Active Vision

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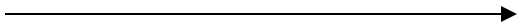
Slides credit:Bob Fisher & Bas Boom

Active Vision Introduction

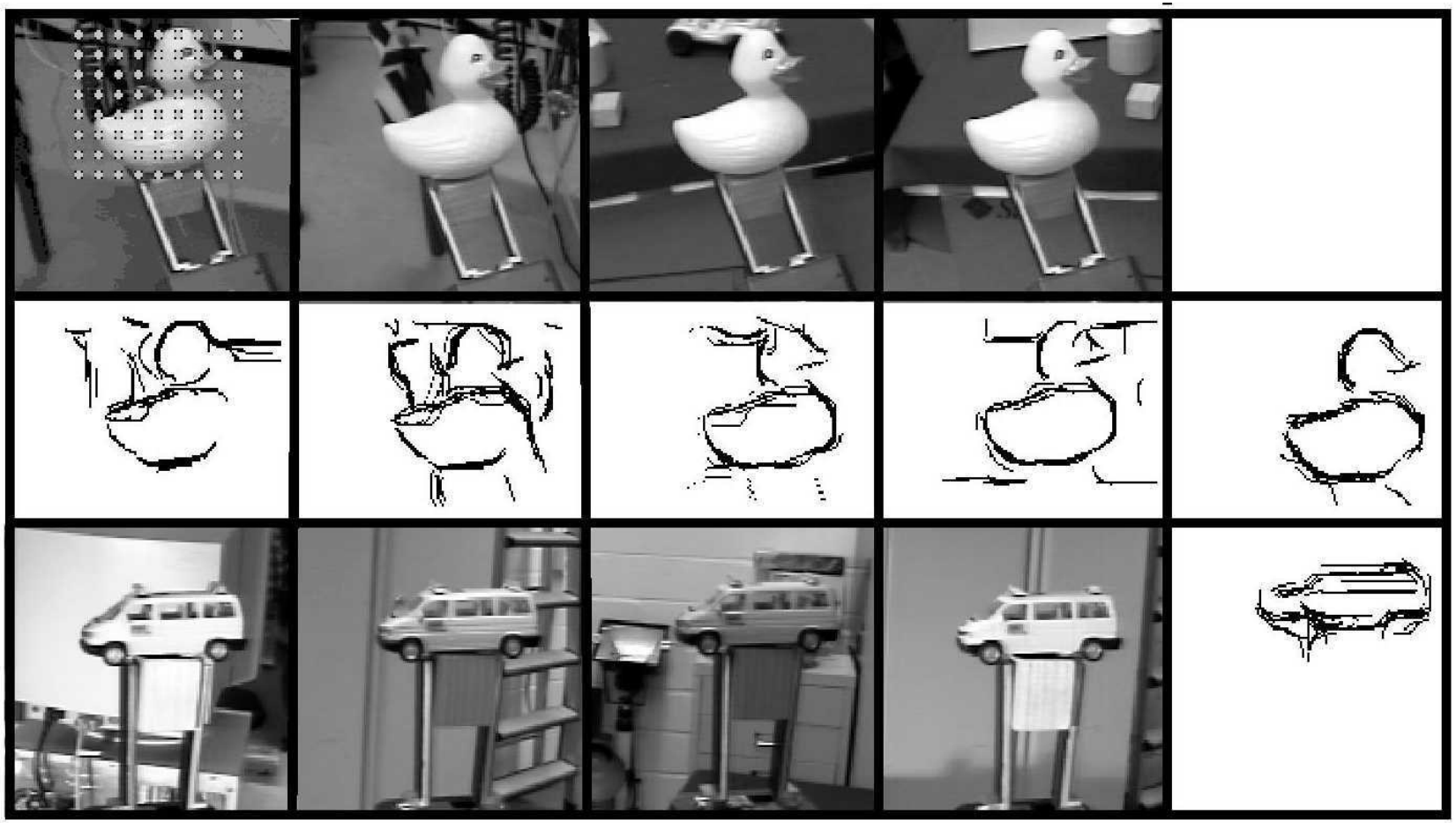
- Acting to obtain extra or easier information
- Extracting motion information from a spatio-temporal image pattern
- Eye movements – focus of attention
- Depth and structure from motion

The importance of activity

- Computer vision is often approached as a problem of passive extraction of information from single images
- But most natural vision systems try to actively sample the visual scene
- Can solve some problems with active system that are hard with passive system

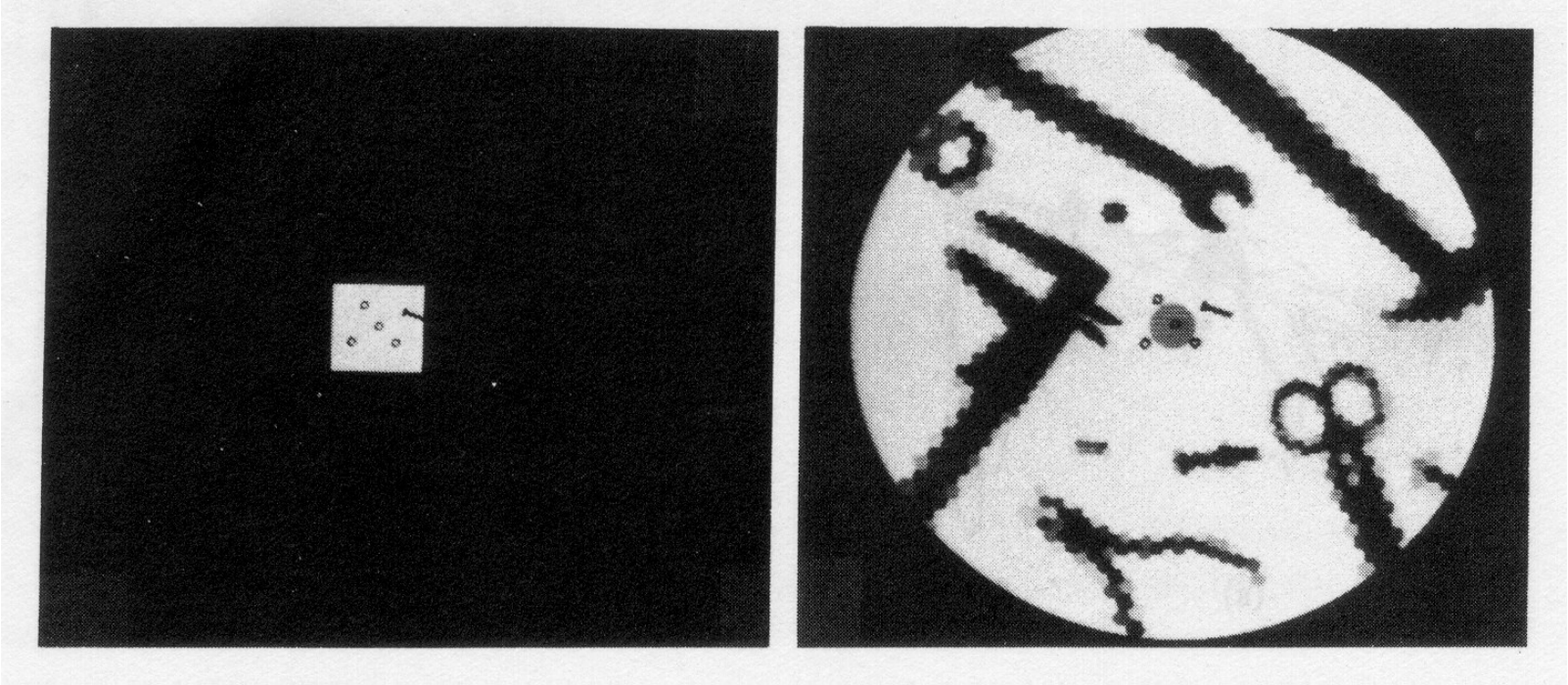


Segmenting (Kruger, 1998)



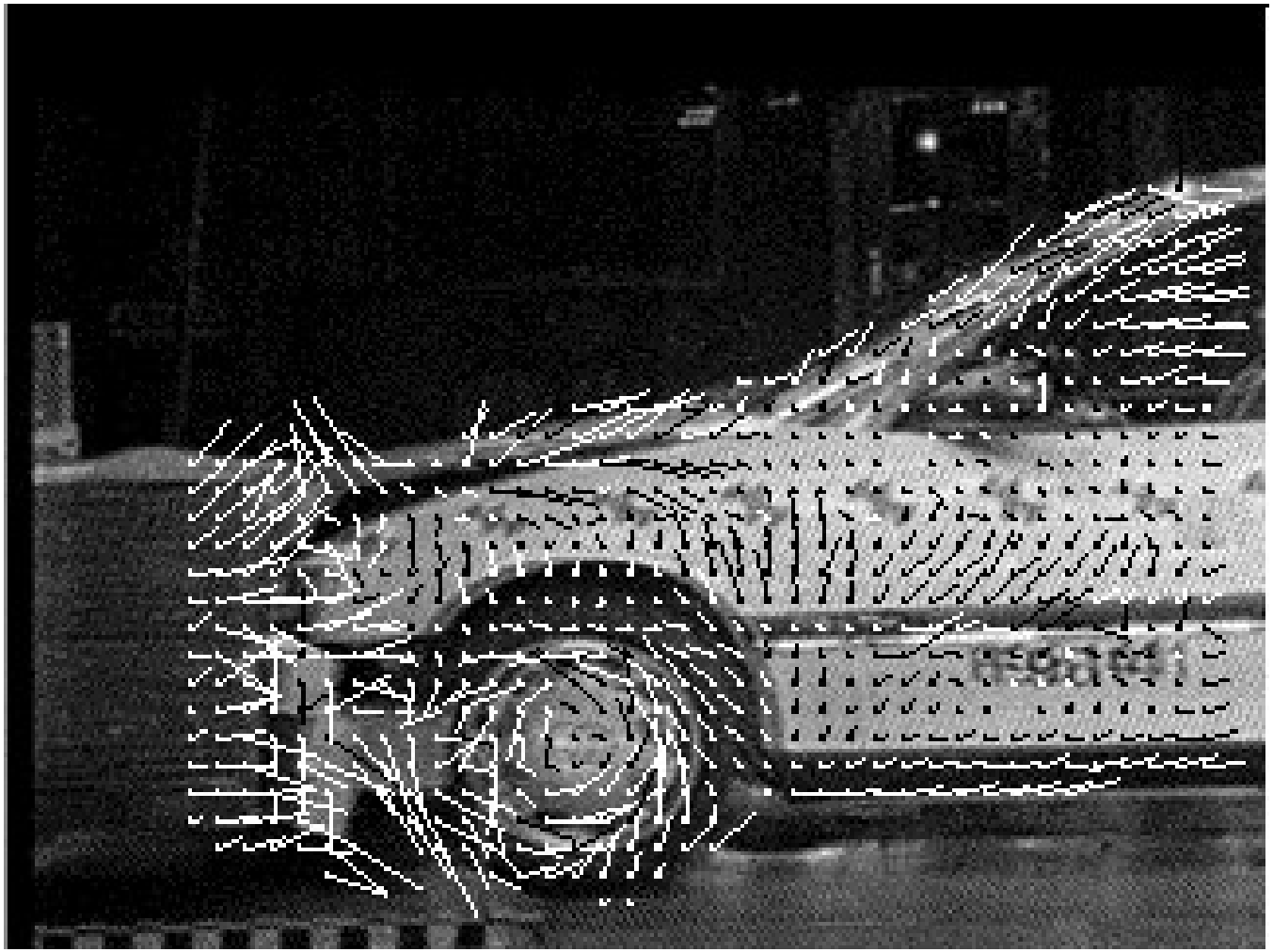
Fixating on foreground with changing background gives object

Improving resolution

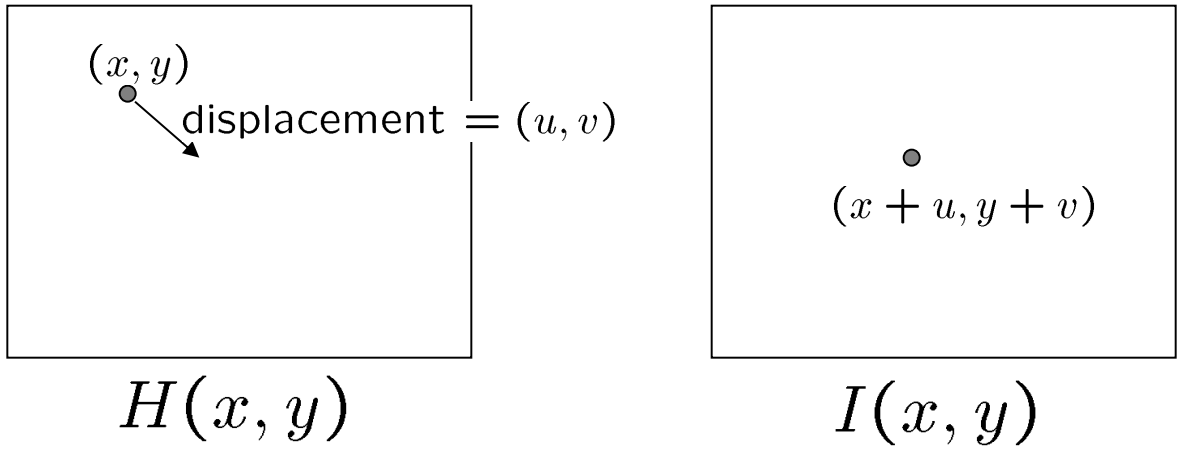


Making best use of fixed number of receptors e.g. 100x100 pixels (Ballard, 1991)

Optical Flow – where every image pixel is moving to



Optical Flow



Let's look at these constraints more closely:

- brightness constancy: Q: what's the equation?

$$H(x, y) = I(x+u, y+v)$$

- small motion: (u and v are less than 1 pixel)

Take the Taylor series expansion of I():

$$I(x+u, y+v) = I(x, y) + \frac{\partial I}{\partial x}u + \frac{\partial I}{\partial y}v + \text{higher order terms}$$

$$\approx I(x, y) + \frac{\partial I}{\partial x}u + \frac{\partial I}{\partial y}v$$

Optical Flow 2

Combining these two equation:

$$
\begin{aligned}
0 &= I(x+u, y+v) - H(x,y) \\
&\approx I(x,y) + I_x u + I_y v - H(x,y) \\
&\approx (I(x,y) - H(x,y)) + I_x u + I_y v \\
&\approx I_t + I_x u + I_y v \\
&\approx I_t + \nabla I \cdot [u \ v]
\end{aligned}
$$

shorthand: $I_x = \frac{\partial I}{\partial x}$

The x-component of the gradient vector.

Lecture Overview

+ Camera or scene motion gives extra information
+ Mathematical relations like optical flow constrain how images can change