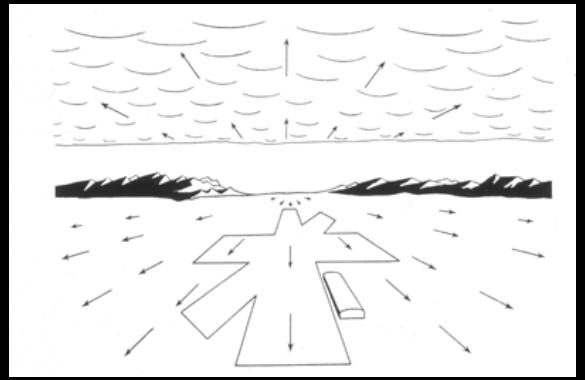
CS4495/6495
Introduction to Computer Vision

6A-L1 *Introduction to motion*



Visual motion

Many slides adapted from S. Seitz, R. Szeliski, M. Pollefeys, K. Grauman and others…

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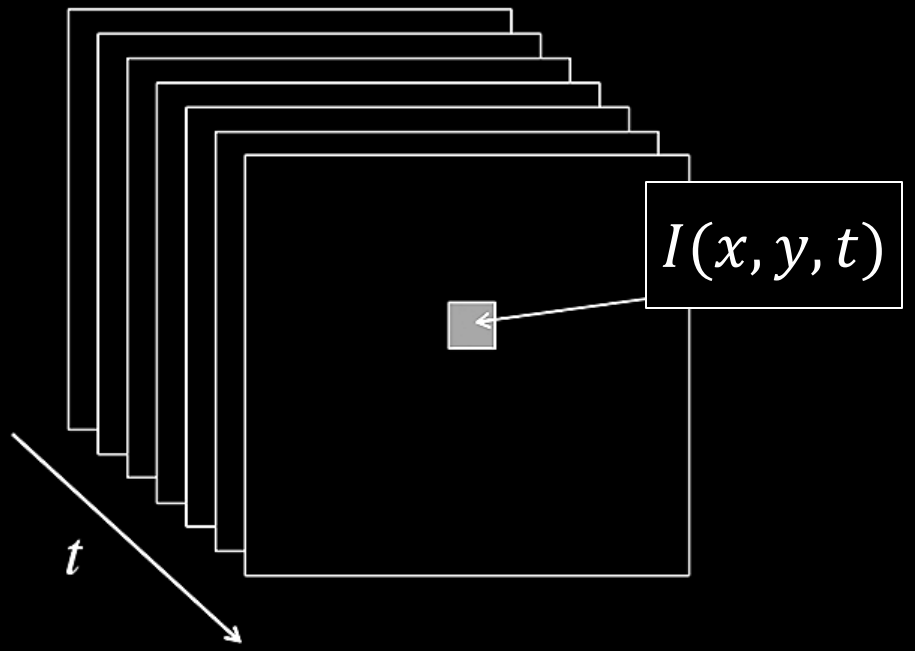
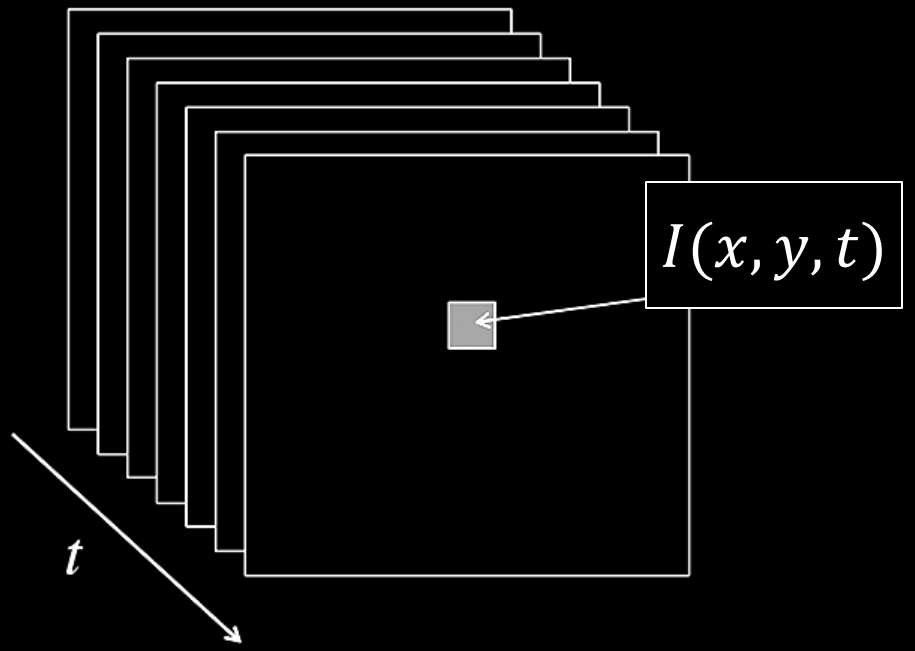
Video

- A video is a sequence of frames captured over time – usually quickly.



Video

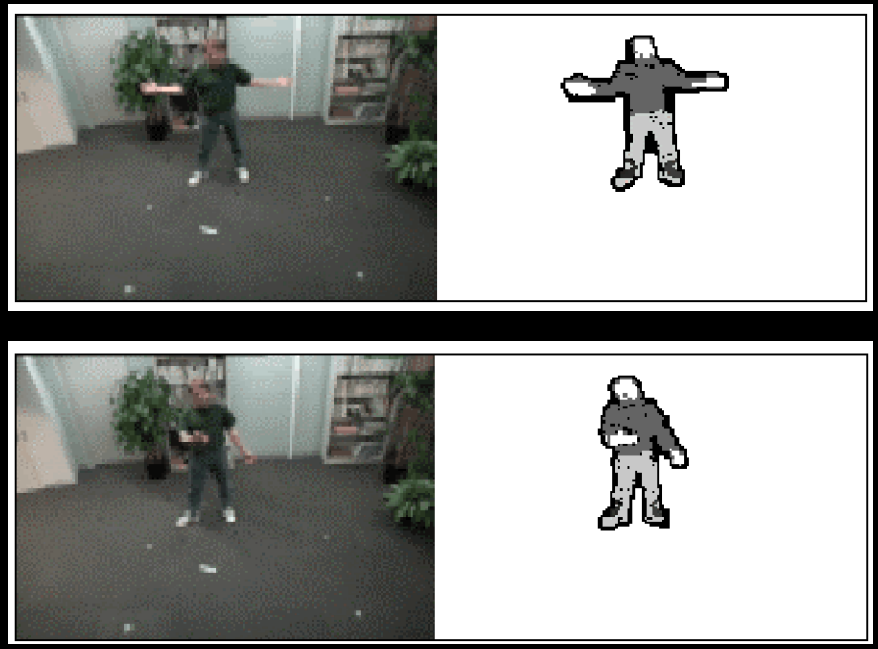
- Now our image data is a function of space (x, y) and time (t)



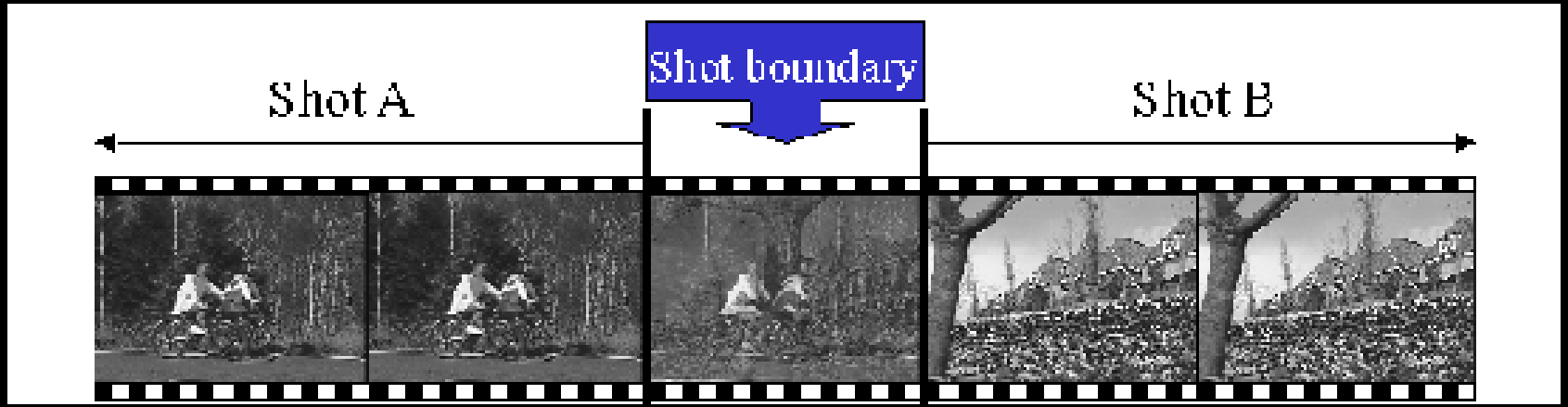
Motion Applications: Video segmentation

Background subtraction

- A static camera is observing a scene
- Goal: separate the static background from the moving foreground



- Shot boundary detection



- Shot boundary detection
  - Commercial video is usually composed of shots
  - Goal: segment video into shots for summarization and browsing
  - Difference from background subtraction: the camera is not necessarily stationary

- Background subtraction
- Shot boundary detection
- Motion segmentation
  - Segment the video into multiple coherently moving objects

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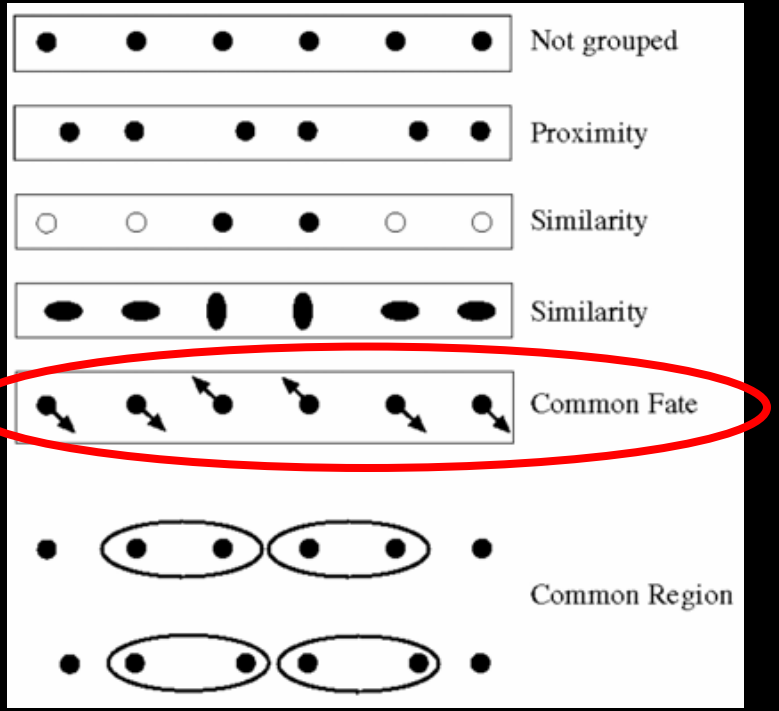
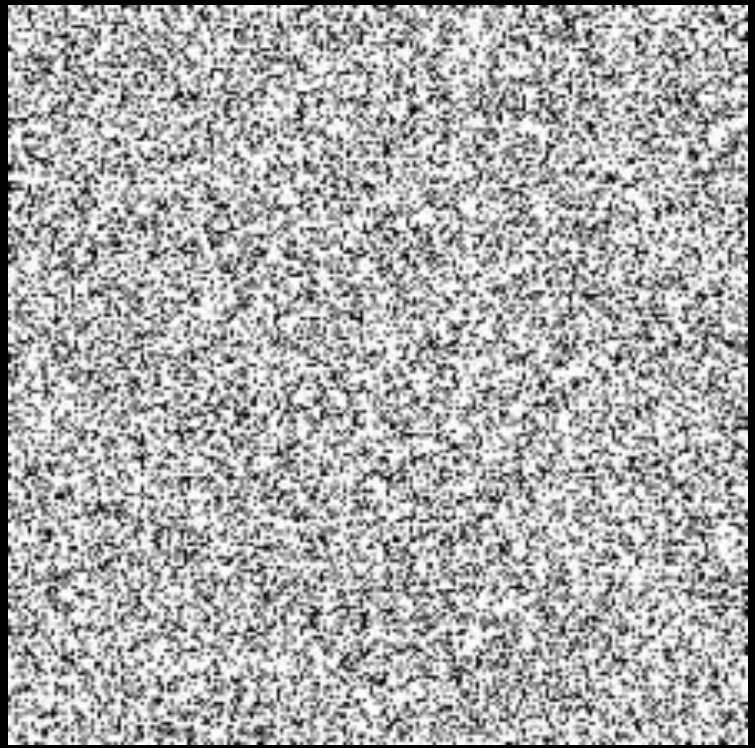
Motion and perceptual organization

- Gestalt psychology (Wertheimer, 1880-1943)



Motion and perceptual organization

- Sometimes, motion is the only cue



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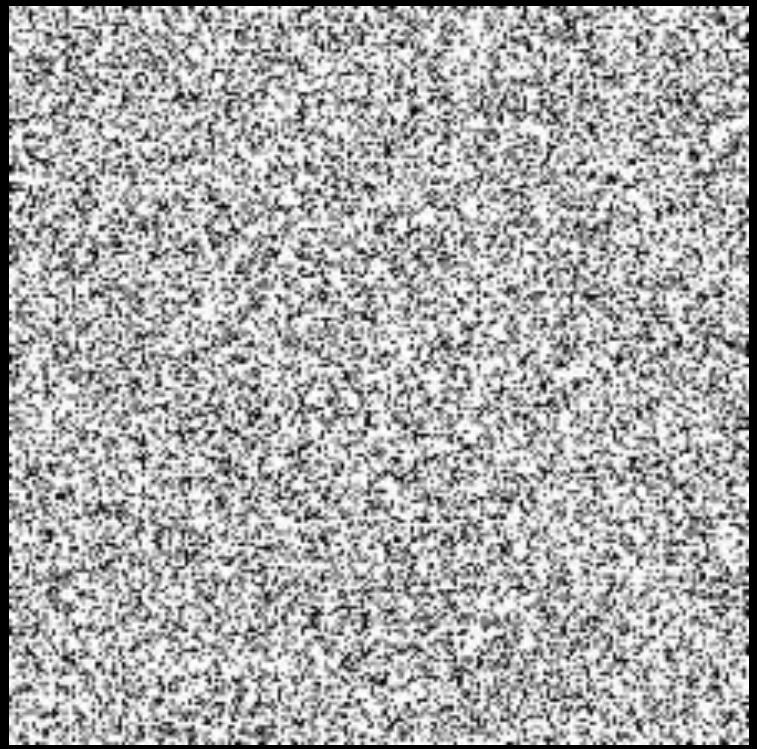

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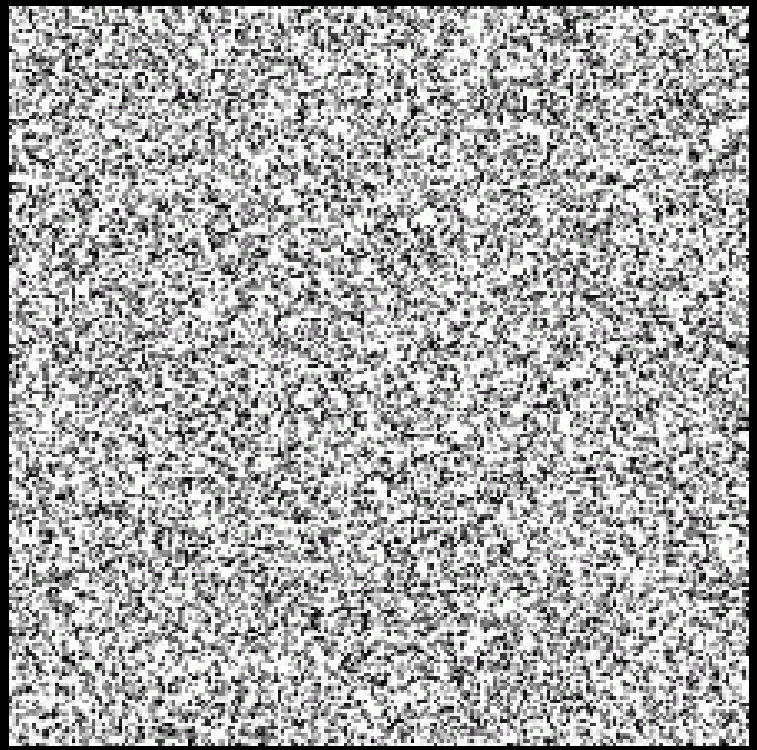
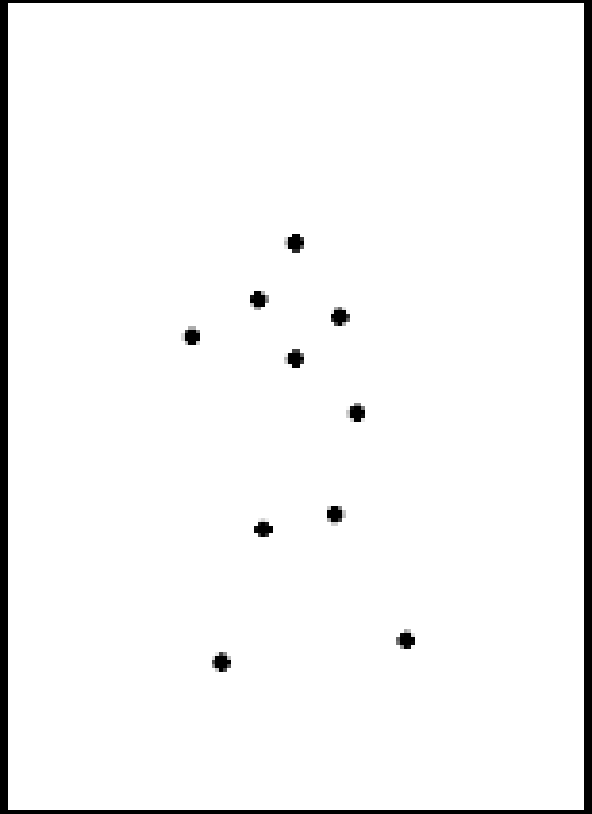


Even *impoverished* motion data can evoke a strong percept



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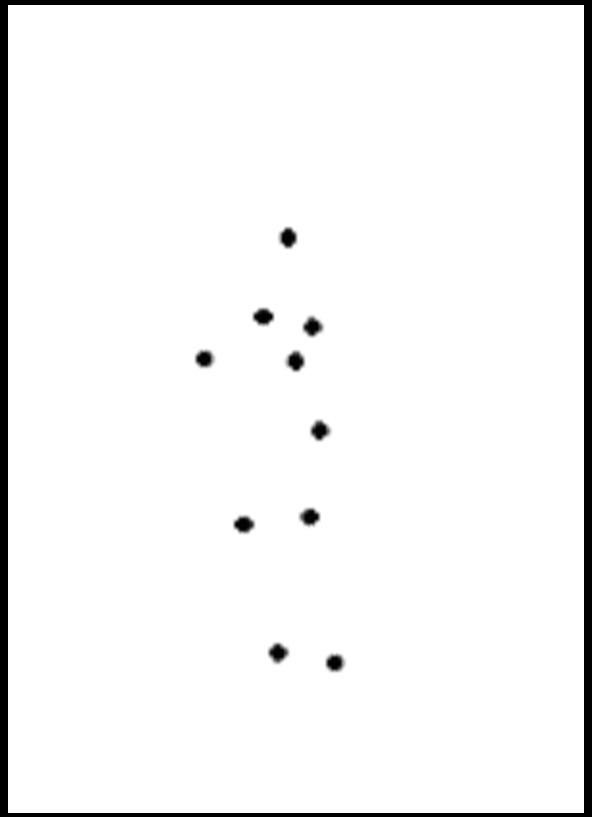
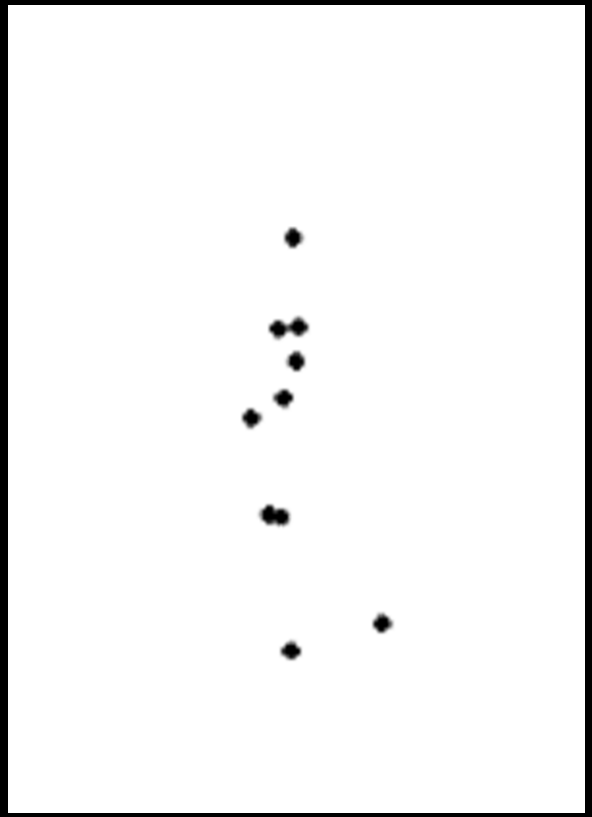
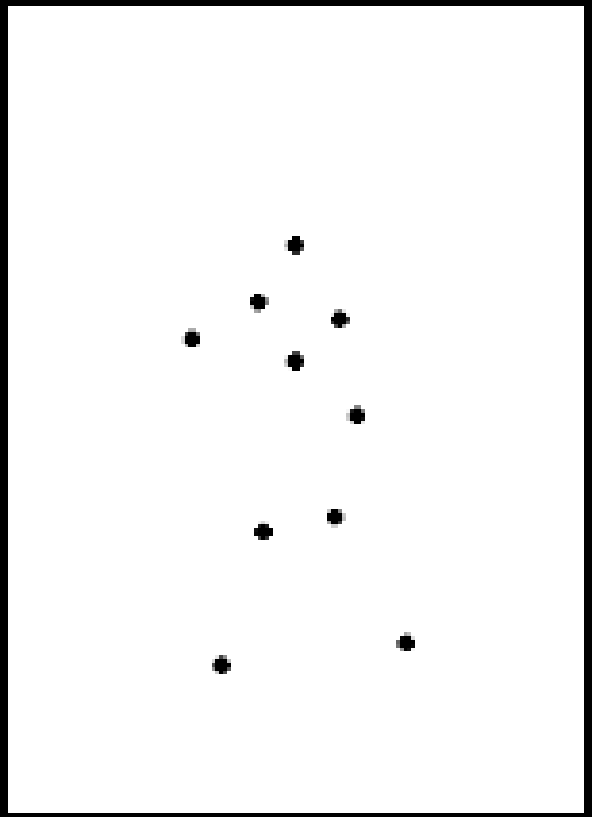
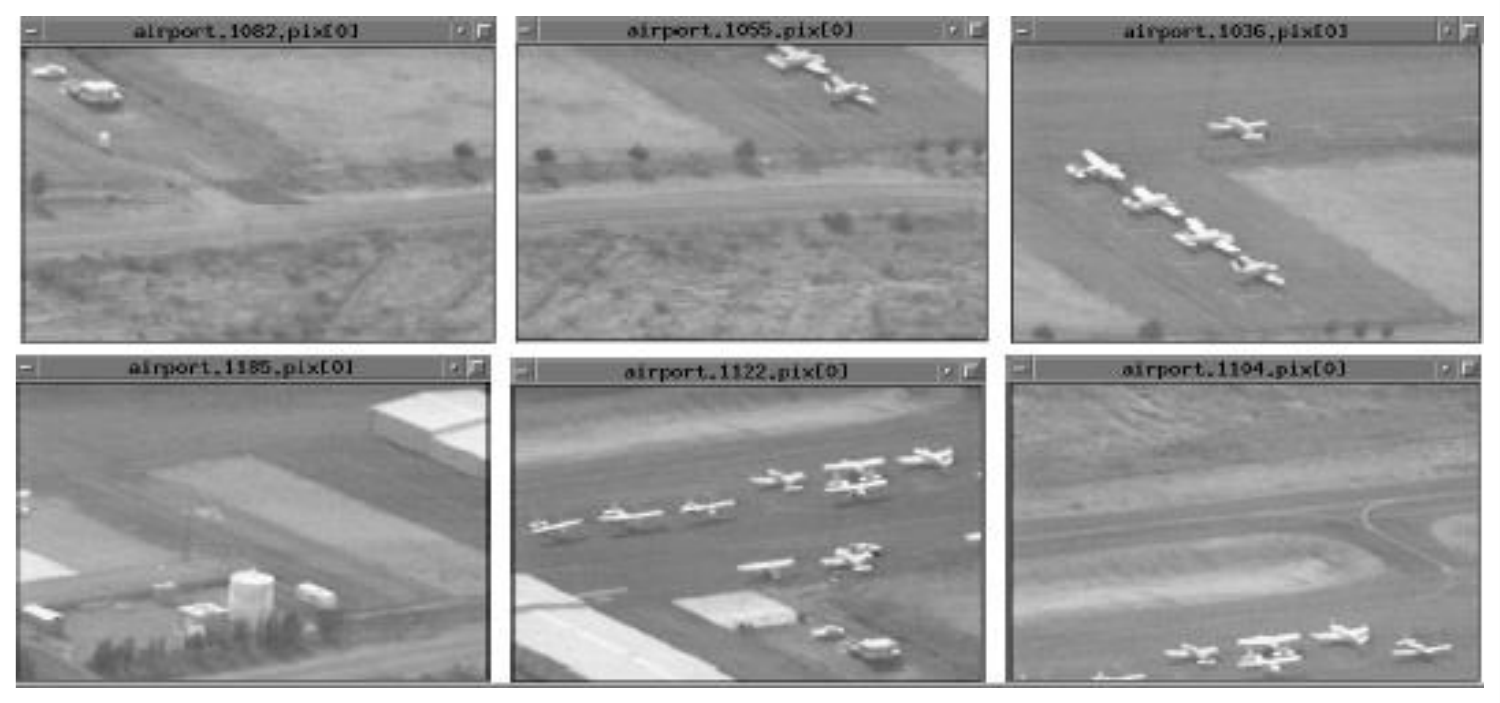






Mosaicing



(Michal Irani, Weizmann)

Mosaicing

(Michal Irani, Weizmann)

More applications of motion analysis

- Segmentation of objects in space or time
- Estimating 3D structure
- Learning dynamical models – how things move
- Recognizing events and activities
- Improving video quality (motion stabilization)

Motion estimation techniques

Feature-based methods

- Extract visual features (corners, textured areas) and track them over multiple frames
- Sparse motion fields, but more robust tracking
- Suitable when image motion is large (10s of pixels)

Motion estimation techniques

Direct, dense methods

- Directly recover image motion at each pixel from spatio-temporal image brightness variations
- Dense motion fields, but sensitive to appearance variations
- Suitable for video and when image motion is small