Analysis of Motion

Measuring image motion

CS332 Visual Processing
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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

Measuring image motion

“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
Option 1: Assume *pure translation*

"velocity space"

mystery  Sohie!

motion measurement strategy!
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

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

Rotation of rigid objects in 2D and 3D:

- true & smoothest velocity field
- initial motion measurements

When is it wrong?

- kinetic depth effect
  Wallach & O’Connell

**motion illusions**

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**Measuring motion in one dimension**

\[ I(x) \]

- \( V_x \) = velocity in \( x \) direction
  - rightward movement: \( V_x > 0 \)
  - leftward movement: \( V_x < 0 \)
- speed: \( | V_x | \)
- pixels/time step

\[ V_x = - \frac{\partial l / \partial t}{\partial l / \partial x} \]