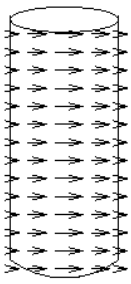
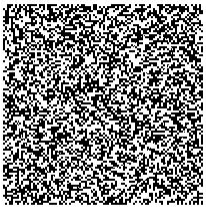
Analysis of Motion

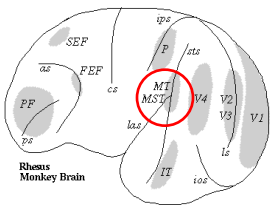
Measuring image motion

CS332 Visual Processing
Department of Computer Science
Wellesley College

Analysis of visual motion



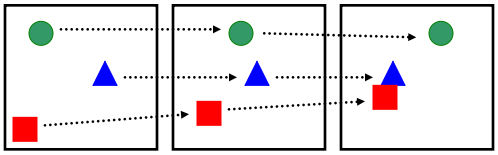




Representations of image motion

(1) velocity field

(2) correspondence



Human visual system:

(1) short-range motion process

(2) long-range motion process

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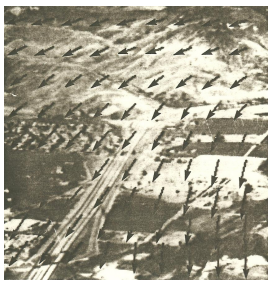
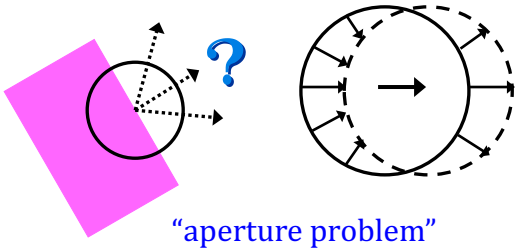
Measuring image motion

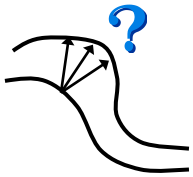


velocity field



"aperture problem"

"local" motion detectors only measure *component of motion* perpendicular to moving edge



2D velocity field not determined *uniquely* from the changing image

need *additional constraint* to compute a unique velocity field

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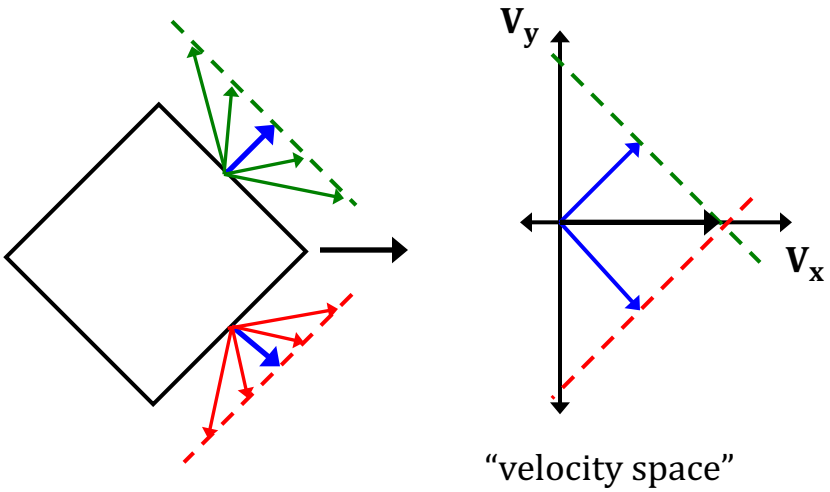
Option 1: Assume *pure translation*



"velocity space"

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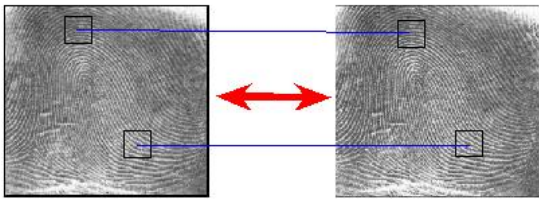
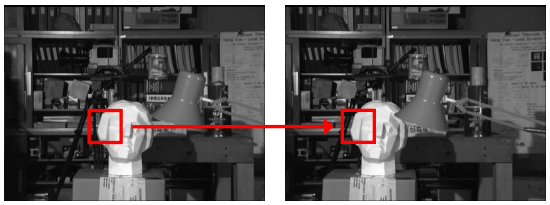


mystery

Sohie!



motion measurement strategy!

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Practical considerations for methods based on pure translation:

- Error in initial motion measurements
- Velocities not constant locally
- Local image features may have small range of orientations

But… such strategies are good for

- detecting sudden movements
- tracking
- detecting boundaries

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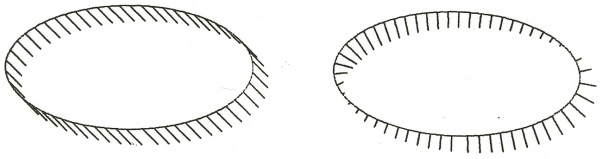
Option 2: *Smoothness* assumption:

Compute a velocity field that:

(1) is consistent with local measurements of image motion (perpendicular components)

(2) has the *least amount of variation* possible

Pure Translation:



true & smoothest velocity field

initial motion measurements

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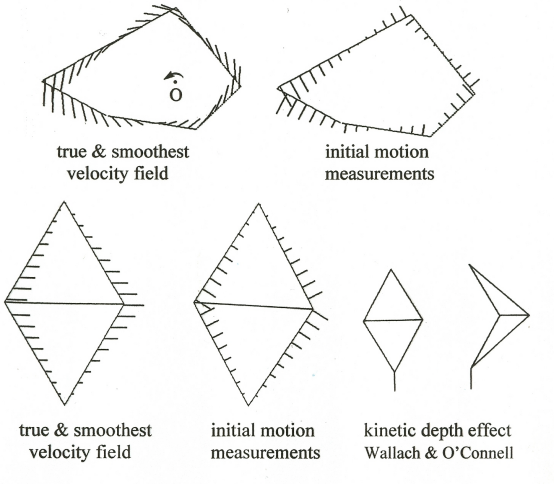
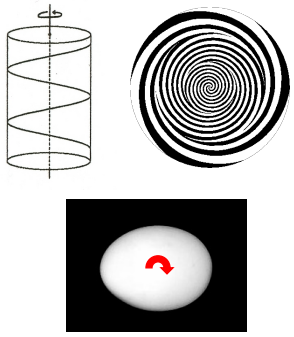
When is the *smoothest* velocity field *correct?*

Rotation of rigid objects in 2D and 3D:



When is it *wrong?*



motion *illusions*

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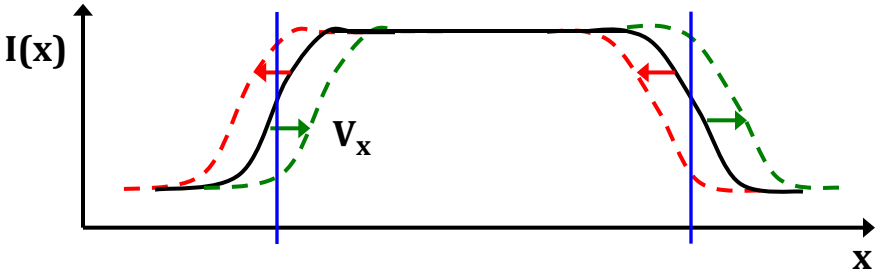
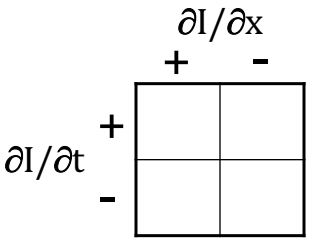
Measuring motion in one dimension



V_x = velocity in x direction

- rightward movement: $V_x > 0$
- leftward movement: $V_x < 0$
- speed: $|V_x|$
- pixels/time step

$$V_x = -\frac{\partial I/\partial t}{\partial I/\partial x}$$



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