47 27 75 67 - Fax : (1) 47 55 48 57

David HUBEL & Torsten WIESEL



David Hubel writes:

"The commonest type of cells fires most vigorously to a short line segment — to a dark line, a bright line, or to an edge boundary between dark and light. Each cell is influenced in its firing only by a restricted range of line orientations: a line more than about 15 to 30 degrees from the optimum generally evokes no response. Cells are determining whether there are contours (light-dark or color) in the visual scene, and collectively registering their orientations..."

Contours with finite length can be drawn (by a painter).
The mathematical model is

$$BV(\mathbb{R}^2).$$

Example of a texture: a cornfield.
A painter does not draw every ear of a cornfield.

Modelling textures raises difficult problems.

Additive models

$f = u + v$ (or $f = u + v + w$)

where

u represents the objects delimited by contours with finite lengths

v represents the texture

w represents the noise.

PROGRAM

1. Modelling <u>objects</u> with their <u>contours</u>

2. Modelling the unorganized component of an image (<u>texture</u> + <u>noise</u>).

3. <u>Decomposition</u> of an image f as a sum $f = u + v$ where u = <u>objects</u> with their contours,
v = <u>texture + noise</u>.

4. Denoising and <u>compression</u>.